AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

AquaNereda®

SUBMITTAL MANUAL

NAPANEE WPCP UPGRADES

BASINS: (4) AGS, (2) SBB

NAPANEE, ONTARIO, CANADA

PROJECT I.D. 704419A

PUBLISHED DATE: FEB-13-2025

6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

Submittal Review Stamp

Project Name: Napanee WPCP Upgrades
Project Location: Napanee, Ontario, Canada
Project I.D.: 704419A

Contractor's Review Stamp

Engineer's Review Stamp

Introduction Letter

The purpose of this submittal manual is to communicate the equipment manufacturer's scope of supply, material of construction, and level of responsibility.

As the equipment manufacturer, Aqua-Aerobic Systems' intent is to interface equipment into your wastewater/water system such that our equipment either meets or exceeds all customer specifications. Please review all information within this submittal package to determine accurate civil basin work and/or foundation dimensions, verify the surrounding site components do not interfere with equipment proposed, and that the manufacturer has complied with all materials and specifications. In the event that the manufacturer has not met the customer's specifications for a given item, please **mark in red** and **flag the page** in the submittal. This will facilitate a fast response and insure that said items are responded to by the equipment manufacturer.

If there are any questions regarding this submittal, please feel free to contact the equipment manufacturer and /or representative.

Please remember that Aqua-Aerobic Systems, Inc. is there for you in the long run, starting with process / system design through post installation field support. This kind of philosophy insures a working relationship with Aqua- Aerobic Systems, Inc. We hope this submittal meets your needs. Please return one (1) copy stamped and signed "approved".

Thank you.

Project Associates

OWNER

The Corporation of the Town of Greater Napanee
99-A Advance Avenue
Napanee, Ontario K7R 3Y5

CONTRACTOR

ENGINEER

EVB Engineering
800 Second Street West
Comwall, Ontario K6J 1H6

AQUA-AEROBIC SALES REPRESENTATIVE

ACG-Envirocan
7-131 Whitmore Road
Woodbridge, Ontario L4L6E3
905-856-1414 X222

AQUA-AEROBIC PROJECT MANAGER

Mike Swartz
6306 North Alpine Road
Loves Park, IL 611111-7655
Phone: 815/639-4450 Fax:
815/654-8258
Email: mswartz@aqua-aerobic.com

Project Name: NAPANEE WWTP ON
Project Location: NAPANEE, ON
AASI Project ID: 704419A

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

NEREDA® NON DISCLOSURE AGREEMENT

BY AND BETWEEN North America Construction (1993) Ltd., having its registered office at 21 Queen Street, Morriston, Ontario……., hereinafter to be referred to as *"Recipient",*

And

Aqua-Aerobic Systems, Inc., a company incorporated in the United States of America, having its registered head office at 6306 N. Alpine Rd, Loves Park, IL 61111 United States, hereinafter referred to as *"Partner"*, on the other hand.

WHEREAS, *Partner* owns proprietary know-how and information with regard to water and waste water treatment in general and is a licensee of HaskoningDHV Nederland B.V. (hereinafter *"Royal HaskoningDHV"*) with respect to the Nereda® Technology as defined hereafter, hereinafter in general terms referred to as *"Proprietary Know-How"*;

WHEREAS, *Royal HaskoningDHV* owns proprietary know-how and information with regard to and the technology for biological treatment of waste water with aerobic granular biomass, of which the method, the design, the embodiments, the use and/or the operation thereof, are patented around the world including but not limited to the patents EP 0964831 and EP 1542932, US patents US6566119 and US72735, defined herein as *"Nereda Technology"*;

WHEREAS, Nereda® is a registered trade mark of *Royal HaskoningDHV* variably registered around the world for practical purposes herein referred to as *"Nereda"*;

WHEREAS, *Recipient* is a general contractor;

WHEREAS, *Recipient* is active in the field of general construction contracting; and

WHEREAS, both Parties want to collaborate on a waste water treatment plant, (hereinafter referred to as '*Purpose*') for which *Purpose* it will be necessary to disclose or allow disclosure to *Recipient* of certain *Confidential Information,* as defined hereafter, and to this end *Partner* requires *Recipient* to sign a non-disclosure agreement, hereinafter referred to as *'Agreement'.*

WHEREAS, *Recipient* considers to apply Nereda® technology for a waste water treatment plant located at Napanee WWTP ON, 300 Water Street W., Napanee, ON K7R 1X3, having a *Partner* Project Identification Number of 704419A;

NOW THEREFORE THE PARTIES HERETO HAVE MUTUALLY AGREED AS FOLLOWS;

1. *"Confidential information"* (as set out hereafter) means Know How ("Know How" means all unpatented information, whether or not published, relating to the Nereda® Technology, conceived, developed, or acquired by Royal HaskoningDHV or *Partner*, including the Royal HaskoningDHV proprietary process control system (including software) for process control of Nereda installations (hereinafter called the 'Nereda Controller'), the Nereda® Granular Sludge and any information obtained by Royal HaskoningDHV during the operation of the Plant, that is provided to *Recipient* from *Partner*) and all information related to Nereda® Technology communicated orally and within ten (10) days confirmed as confidential in writing, or in written form, in analog or digital format marked as confidential, including but not limited to software, documents, graphs, designs, specifications, drawings, reports and all other technical and non-technical information, relating to the Nereda® Technology and/or the Nereda® Granular Sludge disclosed to *Recipient* either directly or indirectly by *Partner* and/or Royal HaskoningDHV in writing and marked 'confidential', or if disclosed orally or visually confirmed in writing as confidential within ten (10) days as of the date of such disclosure.

   "Confidential Information" shall exclude, as evidenced by *Recipient*, any and all information and data which (i) was already in the possession of *Recipient* at the moment of disclosure or transfer by *Partner*, or (ii) was in the public domain at the moment of disclosure or transfer by *Partner* to *Recipient*, or (iii) is lawfully obtained from a third party without obligation of confidentiality to *Recipient*; or (iv) appears in the public domain, but not because of negligence or willful misconduct by *Recipient*.

   Notwithstanding the foregoing, *Recipient* may disclose *Confidential Information* to employees of *Recipient* who agree to abide by the terms of this *Agreement*.

2. In consideration of the disclosure of the *Confidential Information* by *Partner* to the *Recipient*, the *Recipient* agrees to treat as confidential, to hold in confidence and not to use or commercially exploit except for the *Purpose* including without limitation not to sell, disclose to any third party, copy, duplicate, use for reverse engineering or to otherwise reproduce, any and all *Confidential Information* without having first obtained the express written consent of *Partner* and in strict accordance with the terms of such consent and whether this information has been disclosed to *Recipient*, directly or indirectly, through, by or on behalf of *Partner*, its holding companies, subsidiaries or affiliates, or has been developed by or been contributed by *Recipient*, in whole or in part, at the instruction and/or expense of *Partner*. The foregoing obligations of non-disclosure and non-use include the obligation not to include *Confidential Information* in any patent applications and not to disclose *Confidential Information* to the patent office of any country. *Recipient* agrees to treat any *Confidential Information* at least with the same care as the *Recipient* observes, or should observe, towards its own confidential information.

3. *Recipient* agrees that all information, defined herein as *Confidential Information*, shall remain the property of *Partner*. Each Party acknowledges that neither Party is obligated to supply any *Confidential Information* under this *Agreement*. Neither Party shall have liability to the other Party resulting from the use of *Confidential Information* nor any other information or advice provided hereunder. In providing *Confidential Information*, no obligation is undertaken by either Party to provide additional information or to update or correct inaccuracies which may become apparent in any *Confidential Information.*

4. *Recipient* shall neither have rights nor license express or implied under this *Agreement* other than those expressly provided herein.

5. Notwithstanding the provisions of Clause 2 and provided the *Recipient* has convincingly evidenced to *Partner* that any *Confidential Information* satisfies the requirements i, ii or iii below, the *Recipient* shall be entitled to make any disclosure of the *Confidential Information:*
   i. to the extent required by, or essential to comply with, any law or the requirements of any government, court or regulatory authority provided that it gives *Partner* not less than five business days' prior notice of such disclosure where such notice is practicable and lawful and *Partner* shall have the right, at its own expense, to contest any such disclosure under this Clause 5.i or

ii. to any of its directors, officers, employees, legal counsels or auditors, who have a need to know the *Confidential Information* in order to perform their roles or professional functions in connection with the *Purpose,* and only upon ensuring that such persons are bound by terms of confidentiality which are at least as onerous as those agreed hereunder;

iii. other than under Clause 5.i hereunder, to third parties only upon the *Recipient's* receipt of the prior written consent of *Partner,* provided that the *Recipient* shall take all reasonable measures to limit the *Confidential Information* disclosed to a minimum, and such third parties are legally bound to confidentiality obligations no less than set forth herein.

6. Within fifteen (15) days of the receipt of *Partner's* notice, the *Recipient* shall destroy or return to *Partner* all of the *Confidential Information* and copies, extracts or other reproductions thereof. This provision specifically includes, but is not limited to, all related samples and technical drawings and any revisions thereto. Notwithstanding the return or destruction of the *Confidential Information*, each party shall continue to be bound by its confidentiality and other obligations hereunder for the term provided.

7. Without prejudice to any other rights or remedies which *Partner* may have, the *Recipient* acknowledges and agrees that damages may not be an adequate remedy for any breach by the *Recipient* of the provisions of the *Agreement. Partner* may be entitled – ~~without proof of special damage~~ – to the remedies of injunction, specific performance and other equitable relief for any ~~threatened or actual~~ breach of any such provision by the *Recipient.* Notwithstanding the aforementioned, for each and every breach of this *Agreement Partner* shall have the right to be compensated for any and all losses and damages caused by such breach by *Recipient.*

BQ

BQ

8. This *Agreement* shall be binding upon the *Parties* and their respective legal successors, except that this *Agreement* is personal to the parties hereto and may not be assigned by *Recipient* without prior written approval of *Partner.*

9. In respect of any right in this *Agreement* the benefit of which is expressed to be in favour of directors, officers, employees, legal counsels or auditors of the *Recipient* or the holding companies, subsidiaries or affiliates of *Partner* (as the case may be) then the *Recipient* or *Partner* (as applicable) shall be deemed to have entered into this *Agreement* as agent on behalf of those directors, officers, employees, legal counsels or auditors in relation to the *Recipient* or the holding companies, subsidiaries or affiliates in relation to *Partner* in order that those persons shall have the benefit of any such right.

10. Subject to Clauses 5.i, 7, and 8, a person who is not a party to this *Agreement* has no right under the Contracts (Rights of Third Parties) Act 1999 or any similar law regarding third party rights in any jurisdiction to enforce any term of this *Agreement.*

11. No provision of this *Agreement* shall be considered to have been waived by any party hereto except when such waiver is made in writing.

12. In case any term or provision of this *Agreement* should prove to be invalid or ineffective, the validity or the other provisions hereof shall not be affected thereby. The parties to the *Agreement*, or, if the case occurs, the arbiters, shall endeavor to replace the invalid or ineffective terms or provisions by valid and effective ones, which correspond best to the original economic and general intent.

13. This *Agreement* (and any dispute or claim arising out of or in connection with it or its subject matter or formation, including non-contractual claims or disputes) shall be governed by and construed in accordance with the internal laws of the State of Illinois without giving effect to any choice or conflict of law provision or rule (whether of the State of Illinois or any other jurisdiction). EACH PARTY HERETO AGREES THAT IT WILL BRING ANY ACTION UNDER THIS AGREEMENT EXCLUSIVELY IN THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA OR THE COURT OF THE STATE IN EACH CASE LOCATED IN THE CITY OF ROCKFORD, ILLINOIS AND COUNTY OF WINNEBAGO, AND EACH PARTY IRREVOCABLY SUBMITS TO THE EXCLUSIVE JURISDICTION OF SUCH COURTS IN ANY SUCH SUIT, ACTION OR PROCEEDING. The Parties shall seek a protective order in such proceedings to protect the confidentiality of

6306 N. Alpine Rd. Loves Park, IL 61111-7655 **p** 815.654.2501 **f** 815.654.2508 **www.aqua-aerobic.com**

all *Confidential Information* and shall cooperate with each other to ensure that available legal procedures will be applied for and used to protect such documents and other confidential information during court procedures.

14. This *Agreement* shall take effect upon signature by the parties and shall continue in full force and effect until 3 (three) calendar twelve month periods after the Plant has definitely been taken out of operation, or in any case at least 5 (five) calendar twelve month periods after signing of this *Agreement*. The foregoing notwithstanding, all trade secret information shall be safeguarded by *Recipient* as required by this *Agreement* in perpetuity or for so long as such information remains a trade secret under applicable law, whichever occurs first.

AS AGREED BY BOTH PARTIES BY THEIR REPRESENTATIVES THERETO DULY AUTHORIZED,

Place: Loves Park, IL Date: Jan. 9, 2025

Aqua-Aerobic Systems, Inc.

Name: Brett Quimby

Signature: ……………………………………

Place: Morriston, ON Date: January 8, 2025

Recipient: North America Construction (1993) Ltd.

Name: Keith Burrow, CF APMP

Signature: ……………………………………

NEREDA® NON DISCLOSURE AGREEMENT

BY AND BETWEEN CIMA+, having its registered office at 600-1400 Blair Towers Place, Ottawa, ON K1J 9B8, hereinafter to be referred to as *"Recipient",*

And

Aqua-Aerobic Systems, Inc., a company incorporated in the United States of America, having its registered head office at 6306 N. Alpine Rd, Loves Park, IL 61111 United States, hereinafter referred to as *"Partner"*, on the other hand.

WHEREAS, *Partner* owns proprietary know-how and information with regard to water and waste water treatment in general and is a licensee of HaskoningDHV Nederland B.V. (hereinafter *"Royal HaskoningDHV"*) with respect to the Nereda® Technology as defined hereafter, hereinafter in general terms referred to as *"Proprietary Know-How"*;

WHEREAS, *Royal HaskoningDHV* owns proprietary know-how and information with regard to and the technology for biological treatment of waste water with aerobic granular biomass, of which the method, the design, the embodiments, the use and/or the operation thereof, are patented around the world including but not limited to the patents EP 0964831 and EP 1542932, US patents US6566119 and US72735, defined herein as *"Nereda Technology"*;

WHEREAS, Nereda® is a registered trade mark of *Royal HaskoningDHV* variably registered around the world for practical purposes herein referred to as *"Nereda"*;

WHEREAS, *Recipient* is an engineering firm;

WHEREAS, *Recipient* is active in the field of engineering; and

WHEREAS, both Parties want to collaborate on a wastewater treatment plant, (hereinafter referred to as '*Purpose*') for which *Purpose* it will be necessary to disclose or allow disclosure to *Recipient* of certain *Confidential Information,* as defined hereafter, and to this end *Partner* requires *Recipient* to sign a non-disclosure agreement, hereinafter referred to as *'Agreement'.*

WHEREAS, *Recipient* considers to apply Nereda® technology for a waste water treatment plant located at Napanee WWTP ON, 300 Water Street W., Napanee, ON K7R 1X3, having a *Partner* Project Identification Number of 704419A;

NOW THEREFORE THE PARTIES HERETO HAVE MUTUALLY AGREED AS FOLLOWS;

1. *"Confidential information"* (as set out hereafter) means Know How ("Know How" means all unpatented information, whether or not published, relating to the Nereda® Technology, conceived, developed, or acquired by Royal HaskoningDHV or *Partner*, including the Royal HaskoningDHV proprietary process control system (including software) for process control of Nereda installations (hereinafter called the 'Nereda Controller'), the Nereda® Granular Sludge and any information obtained by Royal HaskoningDHV during the operation of the Plant, that is provided to *Recipient* from *Partner*) and all information related to Nereda® Technology communicated orally and within ten (10) days confirmed as confidential in writing, or in written form, in analog or digital format marked as confidential, including but not limited to software, documents, graphs, designs, specifications, drawings, reports and all other technical and non-technical information, relating to the Nereda® Technology and/or the Nereda® Granular Sludge disclosed to *Recipient* either directly or indirectly by *Partner* and/or Royal HaskoningDHV in writing and marked 'confidential', or if disclosed orally or visually confirmed in writing as confidential within ten (10) days as of the date of such disclosure.

   "Confidential Information" shall exclude, as evidenced by *Recipient*, any and all information and data which (i) was already in the possession of *Recipient* at the moment of disclosure or transfer by *Partner*, or (ii) was in the public domain at the moment of disclosure or transfer by *Partner* to *Recipient*, or (iii) is lawfully obtained from a third party without obligation of confidentiality to *Recipient*; or (iv) appears in the public domain, but not because of negligence or willful misconduct by *Recipient*.

   Notwithstanding the foregoing, *Recipient* may disclose *Confidential Information* to employees of *Recipient* who agree to abide by the terms of this *Agreement*.

2. In consideration of the disclosure of the *Confidential Information* by *Partner* to the *Recipient*, the *Recipient* agrees to treat as confidential, to hold in confidence and not to use or commercially exploit except for the *Purpose* including without limitation not to sell, disclose to any third party, copy, duplicate, use for reverse engineering or to otherwise reproduce, any and all *Confidential Information* without having first obtained the express written consent of *Partner* and in strict accordance with the terms of such consent and whether this information has been disclosed to *Recipient*, directly or indirectly, through, by or on behalf of *Partner*, its holding companies, subsidiaries or affiliates, or has been developed by or been contributed by *Recipient*, in whole or in part, at the instruction and/or expense of *Partner*. The foregoing obligations of non-disclosure and non-use include the obligation not to include *Confidential Information* in any patent applications and not to disclose *Confidential Information* to the patent office of any country. *Recipient* agrees to treat any *Confidential Information* at least with the same care as the *Recipient* observes, or should observe, towards its own confidential information.

3. *Recipient* agrees that all information, defined herein as *Confidential Information*, shall remain the property of *Partner*. Each Party acknowledges that neither Party is obligated to supply any *Confidential Information* under this *Agreement*. Neither Party shall have liability to the other Party resulting from the use of *Confidential Information* nor any other information or advice provided hereunder. In providing *Confidential Information*, no obligation is undertaken by either Party to provide additional information or to update or correct inaccuracies which may become apparent in any *Confidential Information.*

4. *Recipient* shall neither have rights nor license express or implied under this *Agreement* other than those expressly provided herein.

5. Notwithstanding the provisions of Clause 2 and provided the *Recipient* has convincingly evidenced to *Partner* that any *Confidential Information* satisfies the requirements i, ii or iii below, the *Recipient* shall be entitled to make any disclosure of the *Confidential Information:*
   i. to the extent required by, or essential to comply with, any law or the requirements of any government, court or regulatory authority provided that it gives *Partner* not less than five business days' prior notice of such disclosure where such notice is practicable and lawful and *Partner* shall have the right, at its own expense, to contest any such disclosure under this Clause 5.i or

ii. to any of its directors, officers, employees, legal counsels or auditors, who have a need to know the *Confidential Information* in order to perform their roles or professional functions in connection with the *Purpose,* and only upon ensuring that such persons are bound by terms of confidentiality which are at least as onerous as those agreed hereunder;

iii. other than under Clause 5.i hereunder, to third parties only upon the *Recipient's* receipt of the prior written consent of *Partner,* provided that the *Recipient* shall take all reasonable measures to limit the *Confidential Information* disclosed to a minimum, and such third parties are legally bound to confidentiality obligations no less than set forth herein.

6. Within fifteen (15) days of the receipt of *Partner's* notice, the *Recipient* shall destroy or return to *Partner* all of the *Confidential Information* and copies, extracts or other reproductions thereof. This provision specifically includes, but is not limited to, all related samples and technical drawings and any revisions thereto. Notwithstanding the return or destruction of the *Confidential Information*, each party shall continue to be bound by its confidentiality and other obligations hereunder for the term provided.

7. Without prejudice to any other rights or remedies which *Partner* may have, the *Recipient* acknowledges and agrees that damages may not be an adequate remedy for any breach by the *Recipient* of the provisions of the *Agreement. Partner* may be entitled – without proof of special damage – to the remedies of injunction, specific performance and other equitable relief for any threatened or actual breach of any such provision by the *Recipient.* Notwithstanding the aforementioned, for each and every breach of this *Agreement Partner* shall have the right to be compensated for any and all losses and damages caused by such breach by *Recipient.*

8. This *Agreement* shall be binding upon the *Parties* and their respective legal successors, except that this *Agreement* is personal to the parties hereto and may not be assigned by *Recipient* without prior written approval of *Partner.*

9. In respect of any right in this *Agreement* the benefit of which is expressed to be in favour of directors, officers, employees, legal counsels or auditors of the *Recipient* or the holding companies, subsidiaries or affiliates of *Partner* (as the case may be) then the *Recipient* or *Partner* (as applicable) shall be deemed to have entered into this *Agreement* as agent on behalf of those directors, officers, employees, legal counsels or auditors in relation to the *Recipient* or the holding companies, subsidiaries or affiliates in relation to *Partner* in order that those persons shall have the benefit of any such right.

10. Subject to Clauses 5.i, 7, and 8, a person who is not a party to this *Agreement* has no right under the Contracts (Rights of Third Parties) Act 1999 or any similar law regarding third party rights in any jurisdiction to enforce any term of this *Agreement.*

11. No provision of this *Agreement* shall be considered to have been waived by any party hereto except when such waiver is made in writing.

12. In case any term or provision of this *Agreement* should prove to be invalid or ineffective, the validity or the other provisions hereof shall not be affected thereby. The parties to the *Agreement*, or, if the case occurs, the arbiters, shall endeavor to replace the invalid or ineffective terms or provisions by valid and effective ones, which correspond best to the original economic and general intent.

13. This *Agreement* (and any dispute or claim arising out of or in connection with it or its subject matter or formation, including non-contractual claims or disputes) shall be governed by and construed in accordance with the internal laws of the State of Illinois without giving effect to any choice or conflict of law provision or rule (whether of the State of Illinois or any other jurisdiction). EACH PARTY HERETO AGREES THAT IT WILL BRING ANY ACTION UNDER THIS AGREEMENT EXCLUSIVELY IN THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA OR THE COURT OF THE STATE IN EACH CASE LOCATED IN THE CITY OF ROCKFORD, ILLINOIS AND COUNTY OF WINNEBAGO, AND EACH PARTY IRREVOCABLY SUBMITS TO THE EXCLUSIVE JURISDICTION OF SUCH COURTS IN ANY SUCH SUIT, ACTION OR PROCEEDING. The Parties shall seek a protective order in such proceedings to protect the confidentiality of

all *Confidential Information* and shall cooperate with each other to ensure that available legal procedures will be applied for and used to protect such documents and other confidential information during court procedures.

14. This *Agreement* shall take effect upon signature by the parties and shall continue in full force and effect until 3 (three) calendar twelve month periods after the Plant has definitely been taken out of operation, or in any case at least 5 (five) calendar twelve month periods after signing of this *Agreement*. The foregoing notwithstanding, all trade secret information shall be safeguarded by *Recipient* as required by this *Agreement* in perpetuity or for so long as such information remains a trade secret under applicable law, whichever occurs first.

AS AGREED BY BOTH PARTIES BY THEIR REPRESENTATIVES THERETO DULY AUTHORIZED,

Place: Loves Park, IL Date: 9/11/23	Place: Ottawa, ON Date: September 7, 2023
Aqua-Aerobic Systems, Inc.	*Recipient*: CIMA+
Name: Joe Tardio	Name: Bradley Young
Signature: [signature]	Signature: Bradley Young

NEREDA® NON DISCLOSURE AGREEMENT

BY AND BETWEEN EVB, having its registered office at 800 Second Street West, Comwall, ON K6J 1H6, hereinafter to be referred to as *"Recipient"*,

And

Aqua-Aerobic Systems, Inc., a company incorporated in the United States of America, having its registered head office at 6306 N. Alpine Rd, Loves Park, IL 61111 United States, hereinafter referred to as *"Partner"*, on the other hand.

WHEREAS, *Partner* owns proprietary know-how and information with regard to water and waste water treatment in general and is a licensee of HaskoningDHV Nederland B.V. (hereinafter *"Royal HaskoningDHV"*) with respect to the Nereda® Technology as defined hereafter, hereinafter in general terms referred to as *"Proprietary Know-How"*;

WHEREAS, *Royal HaskoningDHV* owns proprietary know-how and information with regard to and the technology for biological treatment of waste water with aerobic granular biomass, of which the method, the design, the embodiments, the use and/or the operation thereof, are patented around the world including but not limited to the patents EP 0964831 and EP 1542932, US patents US6566119 and US72735, defined herein as *"Nereda Technology"*;

WHEREAS, Nereda® is a registered trade mark of *Royal HaskoningDHV* variably registered around the world for practical purposes herein referred to as *"Nereda"*;

WHEREAS, *Recipient* is an engineering firm;

WHEREAS, *Recipient* is active in the field of engineering; and

WHEREAS, both Parties want to collaborate on a wastewater treatment plant, (hereinafter referred to as '*Purpose*') for which *Purpose* it will be necessary to disclose or allow disclosure to *Recipient* of certain *Confidential Information,* as defined hereafter, and to this end *Partner* requires *Recipient* to sign a non-disclosure agreement, hereinafter referred to as *'Agreement'*.

WHEREAS, *Recipient* considers to apply Nereda® technology for a waste water treatment plant located at Napanee WWTP ON, 300 Water Street W., Napanee, ON K7R 1X3, having a *Partner* Project Identification Number of 704419A;

NOW THEREFORE THE PARTIES HERETO HAVE MUTUALLY AGREED AS FOLLOWS;

1. *"Confidential information"* (as set out hereafter) means Know How ("Know How" means all unpatented information, whether or not published, relating to the Nereda® Technology, conceived, developed, or acquired by Royal HaskoningDHV or *Partner*, including the Royal HaskoningDHV proprietary process control system (including software) for process control of Nereda installations (hereinafter called the 'Nereda Controller'), the Nereda® Granular Sludge and any information obtained by Royal HaskoningDHV during the operation of the Plant, that is provided to *Recipient* from *Partner*) and all information related to Nereda® Technology communicated orally and within ten (10) days confirmed as confidential in writing, or in written form, in analog or digital format marked as confidential, including but not limited to software, documents, graphs, designs, specifications, drawings, reports and all other technical and non-technical information, relating to the Nereda® Technology and/or the Nereda® Granular Sludge disclosed to *Recipient* either directly or indirectly by *Partner* and/or Royal HaskoningDHV in writing and marked 'confidential', or if disclosed orally or visually confirmed in writing as confidential within ten (10) days as of the date of such disclosure.

   "Confidential Information" shall exclude, as evidenced by *Recipient*, any and all information and data which (i) was already in the possession of *Recipient* at the moment of disclosure or transfer by *Partner*, or (ii) was in the public domain at the moment of disclosure or transfer by *Partner* to *Recipient*, or (iii) is lawfully obtained from a third party without obligation of confidentiality to *Recipient*; or (iv) appears in the public domain, but not because of negligence or willful misconduct by *Recipient*.

   Notwithstanding the foregoing, *Recipient* may disclose *Confidential Information* to employees of *Recipient* who agree to abide by the terms of this *Agreement*.

2. In consideration of the disclosure of the *Confidential Information* by *Partner* to the *Recipient*, the *Recipient* agrees to treat as confidential, to hold in confidence and not to use or commercially exploit except for the *Purpose* including without limitation not to sell, disclose to any third party, copy, duplicate, use for reverse engineering or to otherwise reproduce, any and all *Confidential Information* without having first obtained the express written consent of *Partner* and in strict accordance with the terms of such consent and whether this information has been disclosed to *Recipient*, directly or indirectly, through, by or on behalf of *Partner*, its holding companies, subsidiaries or affiliates, or has been developed by or been contributed by *Recipient*, in whole or in part, at the instruction and/or expense of *Partner*. The foregoing obligations of non-disclosure and non-use include the obligation not to include *Confidential Information* in any patent applications and not to disclose *Confidential Information* to the patent office of any country. *Recipient* agrees to treat any *Confidential Information* at least with the same care as the *Recipient* observes, or should observe, towards its own confidential information.

3. *Recipient* agrees that all information, defined herein as *Confidential Information*, shall remain the property of *Partner*. Each Party acknowledges that neither Party is obligated to supply any *Confidential Information* under this *Agreement*. Neither Party shall have liability to the other Party resulting from the use of *Confidential Information* nor any other information or advice provided hereunder. In providing *Confidential Information*, no obligation is undertaken by either Party to provide additional information or to update or correct inaccuracies which may become apparent in any *Confidential Information.*

4. *Recipient* shall neither have rights nor license express or implied under this *Agreement* other than those expressly provided herein.

5. Notwithstanding the provisions of Clause 2 and provided the *Recipient* has convincingly evidenced to *Partner* that any *Confidential Information* satisfies the requirements i, ii or iii below, the *Recipient* shall be entitled to make any disclosure of the *Confidential Information:*
   i. to the extent required by, or essential to comply with, any law or the requirements of any government, court or regulatory authority provided that it gives *Partner* not less than five business days' prior notice of such disclosure where such notice is practicable and lawful and *Partner* shall have the right, at its own expense, to contest any such disclosure under this Clause 5.i or

ii. to any of its directors, officers, employees, legal counsels or auditors, who have a need to know the *Confidential Information* in order to perform their roles or professional functions in connection with the *Purpose,* and only upon ensuring that such persons are bound by terms of confidentiality which are at least as onerous as those agreed hereunder;

iii. other than under Clause 5.i hereunder, to third parties only upon the *Recipient's* receipt of the prior written consent of *Partner,* provided that the *Recipient* shall take all reasonable measures to limit the *Confidential Information* disclosed to a minimum, and such third parties are legally bound to confidentiality obligations no less than set forth herein.

6. Within fifteen (15) days of the receipt of *Partner's* notice, the *Recipient* shall destroy or return to *Partner* all of the *Confidential Information* and copies, extracts or other reproductions thereof. This provision specifically includes, but is not limited to, all related samples and technical drawings and any revisions thereto. Notwithstanding the return or destruction of the *Confidential Information,* each party shall continue to be bound by its confidentiality and other obligations hereunder for the term provided.

7. Without prejudice to any other rights or remedies which *Partner* may have, the *Recipient* acknowledges and agrees that damages may not be an adequate remedy for any breach by the *Recipient* of the provisions of the *Agreement. Partner* may be entitled – without proof of special damage – to the remedies of injunction, specific performance and other equitable relief for any threatened or actual breach of any such provision by the *Recipient.* Notwithstanding the aforementioned, for each and every breach of this *Agreement Partner* shall have the right to be compensated for any and all losses and damages caused by such breach by *Recipient.*

8. This *Agreement* shall be binding upon the *Parties* and their respective legal successors, except that this *Agreement* is personal to the parties hereto and may not be assigned by *Recipient* without prior written approval of *Partner.*

9. In respect of any right in this *Agreement* the benefit of which is expressed to be in favour of directors, officers, employees, legal counsels or auditors of the *Recipient* or the holding companies, subsidiaries or affiliates of *Partner* (as the case may be) then the *Recipient* or *Partner* (as applicable) shall be deemed to have entered into this *Agreement* as agent on behalf of those directors, officers, employees, legal counsels or auditors in relation to the *Recipient* or the holding companies, subsidiaries or affiliates in relation to *Partner* in order that those persons shall have the benefit of any such right.

10. Subject to Clauses 5.i, 7, and 8, a person who is not a party to this *Agreement* has no right under the Contracts (Rights of Third Parties) Act 1999 or any similar law regarding third party rights in any jurisdiction to enforce any term of this *Agreement.*

11. No provision of this *Agreement* shall be considered to have been waived by any party hereto except when such waiver is made in writing.

12. In case any term or provision of this *Agreement* should prove to be invalid or ineffective, the validity or the other provisions hereof shall not be affected thereby. The parties to the *Agreement*, or, if the case occurs, the arbiters, shall endeavor to replace the invalid or ineffective terms or provisions by valid and effective ones, which correspond best to the original economic and general intent.

13. This *Agreement* (and any dispute or claim arising out of or in connection with it or its subject matter or formation, including non-contractual claims or disputes) shall be governed by and construed in accordance with the internal laws of the State of Illinois without giving effect to any choice or conflict of law provision or rule (whether of the State of Illinois or any other jurisdiction). EACH PARTY HERETO AGREES THAT IT WILL BRING ANY ACTION UNDER THIS AGREEMENT EXCLUSIVELY IN THE FEDERAL COURTS OF THE UNITED STATES OF AMERICA OR THE COURT OF THE STATE IN EACH CASE LOCATED IN THE CITY OF ROCKFORD, ILLINOIS AND COUNTY OF WINNEBAGO, AND EACH PARTY IRREVOCABLY SUBMITS TO THE EXCLUSIVE JURISDICTION OF SUCH COURTS IN ANY SUCH SUIT, ACTION OR PROCEEDING. The Parties shall seek a protective order in such proceedings to protect the confidentiality of

all *Confidential Information* and shall cooperate with each other to ensure that available legal procedures will be applied for and used to protect such documents and other confidential information during court procedures.

14. This *Agreement* shall take effect upon signature by the parties and shall continue in full force and effect until 3 (three) calendar twelve month periods after the Plant has definitely been taken out of operation, or in any case at least 5 (five) calendar twelve month periods after signing of this *Agreement*. The foregoing notwithstanding, all trade secret information shall be safeguarded by *Recipient* as required by this *Agreement* in perpetuity or for so long as such information remains a trade secret under applicable law, whichever occurs first.

AS AGREED BY BOTH PARTIES BY THEIR REPRESENTATIVES THERETO DULY AUTHORIZED,

Place: Loves Park, IL Date: 8/10/2023

Aqua-Aerobic Systems, Inc.

Name: Joe Tardio

Signature: [signature]

Place: Cornwall, ON, CA Date: 08:10:2023

Recipient: EVB

Name: Jamie Baker

Signature: [signature]

SUPPLIER TECHNOLOGY AND EQUIPMENT ENGAGEMENT AGREEMENT

THIS AGREEMENT made in triplicate this 28th day of July 2023.

B E T W E E N:

ACG ENVIROCAN INC.

AND

AQUA-AEROBIC SYSTEMS, INC.

(hereinafter called "The Supplier")
OF THE FIRST PART

\- and -

THE TOWN OF GREATER NAPANEE

(hereinafter called "The Owner")
OF THE SECOND PART

Witnesseth

That the Owner and the Supplier in consideration of the fulfilment of their respective promises and obligations herein set forth covenant and agree with each other as follows:

ARTICLE 1 – DEFINITIONS

"Engagement Agreement":	This supplier technology and equipment engagement agreement
"Owner":	The Town of Greater Napanee
"Supplier":	Includes the two parties of ACG Envirocan Inc. and Aqua-Aerobic Systems Inc.
"Engineer":	CIMA+ and EVB Engineering who are acting as the Town's Municipal Engineering Consultant
"Ministry":	The Ministry of Environment, Conservation and Parks
"Contract":	Construction Contract for Wastewater Treatment Facility Expansion.
"Equipment":	Supplier Specified Equipment
"Proposals":	Includes proposal put forth by Aqua-Aerobic Systems Inc. referred to as NAPANEE WWTP ON, Design# 171482, Preliminary AGS Design (3 Basin Option) dated May 18, 2023 ; Proposal for Preliminary Process Design Submittal (PPDS) - Project ID 704419A, dated April 22, 2023
"Project":	Napanee WPCP Expansion

ARTICLE 2 – DESCRIPTION OF WORK

A general description of the work for each Stage of the Project as follows:

Stage 1 – Design/Approvals (This Agreement):

The Supplier shall provide the necessary drawings and technical documents/support related to the Suppliers equipment/technology for the Engineer to complete the process engineering design necessary to prepare/issue the design/drawings for Ministry approval, Public Information Centres and for the Contract with the understanding that the Contract shall be tendered with the Equipment, as outlined in previously submitted Proposals, the equipment purchase will be part of a future construction Contract and subject to a future agreement.

ARTICLE 3 - GENERAL REQUIREMENTS

As part of the Project, the Supplier is to provide the Equipment and technical support required to provide an adequate wastewater treatment system as outlined in the Suppliers' Proposals and subsequent documents as listed below:

- Napanee WWTP ON, Design# 171482 Preliminary AGS Design (3 BASINS OPTION), prepared by Aqua-Aerobic Systems Inc., dated May 18 , 2023
- Process Design Submittal (PPDS) - Project ID 704419A, dated April 22, 2023.

The Supplier must perform all the requirements of the Engagement Agreement to the satisfaction of the Owner, pursuant to Design# 171482.

The Supplier shall not assign this Engagement Agreement, in whole or in part, without the prior written consent of the Owner. The Engagement Agreement must not be amended, in whole or in part, without the prior written agreement of the parties.

ARTICLE 4 – EQUIPMENT COST INDEXING (N/A)

The proposed Equipment will be purchased as a part of Stage 2 and will be subject to a separate agreement. At that time, the Supplier shall sell to the Owner the Equipment as specified within the Proposals for the purchase price specified within the Proposals, subject to an index factor based on the Statistics Canada Industrial Product Price Index (IPPI) as adjusted from the expiration supply date outlined in Proposals.

ARTICLE 5 – TAXES

The Purchase Price shall include all taxes and customs duties, except for H.S.T., in effect at the time of purchase.

Supplier shall keep a record of all taxes and duties carried in the Purchase Price and records and invoices of accounts subject to such taxes and duties paid for substantiating any adjustments in the event of changes in legislation during the course of the Engagement Agreement and for the purpose of claiming exemption or recovering taxes and duties paid.

Upon execution of this Engagement Agreement, the Supplier shall provide the Owner with its GST registration number.

For out of Ontario Suppliers who have a GST registration number, the Supplier shall invoice the Owner for the Ontario HST for applicable goods and services delivered in Ontario.

For out of Ontario Suppliers who do not have a GST registration number, the Owner will self-assess the HST on applicable goods and services delivered in Ontario. If the Supplier does not have a business office in Canada and does not provide a waiver of income tax withholding from the Canada Revenue Agency, the Owner will withhold and remit income tax as necessary.

ARTICLE 6 – DESIGN DRAWINGS AND SPECIFICATIONS

The Supplier shall arrange for the preparation of suitable Equipment design drawings as called for by the proposals or as the Owner may reasonably request.

Prior to submission to the Owner, the Supplier shall review all drawings. By this review, the Supplier represents that the Supplier has determined and verified, either independently or through the Owner as necessary, all field measurements, field construction criteria, materials, catalogue numbers, and similar data and that the Supplier has checked and coordinated each drawing with the requirements of the Proposal documents.

The Supplier shall submit drawings and specifications related to the Equipment to the Owner for their Engineer's review with reasonable promptness and in an orderly sequence to cause no delay to the design. At the time of submission, the Supplier shall notify the Owner in writing of any deviations from the Proposal as warranted.

The responsibility for the detailed design and information inherent in the Equipment drawings, specifications or other submissions shall remain with the Supplier or any other party producing such drawings, specifications, or other submissions.

The Supplier shall make any changes in the drawings which the Owner or their Engineer may require consistent with the Proposal and resubmit unless otherwise directed by the Owner. When resubmitting, the Supplier shall notify the Owner in writing of any revisions other than those requested by the Engineer.

Please note Aqua-Aerobic Systems' revision of engineer's submittal data at no additional cost is limited to revisions required due to errors/omissions on Aqua-Aerobic Systems' part. Changes due to design revision(s) during the engineer's submittal review stage may be subject to additional charges for engineering as mutually agreed upon between Aqua-Aerobic Systems and the Buyer.

ARTICLE 7 – PATENTS AND COPYRIGHT

The Supplier shall not, in the performance of the Engagement Agreement, infringe or violate any patent, copyright, trade secret, trademark, industrial design, intellectual property right, or any other right of any person or entity. The Supplier warrants that it owns the Equipment, software, and documentation and that it has the rights to the Equipment, software, technology, and documentation granted hereby. The Supplier further warrants that the Equipment, software, technology, and documentation shall be delivered free of any rightful claim of any third party for infringement of any patent, copyright, trade secret, or other intellectual property right. The Supplier shall indemnify and hold harmless the Owner and their subsidiaries or affiliates under their control, and their elected officials, trustees, officers, employees and agents, against any and all losses, liabilities, judgments, awards and costs (including legal fees and expenses) arising out of or related to any claim that the Owner's or Owner's use or possession of the Equipment, software or documentation pursuant to and for the purposes set forth in this Engagement Agreement, or the license granted hereunder, infringes or violates any patent, copyright, trade secret, or other proprietary rights of any third party. The Supplier shall defend and settle at its sole expense all suits or proceedings arising out of the foregoing, provided that the Owner gives the Supplier notice of any such claim of which it learns. No such settlement which prevents the Owner from continuing to use the Equipment and Software as provided herein shall be made without the Owner's prior written consent. In all events, The Owner shall, at their own cost and expense, have the right to participate in the defense of any such suit or proceeding through counsel of its own choosing. In case the Equipment, software or documentation, or any part thereof, are held to constitute such an infringement and the use for the purpose intended of said Equipment or software is enjoined, then the Supplier shall, at the Owner's option, and at the Supplier's expense, either procure for the Owner the right to continue using same, or replace same with a non-infringing Equipment, or modify same so it becomes non-infringing.

ARTICLE 8 – TERMINATION

If the Supplier should be adjudged bankrupt or makes a general assignment for the benefit of creditors because of insolvency or if a receiver is appointed because of the Supplier's insolvency, the Owner may, without prejudice to any other right or remedy the Owner may have, by giving the Supplier or Receiver or Trustee in Bankruptcy written notice, terminate the Engagement Agreement.

At any time before the completion of the Engagement Agreement, the Owner may, by giving notice to the Supplier, terminate for convenience all or part of this Engagement Agreement. In such case, the Supplier will be paid for Stage 1 work that has been performed, accepted and unpaid in accordance with the Engagement Agreement. The Supplier will be entitled to be reimbursed the actual costs reasonably and properly incurred as a direct result of the termination, but in no case will such reimbursement exceed the Purchase Price. The Supplier will have no claim for damages, compensation, loss of profit or otherwise, except as provided in this section.

ARTICLE 9 – CONFLICT OF INTEREST

The Supplier shall disclose to the Owner prior to the commencement of the Engagement Agreement as well as during the performance of the Engagement Agreement, any potential conflict of interest. If such a conflict of interest does exist, the Owner may, at its discretion, withhold or suspend this order until the matter is resolved to the satisfaction of the Owner.

ARTICLE 10 – COMPLIANCE WITH LAWS

The Supplier shall comply with all federal, provincial and municipal laws, regulations, rules, orders, codes, and standards applicable to the performance of the Engagement Agreement. If requested by the Owner, the Supplier shall provide evidence of compliance with such laws, regulations, rules, orders, codes, and standards to the Owner.

The Supplier must obtain and maintain at its own costs all permits, licenses, regulatory approvals and certificates required to perform the Engagement Agreement, unless otherwise stated in the Engagement Agreement. If requested by the Owner, the Supplier must provide a copy of any required permit, license, regulatory approvals or certificate to the Owner.

ARTICLE 11 – CONFIDENTIALITY AND DISCLOSURE

The Supplier acknowledges and agrees that the Owner shall be bound by the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA) in the performance of this Engagement Agreement, and the Supplier must, to the extent possible, assist the Owner, as applicable, in discharging its responsibilities thereunder.

Subject to MFIPPA, the parties shall hold in confidence any information and material which is designated by either the Owner or Supplier as proprietary and confidential, herein or otherwise. It is understood that this confidentiality clause does not include information which: (i) is now or hereafter in the public domain through no fault of the party being provided the confidential information; (ii) prior to disclosure hereunder, is property within the rightful possession of the party being provided the confidential information; (iii) subsequent to disclosure hereunder, is lawfully received from a third party with no restriction on further disclosure, or (iv) is obligated to be produced under order of a court of competent jurisdiction, unless made the subject of a confidentiality agreement or protective order in connection with such proceeding, which the parties in all cases will attempt to obtain. The Owner and Supplier hereby covenant that each shall not disclose such information to any third party without prior written notification of the other. The Supplier further covenants not to disclose or otherwise make known to any party nor to issue or release for publication any articles or advertising or publicity matter relating to this Engagement Agreement in which the name of the Owner or any of their affiliates is mentioned or used, directly or indirectly, unless prior written consent is granted by the Owner.

ARTICLE 12 – FORCE MAJEURE

The performance of any of the obligations of any of the parties to the Agreement may be delayed or suspended at any time while, but only so long as such party is hindered in or prevented from performance by an Act of God or the Queen, or the Queen's enemies.

ARTICLE 13 – NOTICE

All notices and other communications pertaining to this Engagement Agreement shall be in writing and shall be deemed duly to have been given if personally delivered to the other party or if sent by same day courier, by facsimile transmission or by email. All notices or communications between the Owner and Supplier pertaining to this Engagement Agreement shall be addressed as specified in the Engagement Agreement. Either party may change its notification address by giving written notice to that effect to the other party in the manner provided herein.

ARTICLE 14 – GOVERNING LAW

This Engagement Agreement shall be governed by the laws of the Province of Ontario. Each of the parties to this Engagement Agreement hereby irrevocably and unconditionally: (i) consents to submit to the exclusive jurisdiction of the courts of the Province of Ontario for any proceeding arising in connection with this Engagement Agreement and each such party agrees not to commence any such proceeding except in such courts, and (ii) waives any objection to the laying of venue of any such proceeding in the courts of the Province of Ontario. Each party, knowingly and after consultation with counsel, for itself, its successors and assigns, waives all right to trial by jury of any claim arising with respect to this Engagement Agreement or any matter related in any way thereto.

ARTICLE 15 – ENTIRE AGREEMENT

This Engagement Agreement and all the documents referenced herein are intended as the complete and exclusive statement of the agreement between the Owner and the Supplier with respect to the subject matter hereof, and supersede all prior agreements and negotiations related thereto. The provisions hereof shall be binding upon and shall inure to the benefit of the Owner and Supplier, their respective successors, and permitted assigns.

ARTICLE 16 – SURVIVAL

In the event of any termination of this Agreement for any reason whatsoever, the provisions of this Agreement that by their nature extend beyond the termination of this agreement will survive and remain in effect until all obligations are satisfied.

ARTICLE 17 – COMMUNICATION

Where any notice, direction or other communication is required to be or may be given or made by one of the parties hereto to the other or to the Owner or the Engineer, it shall be deemed sufficiently given or made if mailed or delivered in writing to such part or to the Owner at the following addresses:

The Owner:	The Town of Greater Napanee 99-A Advance Avenue Napanee, ON K7R 3Y5 pdafoe@greaternapanee.com
The Supplier:	Aqua-Aerobic Systems 6306 N. Alpine Rd. Loves Park, IL 61111-7655 jtardio@aqua-aerobic.com
	ACG-Envirocan Inc. #7-131 Whitmore Road Woodbridge, ON L4L 6E3 dale@acg-envirocan.ca

The Engineer: CIMA+
600–1400 Blair Towers Place
Ottawa, ON K1J 9B8
Bradley.Young@cima.ca

EVB Engineering
800 Second Street West
Cornwall, ON K6J 1H6
Jamie.Baker@ebvengineering.com

ARTICLE 18 – TIME IS OF THE UTMOST IMPORTANCE

Time is of the utmost importance of this Agreement.

ARTICLE 19 – BINDING

The Contract shall apply to and be binding on the parties hereto and their successors, administrators, executors and assigns and each of them.

IN WITNESS WHEREOF the parties hereto have hereunto set their hands and seals the day and year first above written or caused their corporate seals to be affixed, attested by the signature of their proper officers, as the case may be.

FOR

Aqua-Aerobic Systems, Inc.

- Supplier -

Witness as to Signature of Supplier*

6306 N. Alpine Rd
Loves Park, IL 61111-7655

Address

Product Manager - AquaNereda

Occupation

AND FOR

ACG-Envirocan Inc.

- Supplier -

Witness as to Signature of Supplier*

#7-131 Whitmore Road
Woodbridge, ON L4L 6E3

Address

Technical Sales Representative

Occupation

FOR THE TOWN OF GREATER NAPANEE

Jessica Walters, Clerk/Director of Legislative Services

Terry Richardson, Mayor, Town of Greater Napanee

* Not necessary if corporate seal is affixed.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

NEREDA® END USER LICENSE AGREEMENT

Parties, Town of Greater Napanee ON, having its office at 99-A Advance Avenue, Napanee, ON K7R 3Y5, hereinafter to be referred to as "*End User*",

And

Aqua-Aerobic Systems, Inc., a company incorporated in the U.S.A., having its registered head office located at 6306 N. Alpine Road, Loves Park, IL 61111-7655, hereinafter referred to as "*PARTNER*".

Whereas:

- *PARTNER, as the Technology Provider*,, has a license to use the Nereda® Technology from Royal HaskoningDHV for the Project and shall design, build, and deliver the Nereda® Installation (as defined hereafter) as part of the Project.
- HaskoningDHV Nederland B.V., part of the Royal HaskoningDHV group, (hereafter "RHDHV" or "Royal HaskoningDHV") is the developer and owner of the proprietary and patented Nereda® Technology (as defined hereinafter).
- The Town of Greater Napanee, (hereinafter the "End User") will acquire through PARTNER a Nereda® Installation (as defined hereinafter) which includes Nereda® Confidential Information (as defined hereinafter) regarding the design, construction, operation and maintenance of the Nereda® Installation as part of the Napanee WWTP ON (hereafter the "Project"), located at 300 Water Street W., Napanee, ON K7R 1X3 and with a *PARTNER* Project ID of 704419A.
- Due to the proprietary nature of the Nereda® Technology, End User requires a license to make use of the confidential information, patents, trade secrets and other proprietary information of Royal HaskoningDHV, and Royal HaskoningDHV is willing to provide such user rights to End User for the full life span duration of the Nereda® Installation. Royal HaskoningDHV also needs to protect the great amount of effort and money invested into its Nereda® Technology by safeguarding and ensuring that confidential information does not enter the public domain. The End User is therefore expected to accept and uphold the terms and conditions in this Nereda® End User License.

UPON ACCEPTANCE OF THESE TERMS & CONDITIONS, PARTNER PROVIDES THE END USER WITH THE FOLLOWING USER LICENSE:

1. **Definitions (in the recitals hereinabove and hereinafter):**

- "*Nereda® Confidential Information*" means any and all know-how, information and data relating to the Nereda® Technology, its Nereda® Controller, aerobic granular biomass and Results, received or obtained by End User either directly or indirectly from the PARTNER or RHDHV in writing, orally or in any other way, marked as confidential or which End User ought reasonably to regard as confidential.
- "*Nereda® Technology*" means the RHDHV proprietary technology of which the method, the design, the embodiments, the use and/or the operation thereof, are described amongst others in the patents families EP0964831, EP1542932, EP2834198 and EP3630686 and further in documents (co-) authored by RHDHV and/or PARTNER concerning pilot scale research, demonstration scale units and full scale installations working with aerobic granular biomass and all associated applicable or necessary pre- and post-treatment operations and units.
- "*Nereda® Controller*" means any RHDHV proprietary process control system for process control of the Nereda® Installation.
- "*Nereda® Installation*" means the three (3) installed biological treatment reactors with a total volume of approx. 10,600 m3 ('Nereda® Reactors') and – if any - the influent buffer directly preceding those reactors and/or the sludge buffer tanks, delivered under the Project in which the aerobic granular biomass is used for purification means.
- "*Purpose of the End User*" has the meaning as defined in clause 2 below.
- "*Results*" means all data, results, and findings obtained with the Nereda® Installation including but not limited to any results, conclusions, and findings of the Project to the extent related to the Nereda® Installation.

2. **User license**

On acceptance by the End User of the Nereda® End User License terms and conditions, the End User is granted a non-exclusive, non-transferable, right to use the Nereda® Technology and the Nereda® Confidential Information for wastewater treatment at the Project (the "Purpose of the End User") and to the extent required to develop, operate and maintain the Nereda® Installation at the Project until the Nereda® Installation has been taken out of operation.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

The End User shall not sub-license this license nor assign its user rights to any third party without the written consent of RHDHV, which shall not be unreasonably withheld.

End User shall not modify, decompile, disassemble, recreate, reverse engineer, copy, reproduce or make subsequent or derivative versions of the Nereda® Technology, the Nereda® Controller and the Nereda® Confidential Information.

3. Access to Operational Data and Results

RHDHV would appreciate to receive Results of the Nereda® Installation from the End User via the Nereda® Controller and otherwise. Such information shall be used by RHDHV to contribute to the continuous improvement of the Nereda® Technology and treated with the End User's required level of confidentiality and anonymity.

4. Confidential information and Secrecy

The Nereda® Confidential Information may only be used by the End User in accordance with the right to use as set out under clause 2.

The End User will at least use the same standard of care that End User uses to protect its own confidential information against theft, loss or unauthorized use and may only disclose Nereda® Confidential Information to employees of End User who (i) have a reasonable need to know and use such information; (ii) have been informed of the confidential nature of the Nereda® Confidential Information in question; and (iii) are bound by written obligations of secrecy and restricted use.

The End User will undertake not to disclose Nereda® Confidential Information to any third party except as will be necessary to disclose to any contractor in the framework of operating and maintaining or dismantling the Nereda® Installation at the Project, in which case End User will point out to such third party the confidential nature of the information and ensure that third party is bound by written obligations of secrecy and restricted use.

The confidentiality obligations shall neither apply to information not suitably marked as Confidential nor apply to information which (i) was already in the possession of End User at the moment of disclosure or transfer by the PARTNER and/or RHDHV, (ii) was in the public domain at the moment of disclosure or transfer by the PARTNER. and/or RHDHV to End User, (iii) is lawfully obtained from a third party without obligation of confidentiality to End User; (iv) appears in the public domain, but not because of negligence or willful misconduct by End User; and/or (v) is to be disclosed due to legal requirements under the applicable laws and regulations to which the End User is bound or due to a legally binding order of a legal or governmental authority.

5. Improvements

In the event End User identifies any improvements to the Nereda® Technology, End User shall inform RHDHV or the PARTNER and treat such improvements as confidential information, and parties will proceed diligently to align whether such improvement is patentable, and if so, to agree in good faith on the terms and conditions to obtain, protect, use and own the intellectual property rights.

6. Publications

RHDHV and PARTNER commits to not disclose any confidential information related to the Project without the prior consent from the End User and the End User commits to obtain similar consent from RHDHV or PARTNER for any first disclosures related to the Nereda® Technology, the Nereda® Installation and the Nereda® Controller to ensure that Nereda® Confidential Information does not become available in the public domain and to ensure proper use of registered or filed trade names of RHDHV.

7. Acceptance

This Nereda® End User License shall take effect as from the date of its signature, and shall expire at the date which the Plant is completely taken out of operation. The foregoing notwithstanding, all trade secret information shall be safeguarded by End User as required by this Agreement for so long as such information remains a trade secret under applicable law. The End User is required to confirm acceptance of this Nereda® End User License and its conditions in writing within this timeframe.

This Agreement represents the entire agreement of the parties concerning this subject matter, and merges and supersedes all other agreement relating to the subject matter hereof.

8. Applicable law and jurisdiction

This Agreement shall be governed by and construed in accordance with the internal laws of the State of Illinois/Province of Ontario without giving effect to any choice or conflict of Law provision or rule.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

As agreed by both parties by their representatives thereto duly authorized:

TOWN OF GREATER NAPANEE ON

Date: July 24, 2023

Place: Napanee, ON

Signature: Jessica Watters

Name: Jessica Watters

Position: Clerk

AQUA-AEROBIC SYSTEMS, INC.

Date: July 28, 2023

Place: Loves Park, IL USA

Signature:

Name: Joe Tardio

Position: Product Manager - AquaNereda

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

NAPANEE WWTP ON

Design# 171482
Option: Preliminary AGS Design (3 Basins Option)

AquaNereda®

Aerobic Granular Sludge Technology

May 18, 2023
Designed By: Nicholas Fortsas

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- 1/4 inch (6 mm) screening (perforated plate-style preferred) and grit removal (95% removal at 140 mesh) is required (by others) ahead of the AquaNereda system.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 2.0 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The following parameters have been assumed, as displayed on the design (engineer to verify): Elevation, ambient temperatures.

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 7.7°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- To achieve the effluent monthly average total phosphorus limit, the biological process, and chemical feed systems need to be designed to facilitate optimum performance.

- A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for total phosphorus analysis.

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- Provisions for a flocculation tank with a minimum of 5-minute HRT at the maximum daily flow shall be furnished after chemical addition.

- pH monitoring 6.5-8.5 of the biological reactor is required when adding metal salts.

- The average, maximum and peak design flow and loading conditions, shown within the report, are based on maximum month average, maximum day and peak hour conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process:
- Post-EQ

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 7 m feet in the Nereda rectors.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

INFLUENT BUFFER DESIGN PARAMETERS

Avg. Daily Flow:	= 5.16 MGD	= 19,550 m3/day
Max. Daily Flow:	= 8.08 MGD	= 30,600 m3/day
No. of AGS Reactors:		= 3

INFLUENT BUFFER VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

INFLUENT BUFFER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 53.2 ft	= (16.2 m)			
Width of Basin:	= 37.7 ft	= (11.5 m)			
Min. Water Depth:	= 0.0 ft	= (0.0 m)	**Min. Basin Vol. Basin:**	= 0 gallons	= (0.0 m³)
Max. Water Depth:	= 14.4 ft	= (4.4 m)	**Max. Basin Vol. Basin:**	= 216,621.0 gallons	= (820.0 m³)

INFLUENT BUFFER EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 8,357 GPM	= (1,898 m³/hr)
Avg. Power Required:	= 590 kWhr/day	

AquaNereda® - Aerobic Granular Sludge Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 5.16 MGD	= 19,550 m3/day
Max Design Flow	= 8.08 MGD	= 30,600 m3/day
Peak Hyd. Flow	= 11.183988 MGD	= 42336 m3/day (modifying cycles)

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Bio/Chem Oxygen Demand:	BOD5	162	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	214	TSSa	10	TSSa	10
Total Kjeldahl Nitrogen:	TKN	45	TKN	--	TKN	--
NH3-N	--	--	NH3-N	2	NH3-N	2
Phosphorus:	Total P	5	Total P	1	Total P	1

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	90 F	32.0 C	0 F	-18.0 C	381 ft
Influent Waste Temperatures:	68 F	20.0 C	46 F	8.0 C	116.0 m

AGS BASIN DESIGN VALUES

				Water Depth		Basin Vol./Basin	
No./Basin Geometry:	3 Rectangular Basin(s)		**Process Level (PWL):**	21.0 ft	(6.4 m)	0.93 MG	(3,533 m³)
Freeboard (from PWL):	2.5 ft	(0.8 m)	**Discharge Level (DWL):**	22.0 ft	(6.7 m)		
Length of Basin:	106.5 ft	(32.5 m)	**Top of Wall (TOW):**	24.0 ft	(7.3 m)		
Width of Basin:	55.8 ft	(17.0 m)					

PROCESS DETAILS

Cycle Duration:	= 4.5 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.037 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.54 Days	
Solids Retention Time:	= 25.80 Days	
Est. Net Sludge Yield:	= 0.98 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 6823.0 lbs. WAS/Day	= (3094.9 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.00	
Actual Oxygen Required:	= 17636 lbs./Day	= (7999.6 kg/Day)
Max. Discharge Pressure:	= 10.81 PSIG	= (75 KPA)
Max. Air Flowrate/Basin:	= 2,199 SCFM	
Min. Air Flowrate/Basin:	= 550 SCFM	
Max. Simultaneous Air:	= 4,354 SCFM	
Min. Simultaneous Air:	= 1,023 SCFM	

RETURN FLOW ESTIMATES

Daily Estimated Return Flow:	= 0.61 MGD
Max. Instantaneous Return Flow:	= 569 GPM

POWER CONSUMPTION

Average Aeration Power Consumption: = 1384 kWh/day (at 48% design load)

Sludge Buffer - Design Summary

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 2 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 15.4 ft	= (4.7 m)
Max. Basin Volume:	= 37,258 gallons	= (141.0 m³)
Length of Basin:	= 19.7 ft	= (6.0 m)
Width of Basin:	= 16.4 ft	= (5.0 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 101 gpm	= (23 m³/hr)
Max. Supernatant Flow Rate Required:	= 405 gpm	= (92 m³/hr)
Average Power Consumption:	= 28 kWh/day (at 48% design load)	

Post-Equalization - Design Summary

POST-EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 5.16 MGD	= (19,550 m^3/day)
Max. Daily Flow (MDF):	= 8.08 MGD	= (30,600 m^3/day)
Decant Flow Rate from (Qd):	= 8,357 gpm	= (1,898 m^3/hr)
Decant Duration (Td):	= 60 min	

POST-EQUALIZATION VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua-Aerobic. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

POST- EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry: = 1 Rectangular Basin(s)

Min. Water Depth:	= 0.0 ft	= (0.0 m)	**Min. Basin Vol. Basin:**	= 0 gal	= (0 m^3)
Max. Water Depth:	= 19.0 ft	= (5.8 m)	**Max. Basin Vol. Basin:**	= 134,964 gal	= (511 m^3)

POST- EQUALIZATION EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 5,970.3 gpm	= (1,356.0 m^3/hr)
Avg. Power Required:	= 589.6 kW-hr/day	

AquaNereda: Influent Buffer

Level Sensor Assemblies

1 Sensor installation(s) consisting of:

- Pressure transducer(s).
- Stainless steel sensor guide rail weldment(s).
- PVC sensor mounting pipe(s).
- Top support(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda

Influent Valves

3 Influent Valve(s) will be provided as follows:

- 24 inch electrically operated plug valve(s).

Influent Distribution System

3 Influent Distribution Assembly(ies) consisting of:

- Influent distribution system consisting of HDPE and PVC pipe with supports.

Effluent Weir Assembly

3 Effluent Weir Assembly(ies) consisting of:

- Concrete main effluent channel(s) provided by others.
- Stainless steel weir assembliy(ies) with supports.

Sludge Removal System

3 Solids Waste System(s) consisting of:

- HDPE or Stainless steel solids waste system(s).
- Pressure transmitter(s).

3 Sludge Decant/WLC Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic control valves and two (2) of the following manual throttling valves:
- 18 inch electrically operated butterfly valve(s).
- 18 inch diameter manual plug valve(s).

3 Air Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic valves and one (1) of the following manual valves:
- 4 inch manually operated butterfly valve(s) with lever handle.
- 4 inch electrically operated butterfly valve(s) with actuator.

Fixed Fine Bubble Diffusers

3 Fixed Fine Bubble Diffuser Assembly(ies) consisting of:

- 304 SS, 12 Ga. drop pipe(s).
- PVC, Sch 40 Manifold(s) with connection to drop pipe.
- PVC, Air distributor(s) with connection to the manifold and required PVC pipe joint connections.
- 304 Stainless steel piping supports with vertical supports, clamps, adjusting mechanism and anchor bolts.
- Fine bubble diffuser assemblies.

- Air muffler(s).

Positive Displacement Blowers

4 Positive Displacement Blower Package(s), with each package consisting of:

- Aerzen 100HP Rotary Positive Displacement Blower(s).
- 8" manual butterfly valve(s).

Air Valves

3 Air Control Valve(s) will be provided as follows:

- 6 inch electrically operated butterfly valve(s) with actuator.
- Auma actuator will be upgraded from open/close service to modulating service.
- Air flow meter(s).
- Flow conditioner(s).
- 6 inch manually operated butterfly valve(s) with lever handle.

Level Sensor Assemblies

3 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

3 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

1 Server Based Control and Monitoring System will be provided as follows:

- Process Controller Server.
- Small server monitor.
- Process Operator Station.

3 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

3 TSS Sensor(s) will be provided as follows:

- TSS probe(s).

3 ORP Sensor(s) will be provided as follows:

- ORP sensor(s).

3 pH Sensor(s) will be provided as follows:

- pH probe(s).

3 Phosphorus Analyzer(s) will be provided as follows:

- Phosphate analyzer(s).

3 Filtrax Sampling System(s) will be provided as follows:

- Sampling system.

3 Process Controller(s) consisting of:

- Controller and display module(s).

3 Process Controller(s) consisting of:

- Controller(s).

2 Process Control System will be provided as follows:

- Hach SC1000 display module.

- FRP enclosure(s) for SC1000 Display.

3 Ammonium Probe(s) will be provided as follows:

- Ammonium probe(s).
- Controller(s).

AquaNereda: Post-Equalization

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaNereda: Sludge Buffer

Transfer Pumps/Valves

2 External pump assembly(ies) consisting of the following items:

- 10HP Pump assembly(ies).
- 3 inch manual plug valve(s).

2 Sludge Valve(s) consisting of the following items:

- 4 inch electrically operated plug valve(s).

2 Supernatant Valve(s) consisting of the following items:

- 6 inch electrically operated plug valve(s).

2 Sludge Buffer Inlet Valve(s) consisting of:

- 18 inch electrically operated butterfly valve(s).

Sludge Removal System

2 Solids Removal Assembly(ies) consisting of:

- Solids removal assembly(ies) consisting of PVC and/or HDPE pipe with supports.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

2 Hach TSS WAS Sensor(s) will be provided as follows:

- Hach Solitax Inline sc stainless steel pipe isertion probe with stainless steel wiper and 33 ft electric cable. One (1) probe per basin.

1 Process Controller(s) consisting of:

- Controller and display module(s).

AquaNereda: PLC Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote access Ethernet modem(s).
- Panel will be CSA labeled.

4/22/2023

Town of Greater Napanee, Ontario
Project ID 704419A

Preliminary Process Design Submittal (PPDS)

Aqua-Aerobic Systems is pleased to present the following proposal for a Preliminary Process Design Submittal (PPDS) for the above-referenced project:

SCOPE AND DELIVERABLES

Available ~3-4 weeks from purchase order, completed design questionnaire and signed Nereda® NDA. Final ETA to be confirmed upon order receipt and acceptance.

Section 1 – Process Design

- Process Design Overview
- Process guarantee and acceptance test protocol
- Cycle structure and flow profile

Section 2 – Equipment and Materials

- Detailed equipment specification with materials of construction and manufacturers

Section 3 –Reference Drawings (PDF and AutoCAD format)

- Preliminary plan view drawings
- Preliminary key section views
- Preliminary System P&ID & equipment schedule
- Instrument mounting diagram
- WLC & SB pump schematic
- Valve schedule
- Hydraulic profile
- One-line electrical drawings

Please note that the information provided in the PPDS is intended to be preliminary and subject to final confirmation at the detailed engineering/shop drawing stage.

TOTAL PRICE	**$100,000 CAD**

TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles.

PAYMENT
Unless specifically stated otherwise, quoted terms are Net 30 Days from shipping date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office.

DURATION OF QUOTATION
This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

SHIPMENT
Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal.

TITLE AND RISK OF LOSS
All prices and all shipments of goods are F.O.B. Aqua-Aerobic Systems, Inc.'s plant at Loves Park, Illinois unless specifically stated otherwise. Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

TAXES
Prices quoted do not include any taxes, customs duties, or import fees. Buyer shall pay any and all use, sales, privilege or other tax or customs duties or import fees levied by any governmental authority with respect to the sale or transportation of any goods covered hereby. If Aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc. is required to pay.

INSURANCE
Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage.

SECURITY
If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

LIMITATION OF ACTION
No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

CANCELLATION CLAUSE
No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be cancelled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefor: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.

PROPRIETARY INFORMATION
This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.

QUALIFIED ACCEPTANCE AND INDEMNITY
In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua-Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER
In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an “Endura Series” motor, the complete Endura Series unit shall be warranted by Aqua to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business at or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-

Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

This Proposal and Offer is hereby accepted by:

By: ____

Printed Name: ______________________________________

Title: ____

Signature: ____

Date: ____

AQUA-AEROBIC SYSTEMS, INC. (Aqua-Aerobic):

Printed Name: Joe Tardio

Title: Product Manager – AquaNereda®

Signature: ____

Date: ____

Confidentiality and Site Visits
AquaNereda®

AquaNereda® technology was developed over the last decades as a result of intensive (and expensive) research and development programs. To protect critical know-how and secure commercial interests, it is important that certain information is treated highly confidential and is not released to third parties that did not commit to confidentiality in writing. Subsequently end users, AquaNereda® licensees, project partners, subcontractors, etc. are bound by law, contracts and/or additional Non-Disclosure Agreements to protect this confidential know-how and not to disclose it to third parties at the expense of being held liable for damages in case of non-compliance with confidentiality.

You are kindly requested to help in protecting the know-how and intellectual property not available in the public domain and in respecting the commercial value of AquaNereda® technology.

Information regarding the influent distribution system design, sludge discharge system design, start-up/granulation/operational strategies, as well as AquaNereda® documentation, hardcopy performance trends, and photos/media shall be kept confidential.

Guidelines for site visitors

Know what information is considered confidential. Prevent that information from being disclosed. Talk frankly about your operational experience and performance of AquaNereda® and feel free to illustrate these discussions with relevant SCADA trends, but do not share any data digitally or in a hardcopy format.

- Request visitors to sign an NDA.
- Restrict photography or videography to areas without visible proprietary system components.
- Do not disclose details regarding the construction or operation of AquaNereda® internals.
- Do not show SCADA or AquaNereda® Controller graphics.
- Keep confidential information such as mechanical drawings, P&IDs, and operational manuals out of sight.
- Do not provide granule samples.

The following page summarizes all guidelines in a printable format for plant staff.

If further guidance is required regarding sharing of confidential information, please contact:

Joe Tardio
Product Manager - AquaNereda
jtardio@aqua-aerobic.com
815-639-4451

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

AquaNereda® Aerobic Granular Sludge Technology
Site Visitor Guidelines

End-users are committed to protect certain confidential information due to the proprietary nature of the AquaNereda® technology. The following guidelines are therefore recommended:

Request the visitor to sign a non-disclosure form
In case you might accidentally share confidential information, you can refer to the visitors' acknowledgement of non-disclosure to prevent potential damages.

Photo restrictions
Forbid taking photographs or movies during the visit, or at the very least avoid pictures that would expose confidential reactor details.

Reactor internals
Do not disclose construction or operational details related to feed distribution and sludge discharge. Do not disclose details on sludge selection such as timer setting and upflow velocities.

SCADA / Nereda® Controller
Do not show SCADA grahics/models that clearly show the reactor internal or detailed control strategies of the Nereda® Controller.

Exposure to confidential documentation
Keep documents with confidential information such as PI&Ds, operation manuals, etc. out of sight.

Granule samples
Do not provide samples without confirming prior consent with Aqua-Aerobic Systems, Inc.

Performance details
Speak freely about your experience and system. Feel free to illustrate these discussions with relevant SCADA trends. Do not – without consent – share any data digitally or in a hardcopy.

Know what is confidential
Familiarize yourself with what is classified as confidential information: consult the documents that specify this or contact Aqua-Aerobic Systems, Inc.

AquaNereda® Table of Contents

THIS SECTION IS LEFT BLANK AND WILL BE INCLUDED IN THE OPERATION & MAINTENANCE MANUAL.

SECTION 8 ELECTRICAL DRAWINGS

GENERAL INFORMATION

Technical Support

For Scheduling Equipment Start-Up Services or Technical Support:

For scheduling Customer Service Representatives for service trips and/or start-up services please call:

815-654-2501 and ask for the Project Management Department.

For assistance with any AASI type equipment including **after normal working hours**, weekends, emergencies, and Federal Holidays, please call:

800-940-5008 and ask for the Technical Support.

For Spare or Replacement Parts Contact:

For assistance in quoting replacement parts and/or ordering parts or equipment, please call:

The Customer Service Department toll free at **877-271-9694** and ask for **"Spare Parts and After Market Services".**

Or e-mail Customer Service at customerservice@aqua-aerobic.com

Ordering replacement parts and/or equipment may be done via our Fax number. Please send order via **Fax: 815-654-8623**, to the attention of **"Spare Parts and After Market Services".**

Please provide the
- desired quantity
- part description
- AASI part number
- Project ID Number

as listed within your operation and maintenance manual when placing your order.

Product Manual Special Messages

Your manual contains special messages to bring attention to potential safety concerns, equipment damage as well as helpful operating and servicing information. Please read all the information carefully to avoid injury and equipment damage.

⚠ DANGER
Indicate an immediately hazardous situation which, if not avoided, will result in death or serious injury. Danger is limited to the most extreme situations.

⚠ WARNING
Indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Caution may also be used to alert against unsafe practices.

NOTICE
Indicate a statement of company policy as the message relates directly or indirectly to the safety of personnel or protection of property.

GENERAL SAFETY
Indicate general instructions relative to safe work practices, reminders of proper safety procedures, and the location of safety equipment.

EQUIPMENT SAFETY DOCUMENTS and PRECAUTIONS

Electrical

Safety Precautions

⚠ CAUTION

- **Be aware of electrical hazards:**
  - **Electric shock and burns** – An electric shock occurs when electric current passes through the body. This can happen when touching an energized part.
  - **Arc-flash burns** – An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure. The arc flash can cause severe burns by direct heat exposure and by igniting clothing.
  - **Arc-blast impacts** – The heating of air and vaporization of metal during an arc, creates a pressure wave that can damage hearing and cause concussions among other injuries.
  - **Falls** – Electric shocks and arc blasts can cause falls.
- Equipment is automated and operates cyclically.
- Never reach into equipment to actuate a device. Unexpected operation could occur.
- Installation and service of electrical machinery and controls must be completed by qualified personnel only.
- Before proceeding with servicing any electrical equipment, all sources of power to the equipment must be disconnected and securely locked out and tagged out. Refer to the Electrical Lockout / Tag Out Procedures for details.
- Refer to NFPA 70E, Standard for Electrical Safety in the Workplace, for additional guidance.

Minimize the hazards. Discuss potential hazards and procedures with supervisors and other workers before starting any electrical wiring or service repairs. De-energize and lockout / tag out all electrical equipment, and insulate, or isolate exposed live parts so contact cannot be made. If this is impossible, obtain and wear proper Personal Protective Equipment (PPE) and tools.

Refer to the Lockout / Tag Out Procedures before attempting to service any electrical equipment.

Electrical Lockout / Tag Out Procedures

Consult your facility procedure. Each facility should have a written lockout/tag out program and train employees in this program. The typical program should cover planning for locating and labeling energy sources, identifying employees at risk, how and by whom the equipment is de-energized, releasing of stored energy, verifying that the circuit is de-energized and can't be restarted, voltage testing, grounding requirements, shift changes, coordination with other jobs in progress, a procedure for keeping track of all involved personnel, applying and removing lockout/tag out devices, return to service, and temporary re-energizing for testing/positioning. Lockout/tag out procedures should be developed for each machine or piece of equipment that will require servicing.

Lockout / Tag Out Application

Each person who could be exposed to electric energy must be involved in the lockout/tag out process. A typical process is described below.

- After de-energizing, each employee at risk should apply an individual lockout/tag out device to each source of electric energy. Pushbuttons or selector switches cannot be used as the only way to de-energize.
- **Lockout Device:** A lockout device is a key or combination lock with a tag that can be attached to a disconnecting device to prevent the re-energizing of the equipment being worked on without removal of the lock. The lockout device should have a way of identifying the individual who tagged it and the reason why it was tagged. Individual lockout devices with worker's name and picture on them are preferred. That worker must be the only person who has the key or combination for the lockout device they install, and that worker should be the only person to remove the lock after all work has been completed.
- **Tag Out Device:** A tag out device is a tag or means that can be attached to the actual lockout device to notify all workers that this equipment has been locked out. The tag out device must include a way to attach to the lockout device that can withstand at least 50 pounds of force. Tag out devices on electrical power should be used alone only when it is **not** possible to install a lockout device.
- **Lockout Tag:** The tag used in conjunction with a lockout or tag out device must have a warning label prohibiting unauthorized disconnecting or removal of the lockout/tag out device.
- Before beginning work, each involved worker must verify through testing that all energy sources have been de-energized.
- Electric lockout/tag out procedures should be coordinated with all other site procedures for controlling exposure to electric energy and other types of energy sources.
- Complex lockout/tag out procedures are special procedures that are needed when there is more than one energy source, crew, craft, location, employer, way to disconnect, or lockout/tag out procedure or for work that lasts beyond one shift. In any of these cases, one qualified person should be in charge of the lockout/tag out procedure with full responsibility for ensuring all energy sources are under lockout/tag out and to account for all people on the job.

- **Removal of Lockout/Tag Out devices:** Lockout and tag out devices should be removed only by the person installing them. If work is not completed when the shift changes, workers arriving on shift should apply their locks before departing workers remove their locks.
- **Return to service:** When electrical work has been completed tests and visual inspections must be made to confirm that all tools, mechanical restraints, electric jumpers, shorts, and grounds have been removed. Once work is completed and lockout/tag out devices are removed, tests and visual inspection must confirm that all tools, mechanical restraints, electric jumpers, shorts, and grounds have been removed. Only then is it safe to re-energize and return to service.
- **Temporary release**: If the job requiring lockout/tag out is interrupted for any reason, the steps outlined in Return to Service (above) should be followed before removing the lockout/tag out devices, and placing the equipment back into operation.

⚠ **WARNING**

Electrical Hazards

- **Electric shock and burns: An electric shock occurs when electric current passes through the body. This can happen when touching an energized part. If the electric current passes across the chest or head, death can result. At high voltages, severe burns can result.**
- **Arc-flash burns: An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure (for instance, while opening or closing disconnects). The arc can heat the air to temperatures as high as 35,000° F, and vaporize metal in the equipment. The arc flash can cause severe skin burns by direct heat exposure and by igniting clothing.**
- **Arc-blast impacts: The heating of air and vaporization of metal creates a pressure wave that can damage hearing and cause memory loss (from concussion) and other injuries. Flying metal parts are also a hazard.**
- **Falls: Electric shocks and arc blasts can cause falls, especially from ladders or unguarded scaffolding.**

Electric Safety Principles - Energized Condition

- **De-energize whenever possible**.
- **Plan every job**. The approach and step-by-step procedures to complete the work at hand must be discussed and agreed upon between all involved employees before beginning. Write down first-time procedures. Discuss hazards and procedures in a job briefing with supervisors and other workers before starting any job. It is the employer's responsibility to have or develop a checklist system for working on live circuits, if such a scenario arises.
- **Identify the hazards**. Conduct a job hazard analysis. Identify steps that could create electric shock or arc-flash hazards.

- **Minimize the hazards**. De-energize any equipment, and insulate, or isolate exposed live parts so contact cannot be made. If this is impossible, obtain and wear proper Personal Protective Equipment (PPE) and tools.
- **Anticipate problems**. If it can go wrong, it might. Make sure the proper PPE and tools are immediately available for the worst-case scenario.
- **Obtain training**. Make sure all involved employees are qualified electrical workers with appropriate training for the job.

Working on De-Energized Equipment

Electrically Safe Condition

The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker ensures they are not.** Every circuit and conductor must be tested every time work is done on them. Proper PPE must be worn until the equipment is proven to be de-energized.

The National Fire Protection Association (NFPA) lists six steps to ensure conditions for electrically safe work.

1. Identify all sources of power to the equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. Remove the load current, and then open the disconnecting devices for each power source.
3. Where possible, visually verify that blades of disconnecting devices are fully open or that drawout-type circuit breakers are fully withdrawn.
4. Apply lockout/tag out devices in accordance with your facilities formal, written policy.
5. Test each phase conductor or circuit part with an adequately rated voltage detector to verify that the equipment is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Check the voltage detector before and after each test to be sure it is working.
6. Properly ground all possible sources of induced voltage and stored electric energy (such as, capacitors) before touching. If conductors or circuit parts that are being de-energized could contact other exposed conductors or circuit parts, apply ground-connecting devices rated for the available fault current.

The process of de-energizing is "live" work and can result in an arc flash due to equipment failure. When de-energizing, follow the procedures below described in "Working on / or Near Energized Equipment."

Working on / or Near Energized Equipment

Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk even though work is on de-energized parts. Common tasks where there may be a need to work on or near live circuits include:

- Taking voltage measurements
- Opening and closing disconnects and breakers

- Racking breakers on and off the bus
- Removing panels and dead fronts
- Opening electric equipment doors for inspection

Facilities should adopt standard written procedures and training for these common tasks. For instance, when opening and closing disconnects, use the **left-hand rule** when possible (stand to the right side of the equipment and operate the disconnect switch with the left hand).

Approach Distances to Exposed Live Parts

The National Fire Protection Association (NFPA) defines three approach boundaries for *shock hazards* and one for *arc flash*.

Shock Hazards

- The *Limited Approach Boundary* is the distance from an exposed live part within which a shock hazard exists.
- The *Restricted Approach Boundary* is the closest distance to exposed live parts a qualified person can approach with or without proper PPE and tools. Inside this boundary, accidental movement can put a part of the body or conductive tools in contact with live parts or inside the prohibited approach boundary. To cross the restricted approach boundary, the qualified person must review and understand Annex C, Limits of Approach, of NFPA 70-E
- The *Prohibited Approach Boundary* is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with a live part.

Arc Flash Hazard

- The Flash Protection Boundary is the approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur. For systems of 600 volts and less, the flash protection boundary is 4 feet (1.2m), based on an available bolted fault current of 50 kA and a clearing time of 6 cycles for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles.

Approach Boundaries to Live Parts for Shock Protection
(All dimensions are distance from live part to worker)

	Limited approach boundary			
Nominal system voltage range, phase to phase	Exposed movable conductor	Exposed fixed-circuit part	Restricted approach boundary (allowing for accidental movement)	Prohibited approach boundary
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in. (3.0m)	3 ft. 6 in. (1.1m)	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in. (3.0m)	3 ft. 6 in. (1.1m)	1 ft. 0 in. (0.3m)	0 ft. 1 in. (25.4mm)
751 to 15 KV KV	10 ft. 0 in. (3.0m)	5 ft. 0 in. 1.5m)	2 ft. 2 in. (0.7m)	0 ft. 7 in. (177.8mm)

Source: Excerpted from table 130.2(C), "Approach Boundaries to Live Parts for Shock

Protection" *(NFPA 70-E Standard for Electrical Safety Requirements for Employee Workplaces, 2004 edition).*

Wet or Damp Locations

Work in wet or damp work locations (i.e., areas surrounded or near water or other liquids) should not be performed unless it is absolutely critical. Electrical work should be postponed until the liquid can be cleaned up. The following special precautions must be incorporated while performing work in wet or damp locations:

- Only use electrical cords that have Ground Fault Circuit Interrupters (GFCIs);
- Place a dry barrier over any wet or damp work surface;
- Remove standing water before beginning work. Work is prohibited in areas where there is standing water;
- Do not use electrical extension cords in wet or damp locations; and
- Keep electrical cords away from standing water.

Other Precautions

When working on de-energized parts, but still inside the flash protection boundary for nearby live exposed parts:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact or PPE must be worn.
- Do not reach blindly into areas that might contain exposed live parts.
- Do not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.
- Conductive articles of jewelry and clothing shall not be worn where they present an electrical contact hazard with exposed live parts.
- Conductive materials, tools, and equipment that are in contact with any part of the body shall be handled in a manner that prevents accidental contact with live parts.

References

- NFPA 70-E, "Standard for Electrical Safety Requirements for Employee Workplaces", 2004 edition.

General Safety Precautions

AquaNereda®

⚠ WARNING

Personal flotation devices may not be effective in aerated basins.

Disconnect and lock out all power sources to equipment before performing maintenance.

GENERAL SAFETY

Read the installation, operation and maintenance instructions in the owner's manual before work begins.

Read and obey all warnings and other safety information within this manual and those attached to equipment.

Keep all warning and safety labels attached and legible. Contact factory for free replacement if labels become unreadable.

Wear personal protective equipment, especially Coast Guard approved personal flotation devices in or near liquid basins. Do not work on equipment alone.

Always wear eye protection when using power tools or when working around rotating equipment.

Exercise all necessary precautions with regard to personal hygiene and sanitation.

Observe all necessary precautions for ventilation and identification of dangerous gases whenever working in confined spaces.

Leave all equipment in crates until installation. Do not stack crates.

Do not lift or transport a load until all personnel are clear. Use lifting lugs where provided on equipment. Use approved rigging only.

Do not begin equipment operation that has just been installed or serviced without notifying personnel near equipment.

Do not manually operate equipment without knowing its result.

BLOWER
SAFETY PRECAUTIONS

⚠ WARNING
Disconnect and lock out all power sources to equipment before performing maintenance. **The blower and blower discharge piping may be extremely hot and cause skin burns on contact.** **Do not operate blower without belt and drive guards in place.** **Keep hands and loose clothing away from rotating parts.**

GENERAL SAFETY
Do not operate blower without all inlet or discharge piping in place. Do not exceed specified pressure limitations. Do not leave any spilled lubricating oil on walkways. Before starting work on blower, make sure to isolate the blower to be worked on and disconnect power to that blower. Wear hearing protection as necessary. Exercise all necessary precautions with regard to personal hygiene and sanitation.

CONTROL PANEL
SAFETY PRECAUTIONS

⚠ CAUTION

- Be aware of electrical hazards:
  - Electric shock and burns – An electric shock occurs when electric current passes through the body. This can happen when touching an energized part.
  - Arc-flash burns – An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure. The arc flash can cause severe burns by direct heat exposure and by igniting clothing.
  - Arc-blast impacts – The heating of air and vaporization of metal during an arc, creates a pressure wave that can damage hearing and cause concussions among other injuries.
  - Falls – Electric shocks and arc blasts can cause falls.

- All electrical service should be performed by qualified personnel.

- Treat all electrical equipment and conductors as though they are energized until they are placed in an electrically safe work condition.

- Create an electrically safe work condition by performing the following lockout/tag out procedures.
  - Notify others prior to beginning a lockout/tag out procedure.
  - Lockout/Tagout out all energy sources following sheet EP-10095 and / or documented site procedures.
  - Confirm that equipment is de-energized by checking voltages.
  - Clean, service, inspect or clear equipment.
  - Make sure others are safe; machine guards are in place; tools, locks, and tags are removed before restoring energy.

- See NFPA 70E for additional guidelines on safety related work practices.

GENERAL SAFETY

- Protect panel components from contamination (metal chips, loose bolts, liquids, etc.).
- Do not use control panels for storage.
- Do not leave an open panel unattended.
- Exercise all necessary precautions with regard to personal hygiene and sanitation.

SUBMERSIBLE PUMP
SAFETY PRECAUTIONS

⚠ WARNING

Personal flotation devices may not be effective in aerated basins.

Disconnect and lock out all power sources to equipment before performing maintenance.

GENERAL SAFETY

Never work alone.

Do not operate pump without all inlet or discharge piping in place.

Use a lifting harness; safety line and a respirator as required.

Always use personal flotation devices when working near water.

Lifting equipment is required for handling the pump. Make sure that it is in good condition.

Make sure the pump has been thoroughly cleaned before handling.

Hold a rag over the oil casing screw when removing it. Pressure that may have been built up in the pump may cause splatter.

Exercise all necessary precautions with regard to personal hygiene and sanitation.

Gorman-Rupp External Pump
SAFETY PRECAUTIONS

⚠ WARNING

- Overheated pumps can cause severe burns and injury. If overheating of pump casing occurs:
  - Stop pump immediately.
  - Allow pump to cool to air temperature.
  - Slowly and cautiously vent pump at drain plug.
  - Refer to O&M before restarting.
- Electrocution may occur whenever electricity is present
- Before working on pumps with electric motors and panels, LOCK control panel in the OFF position:
  - If control panel cannot be locked, pull main fuse or circuit breaker.
  - Remove all v-belts.
  - Disengage drive coupling.
- Never use gas piping as an electrical ground.

⚠ CAUTION

- Allow only qualified personnel to install, wire and operate pumps and motors.
- Always ground electrical units.
- Be sure to connect motor to correct phase and voltage.
- Do not operate pump if voltage is not within limits.
- If circuit breaker or fuse is tripped, locate and fix the problem before restarting pump.
- Make sure all electrical installations are in accordance with National Electrical Code and local codes.
- Do not work in underground pump systems alone or without adequate ventilation.
- Never wear loose clothing around machinery.
- Never operate pumps in explosive or volatile atmospheres unless they are designed to be operated in these environments.
- Do not operate pump without all guards and shields in place.
- Do not remove the cover plate, fill port cap, gauge port plug, or drain plug from any overheated pump. Allow pump to cool to air temperature. Check pump temperature before removing cover plate, fill port cap, gauge port plug, or drain plug.

GENERAL SAFETY

- Read the installation, Operation and Maintenance Manual for your pump before installing, operating or performing maintenance on the pump or its related equipment.
- Cautiously approach any pump that has been in operation.
- Pump only liquids for which the pump was designed.
- Do not pump flammable or corrosive liquids unless pump and piping are designed for such.
- Operating pump with suction and/or discharge closed is one cause of severe overheating.
- Note direction of rotation-operating pump in wrong direction may cause impeller to unscrew and damage pump casing or other pump parts.
- Locate the pump in an accessible location, as close as safely possible to the liquid being pumped.
- Secure the pump so that it cannot move after it is in its operating position.
- Check all lubricants before installation and operation in accordance with maintenance programs.
- When lifting pumps, use only lifting equipment in good repair with adequate capacity.
- Never operate a self-priming pump unless the pump casing is filled with liquid. Doing so may damage the pump. The pump will not prime unless the pump casing is filled with liquid.
- Do not operate pump against a closed valve.
- Check the suction strainer regularly to be sure that it is not clogged.
- Check the pump thoroughly upon delivery for any shipping damage.
- Always read and keep the Installation, operation and Maintenance Manual for your pump.
- When overhauling pumps, never remove or cover warning tags and labels.
- Be sure that only experienced personnel operate machinery.
- Drain pump completely of water before freezing weather.
- Follow motor manufacturer's recommended operation and maintenance instructions.

Outline For Manufacturer Training
AquaNereda®

1. Familiarization

   1.1. Show catalogue, parts lists, drawings, etc., in the plant files and O&M manuals.
   1.2. Check out the installation of the specific equipment items.
   1.3. Answer questions.

2. Safety

   2.1. Point out safety references.
   2.2. Discuss proper precautions around equipment.

3. Operation

   3.1. Point out reference literature.
   3.2. Explain all modes of operation (including emergency).
   3.3. Check out owner's personnel on proper use of the equipment (let them do it).

4. Preventative Maintenance

   4.1. Reference preventative maintenance list including:
      4.1.1. Reference material.
      4.1.2. Daily, weekly, monthly, quarterly, semi-annual, and annual jobs.
   4.2. Show how to perform preventative maintenance jobs.
   4.3. Show owner's personnel what to look for as indicators of equipment problems.

5. Corrective Maintenance

   5.1. List possible problems.
   5.2. Discuss repairs – point out special problems.
   5.3. Open up equipment and demonstrate procedures, where practical.

6. Parts

   6.1. Show how to use parts lists and order parts.
   6.2. Check over spare parts on hand and recommendations.

7. Local Representatives

   7.1. Where to order parts: name, address, telephone, facsimile.
   7.2. Service problems:
      7.2.1. Who to call.
      7.2.2. How to get emergency help.

Training Session Sign-In Sheet

Attendee's Name:	Firm Represented:
1. ______________________	______________________
2. ______________________	______________________
3. ______________________	______________________
4. ______________________	______________________
5. ______________________	______________________
6. ______________________	______________________
7. ______________________	______________________
8. ______________________	______________________
9. ______________________	______________________
10. ______________________	______________________
11. ______________________	______________________
12. ______________________	______________________
13. ______________________	______________________
14. ______________________	______________________
15. ______________________	______________________
16. ______________________	______________________
17. ______________________	______________________

Date Training was completed: ______________

Hours spent for classroom Training: __________

Hours spent for On-Site Training: __________

Instructor's Name: ______________________________

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

February 13, 2025

Correspondence ID#: AAL-50531
EVB Engineering
Attn: Jamie Baker
800 Second St W
Cornwall, Ontario K6J 1H6
Canada
Ph# 613-935-3775
Fax# 613-935-6450
Email: Jamie.Baker@evbengineering.com

Project: NAPANEE WWTP ON

RE: Submittal B Package Notice to Proceed dated July 29, 2024
Project ID #704419A / SO #107522 / AquaNereda® Activated Sludge Technology (Nereda® is a registered trademark of Royal HaskoningDHV)
Warranty Amendment

Dear Jamie,

Aqua-Aerobic Systems, Inc. warrants the goods provided by Aqua-Aerobic Systems, Inc. in accordance with the "Warranty; Limitation Of Liability; And Disclaimer" as amended herein:

In accordance with Specification Section 46 73 00 - Tertiary Filtration System, 3.7 Warranty; Warranty period shall be two (2) years from Substantial Completion.
Freight costs for goods repaired/replaced under warranty are included.
Labor costs for goods repaired/replaced under warranty are included.
Strike "Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof."

Sincerely,

Deborah Heasley

Deborah Heasley
Senior Contract Administrator

CC: File

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER

In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an Endura Series® motor, the complete Endura Series unit shall be warranted by Aqua to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first). **OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED** to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business at or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Receiving

When receiving equipment and crates, the shipment should be completely checked to verify that no transit damage has occurred. All equipment and accessories (if any) must be verified against the packing list and bill of lading to assure proper contents.

If any damage or shortage exists please notify Aqua-Aerobic Systems, Inc. immediately with complete details.

NOTICE

- **Do not sign any receiving tickets or acceptance papers unless the shipment is in proper condition and receipt of all accessories is verified.**
- **Aqua-Aerobic Systems, Inc. purchases certain completed components from third party original equipment manufacturers (OEMs). Examples include actuators, blowers, instrumentation, and pumps. Aqua-Aerobic Systems, Inc. includes the entire OEM documentation within this O&M manual. In addition to the receiving, handling, storage, maintenance, and troubleshooting information provided by Aqua-Aerobic Systems, Inc., please refer to sections 4 and 6 for the OEM documentation pertinent to each of these components.**

If there are shortages on any shipment, the packing slip will indicate that the item is back ordered, or shipping direct from original supplier.

All items back ordered will be shipped as soon as possible to complete entire order. If you have any questions regarding your shipments, or back ordered items, please call Aqua-Aerobic Systems, Inc. at (877) 271-9694 and ask for assistance on your project.

If receiving personnel finds discrepancies, shortages, or damage within any shipment, it must be reported in writing within seven (7) days to Aqua-Aerobic Systems, Inc. to obtain credit from the trucking company. Only the trucking company can supply appropriate credit for loss or damaged goods.

A standard form has been provided in this manual for presentation of loss and damage claims. Also the original bill of lading and shipping list must be submitted.

If at any time shortages or damage has occurred, please notify Aqua-Aerobic Systems, Inc. immediately after filing report with trucking company.

Aqua-Aerobic Systems, Inc. will not be responsible for any items found damaged or lost due to circumstances beyond our control. Aqua-Aerobic Systems, Inc. will repair or replace these items after receipt of a purchase order from the responsible party.

Handling

⚠ CAUTION

- **Care must be taken when handling any type of heavy equipment. Careless handling can result in damage to equipment and/or injury to persons involved.**
- **Do not lift or transport equipment, crates, etc. until all personnel are a safe/approved distance from the work area. Use lifting lugs where provided on the equipment. Only approved rigging should be used.**
- **Short cables or chains can put a cross shear on the lift eyes, breaking them off or otherwise damaging the motor or, causing a threat of falling. The lift must be equal and level. A separate cable or chain should be attached to each lift eye from the lift hook. When only one lift cable or chain is used, NO backup safety exists when a disconnection or break occurs.**
- **Consult the mechanical drawings for the weight of items to be lifted, and verify that all lifting equipment exceeds the required capacity**
- **Lifting cables or chains should be of sufficient length such that the cable or chain angle is no more than 45° off vertical.**

STANDARD FORM FOR PRESENTATION OF LOSS AND DAMAGE CLAIMS

______________________________ (Claimant's Number)* ______________

(Name of person to whom claim is presented) (Address of claimant)

____

(Name of Carrier) (Date) (Carrier's Number)

____

(Address)

This claim for $__________ is made against the carrier named above by ______________________________

(Amount of claim) (Name of claimant)

for ____________________ in connection with the following described shipment(s):

(Loss or damage)

Description of shipment ______________________________

Name & address of consignor (shipper) ______________________________

Shipped from ______________________________ To ______________________________

(City, Town or Station) (City, Town or Station)

Final Destination ______________________________ Routed via ______________________________

(City, Town or Station)

Bill of Lading issued by ______________________________ Co., Date of Bill of Lading ______________

Paid Freight Bill (Pro) Number ______________________________ Original Car Number & Initial ______________

Truck or Trailer Number ______________________________ Connecting Line Reference ______________

Name & Address of Consignee (Whom shipped to) ______________________________

If shipment reconsigned enroute, state particulars: ______________________________

____

DETAILED STATEMENT SHOWING HOW AMOUNT CLAIMED IS DETERMINED

(Number & description of articles, nature & extent of loss or damage, invoice price of articles, amount of claim, etc.)

____

____

____

______________________________ Total Amount Claimed $

IN ADDITION TO THE INFORMATION GIVEN ABOVE, THE FOLLOWING DOCUMENTS ARE SUBMITTED IN SUPPORT OF THIS CLAIM**

( ) 1. Original bill of lading, if not previously surrendered to carrier.

( ) 2. Original paid freight ("Expense") bill.

( ) 3. Original invoice or certified copy.

( ) 4. Other particulars obtainable in proof of loss or damage claimed.

____

Remarks: ______________________________

____

The foregoing statement of facts is hereby certified to as correct.

(Signature of claimant)

***** Claimant should assign to each claim a number, inserting same in the space provided at the upper hand corner of this form. Reference should be made thereat in all correspondence pertaining to this claim.

******Claimant will please place check (x) before such of the documents mentioned as have been attached, and explain under "Remarks" the absence of any of the documents called for in connection with this claim. When for any reason it is impossible for claimant to produce original bill of lading, or paid freight bill, claimant should indemnify carrier(s) against duplicate claim supported by original document.

STORAGE PROCEDURES

Introduction to Storage

The following documents summarize the short-term and special long-term storage procedures required for each piece of equipment and/or instrumentation device. The phrase **"short-term storage"** is recognized herein as *storage of equipment for three months or less, prior to installation.* The phrase **"long-term storage"** is recognized herein as *storage of equipment after the initial start-up period and/or for periods greater then three (3) months*. These procedures are recommended along with the listed precautions, which are necessary for the protection of products due to exposure to the elements after being initially installed. When the equipment has been removed from service for any reason and/or taken out of service and stored in place for any length of time, all equipment, hoses, piping, or manifold openings must be sealed off to prevent water and/or rodents from entering equipment or piping system that may cause damage.

All finished surfaces of exposed flanges, valves, etc. must be sealed off with cap plugs or wooden blank flanges securely bolted or fastened in place over the flange face to prevent entry of contaminants.

NOTICE

The following storage documents list the appropriate procedures required during short-term or long-term storage periods. Failure to comply with these recommended storage procedures will void the warranty and possibly reduce the life of your equipment.

Aqua-Aerobic Systems, Inc. purchases certain completed components from third party original equipment manufacturers (OEMs). Examples include actuators, blowers, instrumentation, and pumps. Aqua-Aerobic Systems, Inc. includes the entire OEM documentation within this O&M manual. In addition to the receiving, handling, storage, maintenance, and troubleshooting information provided by Aqua-Aerobic Systems, Inc., please refer to sections 4 and 6 for the OEM documentation pertinent to each of these components.

Pipe Storage
AquaNereda®

PVC and HDPE piping components are designed and manufactured for use in severe duty systems involving the transport of aggressive liquids. In order to ensure integrity of the system, piping must be handled with reasonable care prior to installation.

Storage Prior to Installation:

When pipe is received it should remain in its original shipping container until ready for use. The shipping containers should not be stacked more than three high and should always be stacked wood on wood. Loose pipe should be stored on racks with a minimum support spacing of (3) three feet.

When loose pipe is stored outdoors, it should be **covered loosely with a light colored covering** to protect from UV and high temperatures. This loose covering will provide for free circulation of air and reduce the heat build-up due to sunlight exposure, which could warp the pipe.

NOTICE

Failure to follow the above recommendations could result in damaged piping.

- **Store pipe under a loosely installed light colored covering.**
- **Adequately support piping that was shipped loose.**

Storage After Installation:

After a piping system is installed but before the system is put online, it must remain protected from UV and high temperatures. Piping installed in a basin can be covered with approximately 6” of water to stop damage from UV as well as provide protection from temperature extremes. Note, piping should not be allowed to reach freezing temperatures with water in it, otherwise damage could occur due to expansion of the water into ice.

Alternatively, piping can be **covered loosely with a light colored covering** until the system is put online.

NOTICE

Failure to follow the above recommendations could result in damaged piping.

- **Do not allow piping to freeze.**
- **Fill basins with installed piping systems with 6” of water OR under a loosely installed light colored covering.**

AERATION SYSTEM

PVC & CPVC Piping Components
Storage and Handling

Industrial pvc/cpvc piping components are designed and manufactured for use in severe duty systems involving the transport of aggressive liquids. In order to ensure their integrity they must be handled with reasonable care prior to installation.

Storage:

Pipe

When pipe is received it should remain in its original shipping container until ready for use. The shipping containers should not be stacked more than three high and should always be stacked wood on wood. Loose pipe should be stored on racks with a minimum support spacing of (3) three feet. Pipe should be shaded but not covered directly when stored outside in high ambient temperatures. This will provide for free circulation of air and reduce the heat build-up due to direct sunlight exposure which can destroy the pipe.

Fittings

Fittings should be stored in their original cartons to keep them free of dirt and reduce the possibility of damage. If possible, fittings should be stored indoors.

Solvent Cements and Primers

⚠ CAUTION

Solvent cements and primers are composed of various solvents and as such require special conditions for storage. Because of their flammability they must not be stored in an area where they might be exposed to ignition, heat, sparks or open flames.

Solvent cements supplied have a definite shelf life and each can and carton is clearly marked with a date of manufacture or used by date. Stock should be rotated to insure that the oldest material is used first. Solvent cements and primers should be stored in a relatively cool shelter away from direct sun exposure.

Handling:

Solvent Cements and Primers

⚠ **DANGER**

- **Solvent cements & primer are extremely flammable. The vapor is harmful. May be harmful if swallowed. May cause skin or eye irritation.**
- **Keep containers for solvent cements tightly closed except when in use. Avoid prolonged breathing of solvent vapors, and when pipe and fittings are being joined in partially enclosed areas use a ventilating device to attenuate vapor levels.**
- **Keep solvent cements, primers and cleaners away from all sources of ignition, heat, sparks and open flames.**
- **Avoid repeated contact with the skin by wearing proper gloves impervious to solvents.**
- **Application of the solvents or cements with rags or bare hands is not recommended; natural fiber brushes and other suitable applicators can produce satisfactory results.**

Pipe and Fittings

Care should be exercised to avoid rough handling of pvc/cpvc pipe and fittings. They should not be dragged over sharp projections, dropped or have objects dropped on them. Pipe ends should be inspected for cracks resulting from such abuse. Transportation by truck or pipe trailer will require that the pipe be continuously supported and all sharp edges on the trailer bed that could come in contact with the pipe must be padded.

DIFFUSED AERATION SYSTEMS & PIPING
SHORT & LONG TERM STORAGE PROCEDURES

Short Term Storage:

Fine bubble membrane diffusers must be protected from direct sunlight until placed into operation and submerged in water. Submerge the diffusers under 6" of water or cover them with a loose fitting white colored tarpaulin to protect against UV radiation and allow cool air to circulate.

NOTICE

Store all fine bubble diffuser components and the diffusers as well as all accessories in their original packaging in a clean, dry, ventilated room.

Protect all diffuser components from frost, excessive heat, direct sunlight, dust, mineral oils and hydrocarbons.

Avoid actions which can lead to damage of the diffusers and their packaging.

Do not store outdoors! Storage time of rubber parts prior to the installation / start-up should not exceed 1 year and storage conditions shall conform to DIN 7716.

During any storage period, including prior to installation, all rubber and plastic parts must be kept in their original packaging until they are installed. Crates/parts exposed to direct sunlight must be covered with white colored tarpaulin to protect against UV-radiation.

Long Term Storage:

When taking the Diffused Air System out of service for any length of time the isolation valves must be closed off, and the air hoses are to remain assembled to keep out dirt and other contaminants. Each manual winch gearbox is to be inspected and filled with oil and rust preventative for long term storage. The manual winches are to be removed from the lifting mechanisms and coated with a light coat of rust inhibitor oil on all surfaces and stored inside. However, if this is not possible they must be covered with a good canvas or heavy plastic tarp to help protect it from rust or corrosion. This type of protective covering must be securely attached around each unit and allow good ventilation to prevent condensation under the covering material. If the winches are removed for inside storage the lifting cables must be coiled and secured to the lifting mechanism to prevent damage to the strands. The electric winch assembly *if applicable* must be inspected to make sure the breather plug is clean and the gearbox filled with oil and rust preventative for long term storage. The electric winch must be stored inside and covered with a good canvas or heavy plastic tarp with a desiccant (a drying agent) placed inside to help protect it from rust or corrosion. Rotate the drum every other month to redistribute the grease and keep bearing and gear surfaces from becoming lacquered.

DIFFUSED AERATION SYSTEMS & PIPING
SHORT & LONG TERM STORAGE PROCEDURES

REGIONS: Where the ambient temperature does not drop below 32º for a period longer than 4 hours.

Fixed Coarse & Fine Bubble diffused air systems may be stored as installed in southern regions or locations where freezing conditions for long periods of time will not be present. When taking any type of diffused aeration basin out of service for three months or longer, the basin must be completely drained, cleaned, then refilled with clean water to provide protection to the diffusers and PVC piping system. The water depth must be at least thirty-nine inches (39") above the diffusers or manifold piping. This water depth will ensure UV protection to the diffusers and the entire system. During winter months, this 39" minimum water level must be increased at least six inches (6") for every five degrees Fahrenheit (5°F) the temperature is predicted to be below 50° F. This new minimum water level must be maintained until the seasonal temperature rises above 50° F or the system is put back into operation. No liquid should be allowed to freeze in or around the diffusers or manifolds. **Notice: Filling the basin with water will not be required for stainless steel diffuser systems.**

PVC header and manifold systems: Upon setting up the basin for a long storage period, the basin must be immediately filled to a water depth of at least thirty-nine inches (39") above the PVC type diffusers and/or the PVC headers and manifold piping. This water depth will ensure UV protection to the diffusers and the entire system. During winter months, this 39" minimum water level must be increased to at least six inches (6") for every five degrees Fahrenheit (5°F) the temperature is predicted to be below 50° F. This new minimum water level must be maintained until the seasonal temperature rises above 50° F, or the system is put back into operation. No liquid must be allowed to freeze in or around the PVC diffusers, headers, or manifold piping.

Stainless steel header and manifold systems: The basin may be stored as installed in southern regions or locations where freezing conditions for long periods of time will not be present. If fine bubble membrane diffusers are utilized within the aeration system, they must be removed from the manifold piping system and/or retrievable frames and placed back into their original cardboard boxes or equivalent containers for inside storage, in a temperature controlled area above freezing. The fine bubble diffusers must not be left installed within the basin, un-protected from the elements and/or possible damage.

DIFFUSED AERATION SYSTEMS & PIPING
SHORT & LONG TERM STORAGE PROCEDURES

REGIONS: Where the ambient temperature does drop below 32º for a period longer than 4 hours.

Fixed Coarse Bubble and Fine Bubble diffused aeration systems in northern regions where freezing conditions will effect the equipment in storage will require a more extreme method for storage of the diffused aeration system. The basin must be completely drained of water and cleaned. The coarse bubble CB-24 diffusers and stainless steel manifold piping may be left as installed, however, precautions must be taken to ensure that water will ***not*** be allowed to accumulate or freeze inside the basin. Fixed coarse bubble PVC diffused air systems will need to be submerged with clean water, covered, or painted to ensure UV protection for the PVC pipe materials. A good canvas or heavy gauge plastic sheathing or tarp should be used as a covering and must be securely fastened over all the PVC materials and the entire system. Water must ***not*** be allowed to freeze in the basin or around the manifold frame structures if the basin is left drained.

PVC header and manifold systems: Upon setting up the basin for a long term storage period for fixed PVC diffusers or fine bubble membrane type diffusers, the basin must be immediately filled to a water depth of at least thirty-nine inches (39”) above the PVC type diffusers and/or the PVC headers and manifold piping. This water depth will ensure UV protection to the diffusers and the entire system. During winter months, this 39” minimum water level must be increased to at least six inches (6”) for every five degrees Fahrenheit (5°F) the temperature is predicted to be below 50° F. This new minimum water level must be maintained until the seasonal temperature rises above 50° F, or the system is put back into operation. No liquid must be allowed to freeze in or around the PVC diffusers, headers, or manifold piping.

The fine bubble membrane diffusers are to be removed from the manifold system or retrievable frames and placed back into their original cardboard boxes or equivalent containers for inside storage, in a temperature control area above freezing. Inside storage will ensure protection to the membrane sleeves as they must not be left installed within the basin, un-protected from the elements and/or possible damage.

Please note that individual diffuser seals/gaskets should be replaced upon reinstallation of the diffuser tubes.

BLOWER PACKAGES

POSITIVE DISPLACEMENT BLOWERS
SHORT & LONG TERM STORAGE PROCEDURES

SHORT TERM STORAGE (up to 3 months)

If blower packages are not installed immediately, store units in a clean, dry, rodent-free, indoor location and protect them from freezing temperatures. Keep cover plates, closing plugs or seals over all openings until ready to start installation.

Outdoor storage is possible if protected from the elements. Blower packages supplied without enclosures must be completely covered with a weather barrier/tarp and must be vented to prevent adverse buildup of moisture. Store on a level surface above ground level, ensuring all openings and drive assemblies are completely sealed. The blower package isolation valves must be installed and tightly closed to help protect against evaporation of the internal protective coating, preventing rust and corrosion. To ensure equipment is properly protected and without signs of corrosion, inspect every four (4) weeks if stored indoors, every two (2) weeks if covered and/or stored outdoors. Any discrepancies found must be immediately corrected. Rotate drive shaft four (4) revolutions every two (2) weeks and regrease bearings per component OEM installation and operation manual recommendations.

LONG TERM STORAGE (greater than 3 months)

If blowers are not to be installed or will be shut down for extended periods of time, store units in a clean, dry, rodent-free, air conditioned and heated building, if possible. If a climate controlled storage location is not possible, units may be stored outdoors. Protect the units from the elements, keeping them as dry as possible and protect from freezing. Follow the short term storage recommendations outlined above. The maximum period of internal protection in a completely sealed unit is considered to be one (1) year maximum under average conditions.

NOTE: For blower packages supplied with enclosures (outdoor installations), outdoor storage is possible, provided water entry into the sound enclosure is avoided. Protect blowers from the elements by keeping the units as dry as possible and avoid freezing temperatures. A weather barrier/tarp is not required, but if used, must be vented to prevent adverse buildup of moisture. Again, to ensure equipment is properly protected and without signs of corrosion, inspect every two (2) weeks if stored outdoors. Any discrepancy must be immediately corrected. Rotate drive shaft four (4) revolutions every two (2) weeks and regrease bearings per component OEM installation and operation manual recommendations.

If equipment is to be shutdown and/or stored for longer than said 3-months storage period, it is recommended that each blower unit be uncoupled from the piping system and closed off as it was originally shipped. Precautions must be taken to prevent rust forming inside the blower casting. Condensation, gas vapors, or seal water can close up internal clearances and cause the unit to bind or seize up the impeller lobes. Injection of oil or other rust retardant lubricants within the oil reservoirs, as described within the operation and maintenance section will help to prevent rusting of the gears or bearings. The impeller case may require additional applications of the inner rust protective coating for humid or corrosive storage environments to prevent rusting of gears, bearings, or impeller case.

The procedures of coating the blower internals are explained below. Refer to the blower section of this Operation & Maintenance manual for further storage details.

⚠ CAUTION

It is not recommended that the blower units be set in place, piped to the diffuser system, and allowed to remain idle for periods longer than 3 months. If maintenance care and planning are not figured into the shut-down or storage scheme of the equipment, the blower packages will not work and/or perform as designed during the next start-up phase.

The following steps must be taken to insure corrosion protection and extended life of the blower packages:

1. Disconnect the blower from the inlet and discharge piping, and discard all paper type inlet filter elements. Felt type or better inlet filters should be clean and stored indoors in a clean, dry, constant temperature location..
2. Remove the belt guard, and belts from the unit so the blower shaft moves freely, coil up the belts and store them indoors in a clean, dry, constant temperature location. This will help protect them from drying out and cracking.
3. Fill drive end bearing reservoir with grease as specified in lubrication section of this manual.
4. Coat internals of cylinder, gearbox with Nox-Rust VCI-10 or equivalent and immediately close off all openings tightly. Repeat storage protection once a year or as conditions may require by storage area. Motorstor is oil soluble and does not have to be removed before lubricating. Nox-Rust VCI-10 may be removed before start-up by spraying a fine mist of petroleum solvent through the blower while it is running at a slow speed with open inlet and discharge. This is a product of Daubert Chemical Co. Inc., 4700 TS. Central Ave. Chicago, IL 60638-1590 Phone # (708) 496-7350 or Suit 1000, Westchester, IL 60154-5716 Phone # (708) 409-5100.
5. Seal inlet, discharge, and all vent openings with tape to prevent Nox-Rust vapors from escaping. If any part is left open to the atmosphere, the Motorstor vapor will escape losing its effectiveness of corrosion protection.
6. Paint shaft extension, inlet & discharge flanges and all other exposed surfaces with Nox-Rust X-110 from Daubert Chemical Co. or equivalent.
7. Motor and blower drive shafts must be rotated fifteen (15) revolutions as a minimum, to redistribute the grease within the bearings. This procedure must be followed every three (3) months the unit remains in storage. This routine procedure must be logged and documented by each person performing the maintenance for the entire storage period and for future servicing. Motor space heaters (*if applicable)* are to be connected and energized during the entire storage period. If space heaters were not included within the motor, the motor windings can be protected from condensation by applying low voltage single-phase power to the line leads. A qualified professional electrician must do this electrical work.
8. The units can not be subjected to any vibration during storage.
9. The blower and motor must be regularly checked for proper levels of lubrication during the storage period, and any signs of rust and/or corrosion. Refer to the blower section of Operation & Maintenance Manual and follow all manufacturers instructions for storage procedures and type of lubricants required.

In addition to the general storage procedures listed above, you should call the blower manufacturer or their local service center for extended storage suggestions and details due to the climate region in your area.

Placing the blower units back into service and/or operation

Refer to the appropriate section of the Operation and Maintenance Manual for the manufacturer's detailed storage instructions and/or procedures to be performed on the units before placing the blowers back into service.

1. Prior to placing the blower units back into service, all flange covers, plugs, covers or seals are to be removed on both the inlet and the discharge points of the blower to inspect interior completely for dirt, foreign material and rust.
2. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent such as DuPont Triclene D. After this, turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the drive shaft extension may also be removed at this time with the same solvent. The corrosion inhibitor used will vaporize and disappear during regular operation.
3. Inspect the drive elements and the slide rails on motor by removing any rust and dirt, and lubricating as necessary so tensioning of the belts will go smoothly and easily. Particular attention should be given to sheave condition and alignment by carefully cleaning off any rust and foreign material. A wire brush followed up with a shop cloth will usually do the job, and re-painting or applying additional protective materials will help extend the life.
4. Check all internal clearances. Also, at this time, remove gearbox and drive end-bearing cover and inspect gear teeth and bearings for rust.
5. Check the belts for cracks and wear, and re-check the sheave alignment for straightness before reattaching the belts and guard. If the belts show any signs of wear they should be discarded and replaced with new. Only qualified personnel with experience in installing light-medium weight machinery for sheave alignment and replacement of the belts. This will produce satisfactory results meeting the compliance with safe practices and care of equipment.
6. It is recommended that a belt-tensioning tool (Browning, A.A.S.I. #2613045) and/or checker be used to properly tension belts, and follow the V-belt installation check list within this manual to help prevent future maintenance problems.
7. The belts must be re-tensioned in accordance with the tension measurement procedures provided with the belt-tensioning tool. These measurement procedures are also provided with charts on deflection force based on sheave diameters within the blower section of this operation and maintenance manual. The ratio of belt deflection to belt span is 1:64 in either unit of measurements. All belts must be properly tensioned prior to providing power to the units.
8. Check all lubrication points of blower and motor to ensure lubrication for expected operating seasonal temperatures prior to attempting to put back into service.

CONTROL PANEL
SHORT & LONG TERM STORAGE PROCEDURES

Short Term Storage
An installed control panel should have all openings sealed and the door properly latched in the closed position. If power is left applied to the panel, internal devices will protect against normal variations in outside temperature and humidity. If power is disconnected, the panel should be stocked with desiccant material or an incandescent lamp to guard against condensation within the panel.

If the control panel cannot be installed and powered without delay, proper precautions must be taken to prevent damage due to corrosive atmospheres, water, humidity, dirt, dust, and physical damage. The control panel should be stored in a climate controlled building. If a climate controlled building is not available, desiccant bags or an incandescent lamp should be placed in the panel to guard against condensation. Protect the panel by covering with a good canvas or heavy gauge plastic tarp or similar covering material if stored outdoors.

Always disconnect and lockout all power sources to panel before working on or preparing for storage.

⚠ WARNING

A warning tag must be attached to the face of the panel or secured to the locking device indicating power is supplied to the panel during storage.

Control panels are top-heavy. Once upright, control panels must be secured to prevent tipping (restated from warning label on inner door panel)

Long Term Storage
If the control panel is to be stored upon arrival at site, it should remain sealed within the crated box or skid and stored in a climate controlled building that is maintained at or above ambient temperature for the entire storage period. The control panel is shipped with corrosion inhibitors installed inside and they have a life expectancy of 2 years provided temperatures do not exceed 104 degrees F (40 degrees C). Life expectancy is reduced by 25% above this temperature limit, which would still give 1 ½ years of protection. Corrosion inhibitors are installed for protection against salt and high humidity. They eliminate pre-coatings, special wraps, and drying agents.

If the control panel has been installed outside and was operational and must be taken out of service, it must contain some type of desiccant bags, drying agent, and/or corrosion inhibitors. The control panel must also be covered with a good canvas or heavy gauge plastic tarp or similar covering material to keep out dust, dirt, water, and foreign substances. If internal heaters are available inside the panel, they are to be connected and energized for the complete storage period. If heaters are not available, an incandescent lamp mounted inside the cabinet with an adequate power supply must be installed. At all times during the storage period, the panel door must be kept closed, sealed securely, and latched.

When determining the proper corrosion inhibitor for your application, assume the enclosure volume to be protected is greater than calculated if (1) the enclosure doors are opened frequently, (2) the enclosure is located in an extremely corrosive area, and/or (3) the enclosure length divided by depth is greater than four (4).

EXTERNAL CENTRIFUGAL PUMP
SHORT & LONG TERM STORAGE PROCEDURES

Short Term Storage:
Inside storage is recommended for all pumps. If this is not possible, a good canvas or heavy gauge plastic sheathing or tarp should be securely fastened around each pump and motor. This type of protective covering must allow good ventilation to prevent condensation under the covering material.

Long Term Storage:
For inside storage, the pumps must be temporarily disconnected from the discharge piping and the casing drain plug must be removed allowing all remaining water to be removed. The ambient temperatures of the inside storage area should not drop below freezing. For long periods of storage, the pump and motor must be protected against moisture and heat, as the pump impeller may freeze at low temperatures. The inside casing area should be allowed to thoroughly dry and the entire internal casing must be protected with a rust inhibitor. The pump impeller must be rotated by hand and protected with the rust inhibitor to prevent the seals from sticking together and to ensure that all parts are operable and lubricated. Condensation, gas vapors, or seal water can close up internal clearances and cause the impeller to bind or seize. Injection of oil or other rust retardant lubricants within the oil reservoirs, as described within the operation and maintenance section will help to prevent rusting of the internal parts or bearings.

Improper storage of electric motors will also result in seriously reduced reliability. For example, a motor exposed to the elements such as normal humidity or extreme temperature changes is likely to encounter rust within the bearings.

NOTICE

Any standard motor being returned to service following 90 days or more shutdown or storage period should have the insulation resistance of the stator windings checked with a megohmeter before placing it back into service or applying power. An acceptable test to insure there are no shorts and open legs of the motor would be to check between all three phases to each other and the ground lead with a meger test of one (1) megohm. If the megohmeter test for each lead result in greater than 1.0 MEG the motor may be placed back into service. All standard motors must also be re-greased (if applicable) by thoroughly flushing the old grease from both motor bearings until bright new grease appears at the open relief port.

Coat internal pump cavity and impeller with a rust inhibitor such as *Sprayon® # S00100 white lithium lube*. Then immediately close off all openings tightly. The Sprayon® lubricant is a high solid white grease in an aerosol form with NSF registration number 115074; H2 rated which inhibits corrosion and works from 20º F to 275º F and is non-melting. An alternative lubricant would be; *Nox-Rust® VCI-10*. Repeat storage protection once a year or as conditions may require by storage area. *Motorstor®* is another good oil soluble lubricant.

Reinstall the drain plug after applying a rust inhibitor and complete piping connection to seal off the pump from any possible moisture that could cause rusting and/or long term corrosion. This procedure must be continued once a year or as storage conditions may require during the entire storage period. The pump and/or motor shafts and all other exposed surfaces should be painted or coated with *Nox-Rust® X-110* or equivalent. Refer to the specific pump and/or motor O&M Manuals for recommendations and instructions for storage and procedures to follow when placing any pump back into operation.

Sprayon® is a product of *Krylon Products Group, 101 W. Prospect Ave. Cleveland, OH 44115, Call Toll Free: (800) 251-2486.*

Nox-Rust® and Motorstor® are products of *Daubert Chemical Co. Inc., 4700 TS. Central Ave. Chicago, IL 60638-1590 Phone # (708) 496-7350 or Suit 1000, Westchester, IL 60154-5716 Phone # (708) 409-5100*.

FLOAT SWITCH
SHORT & LONG TERM STORAGE PROCEDURES

Short Term Storage

Inside storage is preferable. If this is not possible, any float switch installed in potentially freezing environments must be raised up above the water level within the basin. The sensor cable must be tethered in place to prevent impact or damage from wind or the elements during the entire storage period.

Long Term Storage

Although the float switch is designed for tough duty, care must be taken to prevent any possible damage to these devices. When removing the system from operation and during the storage period, it is recommended that all instrumentation type equipment be stored indoors out of the elements in its original carton with the packing material. The instrumentation devices should be stored in a clean, dry, protected area free from excessive vibration and rapid temperature changes. All cables must be protected from damage and individually ty-wrapped in a coil and kept from being kinked in any way.

INSTRUMENTATION

GENERAL INSTRUMENTATION
STORAGE PROCEDURES

Unless otherwise specified, all instrumentation must be stored in a climate controlled environment away from the elements with temperatures that range from 4 to 40 ºC (40 to 104 ºF). All electrical cables must be protected from damage and individually tie-wrapped in a coil and kept from being kinked in any way. The instrumentation must be protected from sharp impact at all times during the storage period.

For more detailed storage procedures, go to individual storage procedures and/or operation and maintenance manuals for each specific component.

Ammonium Sensor Probes
Short & Long Term Storage Procedures

Short Term Storage

Keep the membranes and the salt bridge moist (NO DISTILLED WATER OR DI WATER). This will help avoid long response times when placing the sensor back in the sample flow. Otherwise, the correct operation of the sensor is no longer guaranteed.

Long Term Storage

Use the delivered storage container for long term storage. Fill the container with drinking water (NO DISTILLED WATER) and ensure that the sensor cartridge remains wet. Check the membranes and ensure they are still moist every 2-4 weeks, depending on environmental conditions. Take care of the contacts between sensor and sensor cartridge. The contacts must be stored in a dry place.

The sensors must be stored in temperatures ranging from -20 to 60 ºC (-4 to 140 ºF) and the sensor cartridges must be stored in temperatures ranging from 5 to 40 ºC (41 to 104 ºF).

NOTICE

A storage container is supplied to keep the sensor cartridge moist. Keep sensor cartridge capped within the storage container during short and long term storage.

DISSOLVED OXYGEN SENSORS
STORAGE PROCEDURES

The D. O. probes must be removed from the basin and stored indoors in an area where the ambient temperature will not drop below freezing. Care must be taken to prevent any possible damage to the D. O. probe and devices, when removing the system from operation and during the storage period. All sensor type equipment must be stored indoors out of the elements in its original carton with the packing material. The sensor devices should be stored in a clean, dry, protected area free from excessive vibration and rapid temperature changes. All electrical sensor cables should be protected from damage and individually ty-wrapped in a coil and kept from being kinked in any way.

Most D.O. sensors are shipped with a protective cap installed over the sensor head, and that cap must be removed before installing. This cap serves as protection to the sensor head and membrane and it must be reattached during storage or when taking the probes out of service, even for short inactive periods.

Remove the sensor from the process liquid and wipe with a wet cloth to remove debris and biological growth. Clean the exterior of the sensor with a soft, wet cloth. If the sensor cap is removed from the sensor body, do not leave the interior of the cap exposed to sunlight. Sun exposure to the interior of the cap can adversely affect the performance of the sensor. Degradation from sunlight is only an issue if the sensor cap is off the sensor body and the interior of the sensor cap is exposed to sunlight.
Refer to actual Operation and Maintenance manual for membrane and electrolyte replacement.

NOTICE
Mechanical cleaning of the membrane with abrasives is not recommended.

Filter Probe sc
LONG TERM STORAGE PROCEDURES

NOTICE

If the power supply to the controller is interrupted, frost damage may occur. Ensure that the instrument and tubing cannot freeze.

Take the Filter Probe sc out of operation if there is a risk of frost or to remove from operation for an extended period.

Long Term Storage

1. Remove power from the analyzer. Refer to the appropriate analyzer user manual for more information.

2. Remove power from the Filter Probe sc.

NOTICE

Do not let the filters dry out, as dry filters will become unusable immediately and cannot be repaired.

3. Take the Filter Probe sc out of the process stream.

4. Dismantle the filters (See appropriate Filter Probe sc Manual for instructions). Store the filters in the plastic bag that it was shipped with. Store used filters in the plastic bag with clean water added. Used filters must be kept wet or damage to the filter may occur.

5. Wrap the Filter Probe sc in protective film or a dry cloth and store in a dry location.

The storage temperatures for the Filter Probe sc are ranging from -20 to 60 ºC (-4 to 140 ºF) in 95% relative humidity, non-condensing.

FLOW METER
STORAGE PROCEDURES

- Store the device in a dry, dust free location.
- The storage temperature should be between -40º to 149º F (-40º to 65º C.).
- Avoid continuous direct sunlight.
- Store the device in its original packaging if possible.

LEVEL TRANSDUCERS
SHORT & LONG TERM STORAGE PROCEDURES

Short Term Storage
The level transducer should be stored indoors if possible. If not they should be raised up above the basin wall with the cables coiled up and secured to prevent damage from wind or the elements. This will prevent the possibility of the transducer freezing in the basin and damaging the transducer or cables. The transducers and cables must be protected from sharp impact at all times during the storage period.

Transducers are equipped with custom, vented cable that provides an atmospheric reference for the sensor, which is necessary for insuring the highest possible accuracy when making level measurement. If the vent line is left unprotected, such as during storage, it provides a pathway for water vapor to enter the level transducer. This vapor will condense into water and could create an offset in the transducer output or, cause permanent damage. For these reasons, the level transducers are provided with a sensitive bellows type filter.

The sensitive bellows filter (provided as AASI standard) responds to, and transmits changes in atmospheric pressure to the sensor, while remaining a maintenance-free closed system.

NOTICE
The transducer cable must not be bent sharply, cut, compressed or kinked as this could damage the vent tube and cause inaccurate operation.

Although the level transducers are designed for tough duty, care must be taken to prevent any possible damage to these devices when removing the system from operation and during the storage period.

Long Term Storage
It is recommended that all instrumentation type equipment be stored indoors out of the elements in its original carton with the packing material. The instrumentation devices should be stored in a clean, dry, protected area free from excessive vibration and rapid temperature changes. All electrical sensor cables must be protected from damage and individually ty-wrapped in a coil and kept from being kinked in any way.

ORP SENSORS
SHORT & LONG TERM STORAGE PROCEDURES

Most ORP sensors are shipped with a protective cap installed over the sensor head, and that cap must be removed before installing. This protective cap serves as protection to the process electrode and salt bridge. It must be reattached during storage or when taking the probes out of service, even for short inactive periods.

NOTICE

Short Term Storage:

When the sensor is out of process for more than one hour fill the protective cap with pH 4 buffer or DI water and place the cap back on the sensor. Keeping the process electrode and salt bridge moist will avoid slow response when the sensor is placed back in operation.

Long Term Storage:

The ORP probes must be removed from the basin and stored indoors in an area where the ambient temperature will not drop below freezing. Care must be taken to prevent any possible damage to the ORP probe and devices, when removing the system from operation and during the storage period. All sensor type equipment must be stored indoors out of the elements in its original carton with the packing material. The sensor devices should be stored in a clean, dry, protected area free from excessive vibration and rapid temperature changes. For extended storage, repeat the short term storage procedure every 2 to 4 weeks. All electrical sensor cables should be protected from damage and individually ty-wrapped in a coil and kept from being kinked in any way.

NOTICE

The gold or platinum process electrode at the tip of the ORP sensor has a glass shank (hidden by the salt bridge) which can be broken. Do not subject it to abrupt impact or other mechanical abuse.

Follow the operation and maintenance manual for correct cleaning procedures when removing the sensor for long term storage.

pH SENSORS
SHORT & LONG TERM STORAGE PROCEDURES

Most pH sensors are shipped with a protective cap installed over the sensor head, and that cap must be removed before installing. This protective cap serves as protection to the process electrode and salt bridge. It must be reattached during storage or when taking the probes out of service, even for short inactive periods.

NOTICE

Short Term Storage:

When the sensor is out of process for more than one hour fill the protective cap with pH 4 buffer or DI water and place the cap back on the sensor. Keeping the process electrode and salt bridge moist will avoid slow response when the sensor is placed back in operation.

Long Term Storage:

The pH probes must be removed from the basin and stored indoors in an area where the ambient temperature will not drop below freezing. Care must be taken to prevent any possible damage to the pH probe and devices, when removing the system from operation and during the storage period. All sensor type equipment must be stored indoors out of the elements in its original carton with the packing material. The sensor devices should be stored in a clean, dry, protected area free from excessive vibration and rapid temperature changes. For extended storage, repeat the short term storage procedure every 2 to 4 weeks. All electrical sensor cables should be protected from damage and individually ty-wrapped in a coil and kept from being kinked in any way.

NOTICE

The process electrode at the tip of the pH sensor has a glass bulb, which can be broken. Do not subject it to abrupt impact or other mechanical abuse.

Follow the operation and maintenance manual for correct cleaning procedures when removing the sensor for long term storage.

PHOSPHAX ANALYZER
LONG TERM STORAGE PROCEDURES

⚠ CAUTION

Always wear safety equipment when handling chemicals.

Long Term Storage

Use the following procedure if the instrument is to be taken out of operation for an extended period, or in the case of risk of frost.

1. Immerse the tubing for reagent and cleaning solutions in distilled water.
2. On the controller TEST/MAINT menu, start a cleaning cycle with distilled water using the PREPUMP REAG+CLEAN.
3. Clean the canister lid with distilled water.
4. Take the tubing out of the water and start the PREPUMP ALL function to pump the tubing and the analysis instrument empty.
5. Wipe the canister lids dry and seal the canisters with the corresponding lids.
6. Remove the canisters and store them in a frost-free place and in accordance with local regulations.
7. Isolate the system from the mains and the data network.
8. When using a Filter Probe sc, refer to the Filter Probe sc User Manual for storage information.
9. Install all transport locks.
10. Depending on the duration, remove the system from its mounting and wrap the system in a protective film or dry cloth. Store the system in a dry place.

The storage temperature for the Phosphax Analyzer ranges from -20 to 50 ºC (-4 to 122 ºF)

VALVES & ELECTRIC ACTUATORS
SHORT & LONG TERM STORAGE PROCEDURES

NOTICE

Wide variations in the temperature of the actuator body for electrical valve assemblies will cause moisture to accumulate within the actuator. This accumulated moisture will damage the electrical components and void the actuator warranty. Once power is applied to the actuator, an internal heater will protect the actuator from moisture accumulations.

While the actuator is in storage in an un-powered condition, the actuator must be protected in a climate-controlled room. Installed actuators must remain powered for the internal heater to prevent damage from condensation. In regions with low relative humidity where condensation is unlikely to form, the actuator should be protected from sunlight and stored in a well ventilated, dry environment or covered with a loose fitting waterproof canvas or tarp with bottom open, to prevent heat buildup.

Failure to follow these instructions may void warranty.

Do not wrap with plastic.

Valves with assembled electric actuators, including valves with long stem extensions, should be stored in a climate-controlled building. Normal temperature and humidity variations outdoors or in unheated buildings may result in condensation, which could accumulate inside un-powered actuators. If a climate-controlled building is not available, then the actuators should be powered during storage. Each actuator has an internal compartment heater to prevent condensate accumulation.

All hand-operated valves should be in the open position unless otherwise indicated herein, and metallic valves should be coated with an exterior film of oil. All valves regardless of storage location must be opened and closed at least two times, twice a month during the storage period. This will help prevent seizing and possible damage to inside seats.

Long Term Storage

Valves with assembled electric actuators, including valves with long stem extensions, should remain powered.

If actuated valves are removed from the piping system for storage the internal compartment heaters must be re-connected to the power source during the entire storage period.

If conditions allow, all valves should be cycled two times monthly. All valves removed from the system must be stored in the vertical position making sure they cannot roll or fall over.

All spare actuators should be stored vertically inside, in a climate-controlled building. All conduit openings or plastic protection caps or plugs need to be replaced with threaded pipe plugs to ensure all openings are sealed.

Spare Parts List
AquaNereda®

Project Name: Napanee WPCP Upgrades
Project Location: Napanee, Ontario, Canada
Project I.D.: 704419A

Manufacturer Contacts
24/7 Technical Support & Customer Service: 800-940-5008
After Market Services, M-F 8:00AM-5:00PM CDT: 877-271-9694
Visit us online at http://www.aqua-aerobic.com

MECHANICAL COMPONENTS

Aqua-Aerobic Systems' Part No.	Description	Manufacturer's Catalog No.	Manufacturer	Recommended Quantity	Purchased Quantity
9704419A30349	Air Filter Element, 125HP Blower	2000049288	Aerzen	1	3
9704419A30350	V-Belts (Set of 3), 125HP Blower	156321000	Aerzen	1	3

INSTRUMENTATION MAINTENANCE

AASI PN	Description	Manufacturer	Manufacturer PN	Recommended Quantity
2620399	AMMONIUM SENSOR CHIP 7691	Horiba	3200576504	A/R
2620400	POTASSIUM SENSOR CHIP 7692	Horiba	3200576506	A/R
2620401	REFERENCE ELECTRODE CHIP 7211	Horiba	3200576501	A/R
2620402	LIQUID JUNCTION TIP C-7211	Horiba	3200589010	A/R
2620461-1	1mg/L SOLUTION L-NH-1	Horiba	3200588831	A/R
2620461-10	10mg/L SOLUTION L-NH-10	Horiba	3200588832	A/R
2612327-1	Sensor Cap, LDO	Hach	5791100	1
2620901	Calibration Bag, LDO	Hach	5796605	1
2614176	Salt Bridge, pH/ORP	Hach	SB-P1SV	2
2613926	Solitax Wiper Set (Set of 5)	Hach	LZX050	1

2614840	Solitax Calibration Kit	Hach	57330-00	1
2620904	Filter Pads, Amtax/Phosphax (Set of 2)	Hach	LZY154	1
2620910	Electrolyte Set	Hach	6182500	1
2620903	Reagent, Phosphax, 2000mL	Hach	2825254	1
2620902	Cleaning Solution, Phosphax, 1000mL	Hach	2825352	1
2618630	Filter Module (1 piece)	Hach	LZX677	1
2618631	Cleaning Set	Hach	LZX217	1

NOTES:

Aqua-Aerobic Systems is proud to offer its SpareCare® Parts Replacement Program. SpareCare® program eliminates the hassle of finding spare parts elsewhere for Aqua-Aerobic Systems equipment because your order comes directly from our factory in Rockford, IL. We are your partner for life and will do our best to uphold this promise by offering exceptional service that only a leader in the wastewater treatment industry can provide.

Confidentiality Notice: This spare parts document page and any accompanying pages containing information which is confidential and privileged and is for the sole use of the intended recipient. If you are not the intended recipient, be aware that any disclosure, copying, distribution or use of the contents is prohibited.

It is very difficult to determine an estimated reliability or cycle life of equipment, as every application is different. The equipment selected and provided was designed for years of trouble free maintenance when applied and maintained in accordance to Aqua-Aerobic Systems and/or the Manufacturers operation and maintenance recommendations listed herein.

Availability is quoted on an In-Stock basis and may vary at time of order. Prices and delivery schedules for all other parts and/or recommended spare parts beyond that date will be available upon request. * State and/or local taxes will be added unless we receive a valid resale / exemption certificate at time of order.

The spare parts and quantities shown above within this document are estimated replacement parts for a 5-7 year routine maintenance plan.

To order spare replacement parts, contact the AASI After-Market Services, P.O. Box 2026, Rockford, IL 61131-0026, Phone (800) 940-5008, Fax (815) 654-8247. To contact the Customer Service Department, please call (815) 654-2501, or (800) 940-5008, Fax (815) 654-8623.

For qualifying Next Day shipments via UPS or Fed-EX, the order **must** be received before 2:00 pm.

Prices and/or special part numbers not listed above will be available upon request.

With regard to blower pressure gauges if applicable, consideration should be given to discard rather than repair them. Refer to the operation & maintenance manual – Blower Section for gauge replacement categories. Stocking of gauges is not recommended unless ten (10) or more instruments have been supplied.

With regard to submersible pump re-build kit, depending upon the age of equipment and/or the labor cost requirement; consideration should be given to replace the pump and motor assembly in lieu of re-building the pump. Refer to the pump operation & maintenance section for details.

No special tools are required for the installation, operation, or routine maintenance of this equipment.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Integrated AquaNereda® Aerobic Granular Sludge System and AquaDisk® Pile Cloth Media Filtration

Process Performance Guarantee

Napanee WPCP ON
May 2, 2024

Part A - Aqua-Aerobic Systems' Guaranteed Performance

Aqua Aerobic Systems, Inc. (Aqua-Aerobic) guarantees that the treatment system equipment provided by Aqua-Aerobic for the AquaNereda® Aerobic Granular Sludge System and AquaDisk® Cloth Media Filter, in accordance with Specification Section 45 50 40 and Aqua-Aerobic's Design 171482 and Design Notes dated May 2, shall:

1. Transfer sufficient oxygen in the AquaNereda reactors during aerobic segments of the treatment cycle.
2. Suspend and maintain in suspension normal mixed liquor solids up to a concentration of 8000 mg/l in the AquaNereda reactors. The operating MLSS will be dependent on maintaining an acceptable F/M ratio.
3. Provide sufficient solids separation via settling in the AquaNereda reactors and solids removal through the Cloth Media Filters.

These three (3) conditions, at a minimum, shall be provided by the AquaNereda and Cloth Media Filtration equipment to enable the final filtered effluent to meet the greater of: a) the permit objectives for the parameters listed below, or b) the following monthly average characteristics, based on 24-hour composite samples:

5-day Biochemical Oxygen Demand (BOD_5):	10 mg/l or less
Total Suspended Solids (TSS):	10 mg/l or less
Ammonia (NH_3-N):	2 mg/l or less
Total Phosphorus (P):	0.1 mg/l or less

Part B - Initial Sludge Seeding

As the time that the system will start receiving flow approaches, preparations should be made to seed the plant with activated sludge to treat the incoming wastewater. After seeding of the plant has occurred, acclimation of the biomass to the influent will occur.

Initial activated sludge seeding will be provided by the Installing Contractor or Owner. Measures should be taken to employ the use of the best available sludge as possible based on freshness, settling characteristics, and level of nutrient removal currently being achieved.

In all cases seeding will be sufficient to meet the guaranteed effluent objectives. It is generally recommended to have the desired amount of biomass in the reactor available to perform treatment no more than 24 hours prior to receiving flow. If the seed activated sludge is in the reactor more than 24 hours before receiving flow to the plant, supplemental food and nutrient addition may be required to maintain a viable biomass. If the sludge does not receive food within 24 hours of being introduced to the reactor, then the sludge quality and viability will be reduced which may increase the duration of the startup and acclimation phases.

Part C - Conditions of the Guarantee

1. The influent wastewater to the AquaNereda reactors exhibits monthly average characteristics equal to or less than the following based on 24-hour composite samples:

5-day Biochemical Oxygen Demand (BOD_5):	162 mg/l
Total Suspended Solids (TSS):	214 mg/l
Total Kjeldahl Nitrogen (TKN):	45 mg/l
Total Phosphorus (P):	5 mg/l
Average Flow:	19,550 m^3/day
Maximum Flow:	30,600 m^3/day

2. Influent and reactor monthly average wastewater temperatures are no less than 7.7 °C and no greater than 20 °C.
3. The maximum total volume received by the AquaNereda reactors over any 24 hr period does not exceed 30,600 m^3.
4. The maximum flow to the AquaNereda reactors does not exceed 1895 m^3/hr, including recycle flows.

5. Fats, oils, and grease (FOG) shall be less than 90 mg/l on a daily average basis (based on a 24 hour composite sample), not to exceed a maximum of 100 mg/l at any time.
6. At no time shall the wastewater pH in the AquaNereda basin be less than 6.5 or greater than 8.5.
7. The wastewater does not contain any biologically toxic substances or other physical-chemical characteristics that depress biological activity, oxygen transfer, or settleability within the AquaNereda reactors.
8. The refractory fraction of the organic nitrogen shall not exceed 1 mg/l.
9. Provisions for chemical addition shall be made to each reactor for phosphorus precipitation.
10. Influent TP shall be either in a particle associated form, a reactive soluble phosphate form, or a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system influent, point(s) of chemical addition, and final effluent. The filter will not remove soluble organic phosphorus.
11. A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for water quality analysis.
12. The operator shall be fully responsible for prohibiting or eliminating any potential algae growth within the post-equalization basin to ensure no adverse impact on the filterability of the TSS entering the filter.
13. Should an inability to produce the guaranteed results be related to a deficiency or failure in key system components that have not been supplied by Aqua-Aerobic, this guarantee shall be considered void. Key components are comprised of all equipment, engineering, and plant operations necessary to produce a fully functional system. Key components include, but are not limited to: mechanical equipment, control systems, etc.
14. The waste is amenable to biological reduction within the AquaNereda reactors and filterable by the cloth media filters to the extent guaranteed.
15. The Owner agrees to send monthly performance data related to the AquaNereda system as defined in the Process Manual.

16. The equipment is installed, operated and maintained in full accordance with instructions provided by Aqua-Aerobic in the Operation and Maintenance Manual.
17. The equipment has been paid for in full in accordance with the terms of the contract.
18. In the event any of the filtered effluent parameters listed in Part A exceed the greater of a) the permit objectives for those parameters, or b) the values given in Part A, the Owner agrees to send three (3) months of all available performance data related to the AquaNereda reactors and Cloth Media Filters, including but not limited to influent wastewater flow and constituent concentrations, AquaNereda reactor MLSS concentrations and dissolved oxygen levels, current AquaNereda cycle structure and setpoint values, and filter effluent flow and wastewater constituent concentrations within ten (10) days of receiving lab results.
19. This guarantee shall no longer be applicable or valid if any product supplied by Aqua-Aerobic is modified or altered without the written approval of Aqua-Aerobic, including any software program.

Part D - Guarantee Duration

The process performance guarantee shall be in effect for two (2) years after substantial completion. Substantial completion shall be defined by the date stated on Aqua-Aerobic's final "Manufacturer's Certificate of Inspection" form executed upon completion of start-up services.

Part E - Guarantee Remedies and Supplemental Conditions

If the system fails to meet the conditions given in Part A, and all conditions of Part C have been satisfied, Aqua-Aerobic will modify, supplement or replace equipment by delivering same to the jobsite and supervising installation at no charge to the owner.

If any one of the conditions noted in Part C is not satisfied, the Owner shall have the option of purchasing additional compatible equipment, process optimization and/or operator training visits, or other services from Aqua-Aerobic to account for those deficiencies that are not within Aqua-Aerobic's ability to control. In any event, should a discharge violation occur and any condition listed in Part C is not satisfied, this guarantee is void.

In no event will Aqua-Aerobic's cumulative liability exceed 100% of the price of the goods provided by Aqua-Aerobic Systems, Inc.

6306 N. Alpine Rd. Loves Park, IL 61111-7655 **p** 815.654.2501 **f** 815.654.2508 **www.aqua-aerobic.com**

Aqua-Aerobic Systems, Inc.

____ ________________________

Brett Quimby Execution Date
Product Manager
AquaNereda® Aerobic Granular Sludge

[END-USER]

____ ________________________

Signature Execution Date

____

Printed Name

____

Title

NOTE: Aqua-Aerobic Systems, Inc. will execute the process performance guarantee upon receipt of a purchase order, acceptance of terms and conditions and approved submittal drawings.

Customer Video Recording Notice

NOTICE

- If applicable, in consideration for allowing video recording ("Video Recording") of Aqua-Aerobic Systems, Inc. (AASI) personnel performing maintenance service or the service of giving instruction or training, the Customer acknowledges that AASI has advised the Customer as follows:

- Customer acknowledges that AASI advises against making the Video Recording based on AASI's opinion that the subject matter of the Video Recording is best conveyed in person and in an interactive manner. Customer further acknowledges that AASI has no control over the content or quality of the Video Recording, and, therefore, cannot endorse or approve of the Video Recording or the use of the Video Recording for any purpose. The Video Recording is used at Customer's own risk and is not intended as a substitute for personal training, safety or operating instruction, scheduled maintenance and/or recommended service, or the operating service and maintenance manuals.

- AASI ASSUMES NO LIABILITY IN RESPECT OF THE VIDEO RECORDING, INCLUDING WITHOUT LIMITATION FOR ITS COMPLETENESS OR ACCURACY, ANY CLAIM THAT ARISES OUT OF THE PREPARATION, USE OR RELIANCE UPON THE VIDEO RECORDING IS CUSTOMER'S SOLE RESPONSIBILITY, AND CUSTOMER DOES HEREBY RELEASE, INDEMNIFY, DEFEND AND HOLD AASI HARMLESS FROM ANY CLAIM, CAUSE OF ACTION, LOSS, EXPENSE, DAMAGE OR LIABILITY THAT ARISES THEREFROM.

- Upon request Customer shall give AASI a copy of the Video Recording.

- The Video Recording shall be made at a mutually agreed upon date. The Customer's Video Recording operator and equipment shall not hinder or distract AASI personnel during their work.

- Customer agrees not to prepare any derivative works from the Video Recording.

- The training, service, maintenance and/or demonstration actually depicted on the Video Recording are AASI's proprietary information (the "Information"). AASI's permission for Customer to use the Video Recording does not grant Customer any right or license, express or implied, under any patent or other intellectual property rights of AASI, except for Customer to use the Video Recording for Customer's own operations and use. Customer's obligations of limited use and nondisclosure with respect to the Video Recording shall continue in perpetuity.

AASI & HACH Service Partnership

Project Name: Napanee WPCP Upgrades

Project ID#: 704419A

S.O. Number: 107522

Aqua-Aerobic Systems, Inc. is committed to supporting our customers after the sale has been made, and for that reason we have entered into a joint partnership with the HACH Company. HACH has provided the following service partnership offerings (Service Codes) to cover the Intellipro System equipment for your unique facility. This agreement will only cover the project equipment represented in the following HACH Serial Number Log with listed serial numbers for each device.

Field Service Partnership Agreement (FSP): Where HACH provides service at customer site for probe modules, TSS, Nitrate, and Ammonium sensors, Phosphax analyzer & Filterprobe, relay cards, and air-blast cleaning system. HACH's FSP offers an exclusive priority toll-free (866-902-4224) access to HACH's technical support professionals and priority on-site service. This agreement also covers all on-site preventive maintenance. Preventive maintenance will be scheduled in advance, based on the schedule recommended in the instrument service manual. If emergency field repair is required on covered instruments, HACH will use its best efforts to send a service professional to your site within two (2) weeks or ten (10) working days after HACH receives your request for service on any covered instruments. All parts (including ground shipping), labor, and travel costs are included for all visits, and priority emergency field repair is available at no additional cost.

Preventative Maintenance Partnership Agreement (PMP): Where HACH provides maintenance service at the customer's site, for all probes (LDO D.O. sensors, PHD pH probe, and the ORP probe) that require routine maintenance. HACH's PMP offers a scheduled, on-site preventive maintenance program. Preventive maintenance will be scheduled in advance, based on the schedule recommended in the instrument service manual. All scheduled maintenance labor, travel costs and parts are included in the program (does not include repair parts). Note: Emergency, on-site repair visits are not included in this agreement. Periodic routine maintenance to rinse off instruments / heads such as; D.O. sensors, pH sensors, and ORP sensors on a monthly basis, is the responsibility of the owner.

Note: If at any time during the service agreement period, a probe, probe module, or other device has to be replaced for any reason, please record the serial number of the replacement unit, and contact AASI to have their records and the project O&M manual up dated.

AASI & HACH Service Partnership

Serial Number Log:

Part Number	Description	Model Number	HACH Service Code	Original Unit Serial Number	Replacement Unit Serial Number	Unit Replacement Date
AGS 1						
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2616326	DO Sensor, LDO	9020000-C1D2	PMP			
2618375	TSS Senor, EX-1 (Immersion)	LXV328.99.10002	FSP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2613222	PHD Probe, pH	DPD1P1	PMP			
2613269	PHD Probe ORP	DRD1P5	PMP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2621065	Filtrax Sampling System	5739200	FSP			
2617392	Analyzer, Phosphax	6159600	FSP			
AGS 2						
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2616326	DO Sensor, LDO	9020000-C1D2	PMP			
2618375	TSS Senor, EX-1 (Immersion)	LXV328.99.10002	FSP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2613222	PHD Probe, pH	DPD1P1	PMP			
2613269	PHD Probe ORP	DRD1P5	PMP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2621065	Filtrax Sampling System	5739200	FSP			
2617392	Analyzer, Phosphax	6159600	FSP			
AGS 3						
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2616326	DO Sensor, LDO	9020000-C1D2	PMP			
2618375	TSS Senor, EX-1 (Immersion)	LXV328.99.10002	FSP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2613222	PHD Probe, pH	DPD1P1	PMP			
2613269	PHD Probe ORP	DRD1P5	PMP			
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2621065	Filtrax Sampling System	5739200	FSP			
2617392	Analyzer, Phosphax	6159600	FSP			
SB 1 and 2						
2620812-A1C	Controller, SC4500, Analog, C1D2	LXV525.99P11551	FSP			
2620914	TSS Senor, EX-1 (Insertion)	LXV328.99.30002	FSP			
2620914	TSS Senor, EX-1 (Insertion)	LXV328.99.30002	FSP			

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

ASSEMBLY, INSTALLATION AND START-UP

Quick List of Installation Order

AquaNereda®

NOTICE

This is a generic order of installation for AquaNereda® Aerobic Granular Sludge Technology. Refer to project specific drawings and instructions for additional information.

☐ Before beginning to install equipment make certain that all basin piping (influent, air, sludge, etc.) and conduit has been installed first.

☐ If the conduit for electrical wiring is to be routed beneath a concrete floor / underground it should be installed prior to construction.

☐ **Install Valves**

- ◻ Install all influent, air, effluent (if applicable), and sludge valves in the basin piping.

☐ **Install the Effluent Decanter System**

- ◻ Prior to installing the effluent decanter system, make certain the discharge termination flange is located per the installation drawing.
- ◻ Install the mounting posts and supports for the decanter as located on the installation drawing.
- ◻ Install the effluent decanter system. V-notches to be level within 0.25” (6mm) across entire decanter system.

☐ **Install the Influent System**

- ◻ Prior to installing the influent system, make certain the inlet termination flange is located per the installation drawing.
- ◻ Install the mounting supports for the main header(s) as located on the installation drawing.
- ◻ Install the mounting supports for the influent laterals as located on the installation drawing. Install influent laterals with the orifice facing down. Laterals to be level within 0.25” (6mm).

☐ **Install the Sludge Decanter System**

- ◻ Prior to installing the sludge decanter system, make certain the sludge discharge termination flange is located per the installation drawing.

- ◻ Install the sludge decanter system and supports as located on the installation drawing.

☐ **Install the Diffuser System**

- ◻ Once the air piping has been installed, install the diffusers per the installation drawing.

☐ **Install the Submersible Pump (if so equipped)**

- ◻ Locate and anchor the discharge base elbow per the installation drawing.
- ◻ Locate and anchor the upper guide bar bracket at the top of the basin wall and set slide rails into place.
- ◻ Lower the submersible pump onto the slide rails until it rests on the discharge base elbow and makes all wiring connections.
- ◻ Bump start pump motor to ensure correct direction of rotation.

☐ **Install the External Centrifugal Pump (if so equipped)**

- ◻ Locate and anchor the pump base per the installation drawing.
- ◻ Bump start pump motor to ensure correct direction of rotation.

☐ **Install the Instrumentation**

- ◻ Locate the instrumentation (level transducer, float switch, dissolved oxygen probe, etc.) per the System Plan View drawing.
- ◻ Install the junction boxes, signal converters, controllers, etc. for the instrumentation within reach of the sensor cable.
- ◻ Probes may have a limited storage life and should not be installed until just before system start-up.

☐ **Install the Blowers**

- ◻ If the conduit for electrical wiring for the blowers is to be routed beneath the concrete floor / underground it should be installed prior to the concrete pad.
- ◻ The blower packages should be installed on their pads and anchored in place prior to installing any air piping or supports.

- ☐ Install the air piping and supports per the Contract Drawings.
- ☐ Complete electrical wiring connections to the blower motor.
- ☐ Prior to testing the blower packages, verify there is sufficient oil in the blower. Some packages are shipped without oil.
- ☐ Verify alignment of the drive system.
- ☐ Bump start the blower to ensure the motor is turning in the proper direction. The direction of rotation should be marked on the blower compressor.

☐ **Pre Start-Up**
(Aqua-Aerobic Systems' Field Service Personnel On-Site)

- ☐ Start blowers one at a time to verify performance and to clear any debris from the manifold piping.
- ☐ Aqua-Aerobic Systems' mechanical inspection and check out of electrically operated valves to set limit switches.
- ☐ Install the system control panel per the Contract Drawings and make all electrical connections within the panel.
- ☐ Fill basin with clean water enough to cover diffusers and check for proper air pattern.
- ☐ Aqua-Aerobic Systems' final inspection and adjustment including Operator training.
- ☐ Add seed sludge if not growing granules from scratch.
- ☐ Introduce influent to reactor basins.
- ☐ Aqua-Aerobic Systems' start-up.

ANCHOR INSTALLATION

WEDGE ANCHORS INSTALLATION

APPLICATIONS

Anchoring machinery and conveyors is a common wedge anchor application. The Trubolt is fully threaded to allow a large range of embedment and fixture thickness.

LENGTH INDICATION CODE*

CODE	LENGTH OF ANCHOR in.	LENGTH OF ANCHOR mm	CODE	LENGTH OF ANCHOR in.	LENGTH OF ANCHOR mm
A	1-1/2 < 2	(38.1 < 50.8)	K	6-1/2 < 7	(165.1 < 177.8)
B	2 < 2-1/2	(50.8 < 63.5)	L	7 < 7-1/2	(177.8 < 190.5)
C	2-1/2 < 3	(63.5 < 76.2)	M	7-1/2 < 8	(190.5 < 203.2)
D	3 < 3-1/2	(76.2 < 88.9)	N	8 < 8-1/2	(203.2 < 215.9)
E	3-1/2 < 4	(88.9 < 101.6)	O	8-1/2 < 9	(215.9 < 228.6)
F	4 < 4-1/2	(101.6 < 114.3)	P	9 < 9-1/2	(228.6 < 241.3)
G	4-1/2 < 5	(114.3 < 127.0)	Q	9-1/2 < 10	(241.3 < 254.0)
H	5 < 5-1/2	(127.0 < 139.7)	R	10 < 11	(254.0 < 279.4)
I	5-1/2 < 6	(139.7 < 152.4)	S	11 < 12	(279.4 < 304.8)
J	6 < 6-1/2	(152.4 < 165.1)	T	12 < 13	(304.8 < 330.2)

*Located on top of anchor for easy inspection.

FEATURES

Length ID Head Stamp—provides for embedment inspection after installation

Fully Threaded Design

Cold-Formed—manufacturing process adds strength

Stainless steel split expansion ring

Anchor Body—available in zinc-plated steel, hot-dipped galvanized steel, 304 stainless steel and 316 stainless steel

TRUBOLT® WEDGE ANCHOR

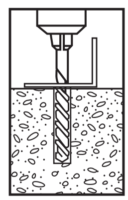
APPROVALS/LISTINGS

Trubolt®
Wedge Anchors

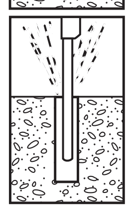
ICC Evaluation Service, Inc. ESR-2251
- Category 1 performance rating
- 2018 IBC compliant
- Meets ACI 318 ductility requirements
- Tested in accordance with ACI 355.2 and ICC-ES AC193
- For use in seismic zones A & B
- 1/4", 3/8" & 1/2" diameter anchors listed in ESR-2251

Underwriters Laboratories
Factory Mutual
Caltrans
Meets or exceeds U.S. Government G.S.A. Specification A-A-1923A Type 4 (formerly GSA: FF-S-325 Group II, Type 4, Class 1)

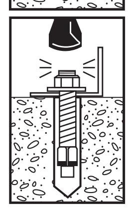
INSTALLATION STEPS



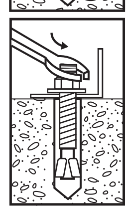
1. Select a carbide drill bit with a diameter equal to the anchor diameter. Drill hole to any depth exceeding the desired embedment. See chart for minimum recommended embedment.



2. Clean hole or continue drilling additional depth to accommodate drill fines.



3. Assemble washer and nut, leaving top of stud exposed through nut. Drive anchor through material to be fastened until washer is flush to surface of material.



4. Expand anchor by tightening nut 3-5 turns past the hand tight position, or to the specified torque requirement.

**** ONLY FOR USE IN CONCRETE****

Trubolt Wedge

304 Stainless Steel

Serves many applications well. It withstands rusting in architectural and food processing environments and resists organic chemicals, dye stuffs and many inorganic chemicals.

Typical Applications—Cladding, Stadium Seating, etc.

Environment—Urban (slight to moderate degree of pollution)

Level of Corrosion—Medium

PART NUMBER	THREAD LENGTH		ANCHOR DIA. & DRILL BIT SIZE (THREADS) PER INCH	OVERALL LENGTH		MAX. THICKNESS OF MATERIALS TO BE FASTENED		QTY/WT PER BOX		QTY/WT PER MASTER CARTON	
	in.	(mm)		in.	(mm)	in.	(mm)	qty.	lbs.	qty.	lbs.
WW-1416	3/4	(19.1)	1/4" - 20	1-3/4	(44.5)	3/8	(9.5)	100	3.2	1000	32
WW-1422	1-1/4	(31.8)		2-1/4	(57.2)	7/8	(22.2)	100	3.7	1000	37
WW-1432	2-1/4	(57.2)		3-1/4	(82.6)	1-7/8	(47.6)	100	4.8	800	39
WW-3822	1-1/8	(28.6)	3/8" - 16	2-1/4	(57.2)	3/8	(9.5)	50	4.1	500	41
WW-3826	1-5/8	(41.3)		2-3/4	(69.9)	7/8	(22.2)	50	4.8	400	39
WW-3830	1-3/4	(44.5)		3	(76.2)	1-1/8	(28.6)	50	5.1	400	42
WW-3836	2-1/2	(63.5)		3-3/4	(95.3)	1-7/8	(47.6)	50	6.0	300	37
WW-3850	3-3/4	(95.3)		5	(127.0)	3-1/8	(79.4)	50	7.5	250	39
WW-1226	1-1/4	(31.8)	1/2" - 13	2-3/4	(69.9)	1/8	(3.2)	25	4.7	200	38
WW-1236	2-1/4	(57.2)		3-3/4	(95.3)	1	(25.4)	25	5.8	150	36
WW-1242	2-3/4	(69.9)		4-1/4	(108.0)	1-1/2	(38.1)	25	6.3	150	39
WW-1254	3	(76.2)		5-1/2	(139.7)	2-3/4	(69.9)	25	7.7	150	47
WW-1270	3-1/2	(88.9)		7	(177.8)	4-1/4	(108.0)	25	9.4	150	57
WW-5834	1-3/4	(44.5)	5/8" - 11	3-1/2	(88.9)	1/8	(3.2)	10	3.6	100	37
WW-5842	2-1/2	(63.5)		4-1/4	(108.0)	7/8	(22.2)	10	4.2	100	43
WW-5850	3-1/4	(82.6)		5	(127.0)	1-5/8	(41.3)	10	4.8	100	49
WW-5860	4-1/4	(107.9)		6	(152.4)	2-5/8	(66.7)	10	5.5	50	28
WW-5870	3-1/2	(88.9)		7	(177.8)	3-5/8	(92.1)	10	6.2	30	20
WW-5884	3-1/2	(88.9)		8-1/2	(215.9)	5-1/8	(130.2)	10	8.0	30	25
WW-3446	2-7/8	(73.0)	3/4" - 10	4-3/4	(120.7)	3/4	(19.1)	10	6.7	60	41
WW-3454	3-5/8	(92.1)		5-1/2	(139.7)	1-1/2	(38.1)	10	7.5	50	38
WW-3470	3-1/2	(88.9)		7	(177.8)	3	(76.2)	10	9.2	30	28
WW-3484	3-1/2	(88.9)		8-1/2	(215.9)	4-1/2	(114.3)	10	12.3	30	38
WW-34100	1-3/4	(44.5)		10	(254.0)	6	(152.4)	10	13.5	30	42
WW-10060	2-1/2	(63.5)	1" - 8	6	(152.4)	1/2	(12.7)	5	8.3	25	43
WW-10090	2-1/2	(63.5)		9	(228.6)	3-1/2	(88.9)	5	11.4	15	35

* For continuous extreme low temperature applications, use stainless steel.

SELECTION CHARTS

Trubolt Wedge

316 Stainless Steel

Contains more nickel and chromium than Type 304, and 2%-3% molybdenum, which gives it better corrosion resistance. It is especially more effective in chloride environments that tend to cause pitting.

Typical Applications—Pumps, Diffusers, Gates, Weir Plates, etc.

Environment—Industrial (moderate to heavy atmospheric pollution)

Level of Corrosion—Medium to High

Typical Applications—Tunnels, Dams, Tiles, Lighting Fixtures, etc.

Environment—Marine (heavy atmospheric pollution)

Level of Corrosion—High

PART NUMBER	THREAD LENGTH		ANCHOR DIA. & DRILL BIT SIZE (THREADS) PER INCH	OVERALL LENGTH		MAX. THICKNESS OF MATERIALS TO BE FASTENED		QTY/WT PER BOX		QTY/WT PER MASTER CARTON	
	in.	(mm)		in.	(mm)	in.	(mm)	qty.	lbs.	qty.	lbs.
SWW-1422	1-1/4	(31.8)	1/4" - 20	2-1/4	(57.2)	7/8	(22.2)	100/	3.7	1000/	37
SWW-1432	2-1/4	(57.2)		3-1/4	(82.6)	1-1/8	(28.6)	100/	4.8	1000/	39
SWW-3822	1-1/8	(28.6)	3/8" - 16	2-1/4	(57.2)	3/8	(9.5)	50/	4.1	500/	41
SWW-3826	1-5/8	(41.3)		2-3/4	(69.9)	7/8	(22.2)	50/	4.8	400/	39
SWW-3830	1-3/4	(44.5)		3	(76.2)	1-1/8	(28.6)	50/	5.2	400/	42
SWW-3836	2-1/2	(63.5)		3-3/4	(95.5)	1-7/8	(47.6)	50/	6.0	300/	37
SWW-3850	3-3/4	(95.3)		5	(127.0)	3-1/8	(79.4)	50/	7.5	250/	39
SWW-1226	1-1/4	(31.8)	1/2" - 13	2-3/4	(69.9)	1/8	(3.2)	25/	4.7	200/	39
SWW-1236	2-1/4	(57.2)		3-3/4	(95.3)	1	(25.4)	25/	5.8	150/	36
SWW-1242	2-3/4	(69.9)		4-1/4	(108.0)	1-1/2	(38.1)	25/	6.5	150/	40
SWW-1254	3	(76.2)		5-1/2	(139.7)	2-3/4	(69.9)	25/	7.8	150/	48
SWW-5842	2-1/2	(63.5)	5/8" - 11	4-1/4	(108.0)	7/8	(22.2)	10/	4.2	100/	43
SWW-5850	3-1/4	(82.6)		5	(127.0)	1-5/8	(41.3)	10/	4.8	100/	49
SWW-5870	3-1/2	(88.9)		7	(177.8)	3-5/8	(92.1)	10/	6.7	30/	21

* For continuous extreme low temperature applications, use stainless steel.

PERFORMANCE TABLE

Trubolt
Wedge Anchors

*Ultimate Tension and Shear Values (lbs/kN) in Solid Concrete**

ANCHOR DIA.		INSTALLATION TORQUE		EMBEDMENT DEPTH		ANCHOR TYPE	f'c + 2,000 PSI (13.8 MPa)				f'c + 4,000 PSI (27.6 MPa)				f'c + 6,000 PSI (41.4 MPa)			
							TENSION		SHEAR		TENSION		SHEAR		TENSION		SHEAR	
in.	(mm)	ft. lbs.	(Nm)	in.	(mm)		lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)
1/4	(6.4)	4	(5.4)	1-1/8	(28.6)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,180	(5.2)	1,400	(6.2)	1,780	(7.9)	1,400	(6.2)	1,900	(8.5)	1,400	(6.2)
				1-15/16	(49.2)		2,100	(9.3)	1,680	(7.5)	3,300	(14.7)	1,680	(7.5)	3,300	(14.7)	1,680	(7.5)
				2-1/8	(54.0)		2,260	(10.1)	1,680	(7.5)	3,300	(14.7)	1,680	(7.5)	3,300	(14.7)	1,680	(7.5)
3/8	(9.5)	25	(33.9)	1-1/2	(38.1)		1,620	(7.5)	2,320	(10.3)	2,240	(10.0)	2,620	(11.7)	2,840	(12.6)	3,160	(14.1)
				3	(76.2)		3,480	(15.5)	4,000	(17.8)	5,940	(26.4)	4,140	(18.4)	6,120	(27.2)	4,500	(20.0)
				4	(101.6)		4,800	(21.4)	4,000	(17.8)	5,940	(26.4)	4,140	(18.4)	6,120	(27.2)	4,500	(20.0)
1/2	(12.7)	55	(74.6)	2-1/4	(57.2)		3,455	(20.7)	4,760	(21.2)	4,920	(22.7)	4,760	(21.2)	6,025	(31.3)	7,040	(31.3)
				4-1/8	(104.8)		4,660	(20.7)	7,240	(32.2)	9,640	(42.9)	7,240	(32.2)	10,820	(48.1)	8,160	(36.3)
				6	(152.4)		5,340	(23.8)	7,240	(32.2)	9,640	(42.9)	7,240	(32.2)	10,820	(48.1)	8,160	(36.3)
5/8	(15.9)	90	(122.0)	2-3/4	(69.9)		5,185	(29.3)	7,120	(31.7)	7,180	(31.9)	7,120	(31.7)	9,225	(43.2)	9,616	(42.8
				5-1/8	(130.2)		6,580	(29.3)	9,600	(42.7)	14,920	(66.4)	11,900	(52.9)	16,380	(72.9)	12,520	(55.7)
				7-1/2	(190.5)		7,060	(31.4)	9,600	(42.7)	15,020	(66.8)	11,900	(52.9)	16,380	(72.9)	12,520	(55.7)
3/4	(19.1)	110	(149.2)	3-1/4	(82.6)		6,765	(31.7)	10,120	(45.0)	10,840	(48.2)	13,720	(61.0)	13,300	(59.2)	15,980	(71.1)
				6-5/8	(168.3)		10,980	(48.8)	20,320	(90.4)	17,700	(78.7)	23,740	(105.6)	20,260	(90.1)	23,740	(105.6)
				10	(254.0)		10,980	(48.8)	20,320	(90.4)	17,880	(79.5)	23,740	(105.6)	23,580	(104.9)	23,740	(105.6)
7/8	(22.2)	250	(339.0)	3-3/4	(95.3)		9,290	(42.3)	13,160	(58.5)	14,740	(65.6)	16,580	(73.8)	17,420	(77.5)	19,160	(85.2)
				6-1/4	(158.8)		14,660	(65.2)	20,880	(92.9)	20,940	(93.1)	28,800	(128.1)	24,360	(108.4)	28,800	(128.1)
				8	(203.2)		14,660	(65.2)	20,880	(92.9)	20,940	(93.1)	28,800	(128.1)	24,360	(108.4)	28,800	(128.1)
1	(25.4)	300	(406.7)	4-1/2	(114.3)		11,770	(62.0)	16,080	(71.5)	19,245	(89.8)	22,820	(101.5)	21,180	(94.2)	24,480	(108.9)
				7-3/8	(187.3)		14,600	(64.9)	28,680	(127.6)	23,980	(106.7)	37,940	(168.8)	33,260	(148.0)	38,080	(169.4)
				9-1/2	(241.3)		18,700	(83.2)	28,680	(127.6)	26,540	(118.1)	37,940	(168.8)	33,260	(148.0)	38,080	(169.4)

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4.
* For Tie-Wire Wedge Anchor, TW-1400, use tension data from 1/4" diameter with 1-1/8" embedment.
* For continuous extreme low temperature applications, use stainless steel.

PERFORMANCE TABLE

Trubolt
Wedge Anchors

*Ultimate Tension and Shear Values (lbs/kN) in Lightweight Concrete**

ANCHOR DIA.		INSTLLATION TORQUE		EMBEDMENT DEPTH		ANCHOR TYPE	LIGHTWEIGHT CONCRETE f'c + 3,000 PSI (20.7 MPa)				LOWER FLUTE OF STEEL DECK WITH LIGHTWEIGHT CONCRETE FILL f'c + 3,000 PSI (20.7 MPa)			
							TENSION		SHEAR		TENSION		SHEAR	
in.	(mm)	ft. lbs.	(Nm)	in.	(mm)		lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)
3/8	(9.5)	25	(33.9)	1-1/2	(38.1)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,175	(5.2)	1,480	(6.6)	1,900	(8.5)	3,160	(14.1)
				3	(76.2)		2,825	(12.6)	2,440	(10.9)	2,840	(12.6)	4,000	(17.8)
1/2	(12.7)	55	(74.6)	2-1/4	(57.2)		2,925	(13.0)	2,855	(12.7)	3,400	(15.1)	5,380	(23.9)
				3	(76.2)		3,470	(15.4)	3,450	(15.3)	4,480	(19.9)	6,620	(29.4)
				4	(101.6)		4,290	(19.1)	3,450	(15.3)	4,800	(21.4)	6,440	(28.6)
5/8	(15.9)	90	(122.0)	3	(76.2)		4,375	(19.5)	4,360	(19.4)	4,720	(21.0)	5,500	(24.5)
				5	(127.0)		6,350	(28.2)	6,335	(28.2)	6,580	(29.3)	9,140	(40.7)
3/4	(19.1)	110	(149.2)	3-1/4	(82.6)		5,390	(24.0)	7,150	(31.8)	5,840	(26.0)	8,880	(39.5)
				5-1/4	(133.4)		7,295	(32.5)	10,750	(47.8)	7,040	(31.3)	N/A	N/A

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4.

PERFORMANCE TABLE

Trubolt
Wedge Anchors

*Recommended Edge and Spacing Distance Requirements for Tension Loads**

ANCHOR DIA. in.	ANCHOR DIA. (mm)	EMBEDMENT DEPTH in.	EMBEDMENT DEPTH (mm)	ANCHOR TYPE	EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. ALLOWABLE EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .65 in.	(mm)	SPACING REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. ALLOWABLE SPACING AT WHICH THE LOAD FACTOR APPLIED = .70 in.	(mm)
1/4	(6.4)	1-1/8	(28.6)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	2	(50.8)	1	(25.4)	3-15/16	(100.0)	2	(50.8)
		1-15/16	(49.2)		1-15/16	(49.2)	1	(25.4)	3-7/8	(98.4)	1-15/16	(49.2)
		2-1/8	(54.0)		1-5/8	(41.3)	13/16	(20.6)	3-3/16	(81.0)	1-5/8	(41.3)
3/8	(9.5)	1-1/2	(38.1)		2-5/8	(66.7)	1-5/16	(33.3)	5-1/4	(133.4)	2-5/8	(66.7)
		3	(76.2)		3	(76.2)	1-1/2	(38.1)	6	(152.4)	3	(76.2)
		4	(101.6)		3	(76.2)	1-1/2	(38.1)	6	(152.4)	3	(76.2)
1/2	(12.7)	2-1/4	(57.2)		3-15/16	(100.0)	2	(50.8)	7-7/8	(200.0)	3-15/16	(100.0)
		4-1/8	(104.8)		3-1/8	(79.4)	1-9/16	(39.7)	6-3/16	(157.2)	3-1/8	(79.4)
		6	(152.4)		4-1/2	(114.3)	2-1/4	(57.2)	9	(228.6)	4-1/2	(114.3)
5/8	(15.9)	2-3/4	(69.9)		4-13/16	(122.2)	2-7/16	(61.9)	9-5/8	(244.5)	4-13/16	(122.2)
		5-1/8	(130.2)		3-7/8	(98.4)	1-15/16	(49.2)	7-1/16	(195.3)	3-7/8	(98.4)
		7-1/2	(190.5)		5-5/8	(142.9)	2-13/16	(71.4)	11-1/4	(285.8)	5-5/8	(142.9)
3/4	(19.1)	3-1/4	(82.6)		5-11/16	(144.5)	2-7/8	(73.0)	11-3/8	(288.9)	5-11/16	(144.5)
		6-5/8	(168.3)		5	(127.0)	2-1/2	(63.5)	9-15/16	(252.4)	5	(127.0)
		10	(254.0)		7-1/2	(190.5)	3-3/4	(95.3)	15	(381.0)	7-1/2	(190.5)
7/8	(22.2)	3-3/4	(95.3)		6-9/16	(166.7)	3-5/16	(84.1)	13-1/8	(333.4)	6-9/16	(166.7)
		6-1/4	(158.8)		6-1/4	(158.8)	3-1/8	(79.4)	12-1/2	(317.5)	6-1/4	(158.8)
		8	(203.2)		6	(152.4)	3	(76.2)	12	(304.8)	6	(152.4)
1	(25.4)	4-1/2	(114.3)		7-7/8	(200.0)	3-15/16	(100.0)	15-3/4	(400.1)	7-7/8	(200.0)
		7-3/8	(187.3)		7-3/8	(187.3)	3-11/16	(93.7)	14-3/4	(374.7)	7-3/8	(187.3)
		9-1/2	(241.3)		7-1/8	(181.0)	3-9/16	(90.5)	14-1/4	(362.0)	7-1/8	(181.0)

* Spacing and edge distances shall be divided by 0.75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

PERFORMANCE TABLE

Trubolt
Wedge Anchors

*Recommended Edge and Spacing Distance Requirements for Shear Loads**

ANCHOR DIA. in.	ANCHOR DIA. (mm)	EMBEDMENT DEPTH in.	EMBEDMENT DEPTH (mm)	ANCHOR TYPE	EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .60 in.	(mm)	MIN. EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .20 in.	(mm)	SPACING REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. ALLOWABLE SPACING BETWEEN ANCHORS in. (mm) LOAD FACTOR APPLIED = .40 in.	(mm)
1/4	(6.4)	1-1/8	(28.6)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	2	(50.8)	1-5/16	(33.3)	N/A	N/A	3-15/16	(100.0)	2	(50.8)
		1-15/16	(49.2)		1-15/16	(49.2)	1	(25.4)	N/A	N/A	3-7/8	(98.4)	1-15/16	(49.2)
3/8	(9.5)	1-1/2	(38.1)		2-5/8	(66.7)	1-3/4	(44.5)	N/A	N/A	5-1/4	(133.4)	2-5/8	(66.7)
		3	(76.2)		3-3/4	(95.3)	3	(76.2)	1-1/2	(38.1)	6	(152.4)	3	(76.2)
1/2	(12.7)	2-1/4	(57.2)		3-15/16	(100.0)	2-9/16	(65.1)	N/A	N/A	7-7/8	(200.0)	3-15/16	(100.0)
		4-1/8	(104.8)		5-3/16	(131.8)	3-1/8	(79.4)	1-9/16	(39.7)	6-3/16	(157.2)	3-1/8	(79.4)
5/8	(15.9)	2-3/4	(69.9)		4-13/16	(122.2)	3-1/8	(79.4)	N/A	N/A	9-5/8	(244.5)	4-13/16	(122.2)
		5-1/8	(130.2)		6-7/16	(163.5)	3-7/8	(98.4)	1-15/16	(49.2)	7-11/16	(195.3)	3-7/8	(98.4)
3/4	(19.1)	3-1/4	(82.6)		5-11/16	(144.5)	3-3/4	(95.3)	N/A	N/A	11-3/8	(288.9)	5-11/16	(144.5)
		6-5/8	(168.3)		6-5/16	(160.3)	5	(127.0)	2-1/2	(63.5)	9-15/16	(252.4)	5	(127.0)
7/8	(22.2)	3-3/4	(95.3)		6-9/16	(166.7)	4-5/16	(109.5)	N/A	N/A	13-1/8	(333.4)	6-9/16	(166.7)
		6-1/4	(158.8)		8-1/2	(215.9)	6-1/4	(158.8)	3-1/8	(79.4)	12-1/2	(317.5)	6-1/4	(158.8)
1	(25.4)	4-1/4	(108.0)		7-7/8	(200.0)	5-1/8	(130.2)	N/A	N/A	15-3/4	(400.1)	7-7/8	(200.0)
		7-3/8	(187.3)		10-1/16	(255.6)	7-3/8	(187.3)	3-11/16	(93.7)	14-3/4	(374.7)	7-3/8	(187.3)

* Spacing and edge distances shall be divided by 0.75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

Combined Tension and Shear Loading—for Trubolt Anchors

Allowable loads for anchors subjected to combined shear and tension forces are determined by the following equation:

$$(Ps/Pt)^{5/3} + (Vs/Vt)^{5/3} \leq 1$$

Ps = Applied tension load Vs = Applied shear load Pt = Allowable tension load Vt = Allowable shear load

ADHESIVE ANCHORS INSTALLATION

The following excerpt are pages from the North American Product Technical Guide, Volume 2: Anchor Fastening, Edition 17.

Please refer to the publication in its entirety for complete details on this product including data development, product specifications, general suitability, installation, corrosion and spacing and edge distance guidelines.
US: http://submittals.us.hilti.com/PTGVol2/
CA: http://submittals.us.hilti.com/PTGVol2CA/

To consult directly with a team member regarding our anchor fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am – 6:00pm CST.
US: 877-749-6337 or HNATechnicalServices@hilti.com
CA: 1-800-363-4458, ext. 6 or CATechnicalServices@hilti.com

Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

1-800-879-8000
www.hilti.com

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Hilti HIT-RE 500 V3 injection system

REV³OLUTIONARY.

How do we take the best and make it better? By listening to our customers!

Fifteen years ago, Hilti set legendary standards for designers and contractors alike with HIT-RE 500 - our first injectable epoxy anchors for post-installed rebar and anchoring applications. And because our customers needed the same high performance and maximum reliability for cracked concrete and seismic applications, Hilti introduced the first approved chemical anchor to do exactly that with HIT-RE 500-SD.

The new HIT-RE 500 V3 delivers ultimate performance and safety in design while making installation even easier and faster than ever before. Teamed up with SafeSet and PROFIS software, HIT-RE 500 V3 is nothing short of revolutionary.

Highlights

- Ultimate bond strength 60% higher than the current market leader HIT-RE 500-SD.
- Fastest cure time among epoxy anchors - Extremely versatile and less sensitive to low or high temperatures.
- Unique SafeSet system simplifies installation process and reduces the risk of human error.
- Pioneer in ICC approval for post-installed rebar connections.
- Along with HIT-HY 200 with the HIT-Z anchor rod, HIT-RE 500 V3 is the only product approved for diamond coring in cracked concrete with the TE-YRT roughening tool.

Applications

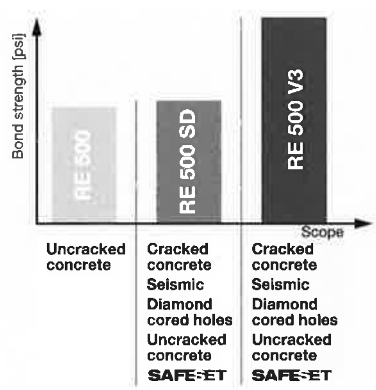
- Structural post-installed rebar connections, e.g. starter bars, beam to column connection, wall extension, etc.
- Heavy-duty fastenings in cracked and uncracked concrete, e.g. for structural beams, columns, silos, machinery, crash barriers, etc.
- Fastenings in diamond cored holes
- Post-installed anchoring in dry, wet, waterfilled or underwater.
- Seismic retrofits

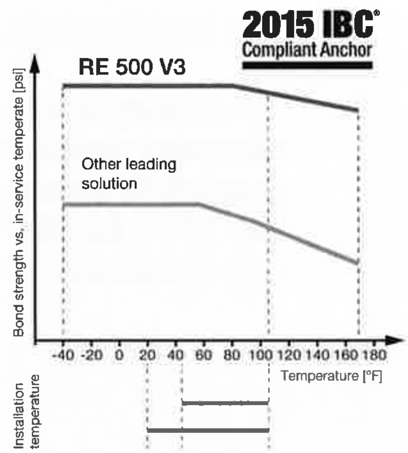
Advantages

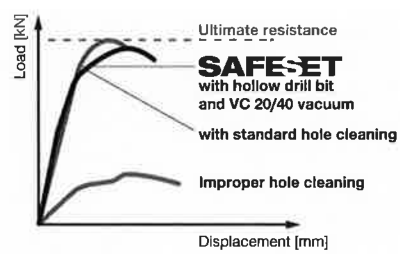
- Higher performance in shorter embedment depths leads to cost savings while maintaining the same loads.
- Fastest curing time and lower sensitivity to temperature conditions allows for unmatched productivity.
- More reliable and safer installation due to simplified cleaning process with SafeSet in hammer drilled and core drilled holes.
- The truly versatile HIT-RE 500 V3 delivers proven performance in applications where others can't.

Next generation performance...

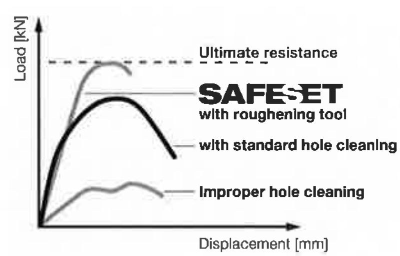
The world's most trusted epoxy injectable mortar for post-installed anchors and rebar is now more advanced than ever. HIT-RE 500 V3 delivers higher bond strength and an even wider range of approved applications.







Anchor Performance with Hammer Drilled Holes



Anchor Performance with Diamond Core drilled holes

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

...that goes to extremes!

Meet the epoxy anchor that is the least sensitive to temperature. HIT-RE 500 V3's endurance in extreme temperature ranges makes it suitable in blistering hot temperatures up to 172° F, to installation in frigidly cold temperatures- even down to 23° F! (77°C to -5°C). In addition, it is the fastest curing epoxy mortar in the market and cures in half the time of its predecessor, HIT-RE 500-SD.

Systematically better.

SafeSet eliminates the most load-affecting steps to make installation safe, simple and reliable. Hilti's hollow drill bit and VC 20/40 vacuum takes borehole cleaning out of the equation to provide maximum loads in all hammer drilled applications, while the new diamond roughening tool prepares diamond-cored holes for reliable anchor installations

In a class of its own.

Post-installed rebar connections. HIT-RE 500 V3 continues where HIT-RE 500-SD started as the first ICC-ES approved solution for post-installed rebar connections. Design is easy because this revolutionary epoxy works like cast-in rebar.

Diamond-cored anchoring in cracked concrete.

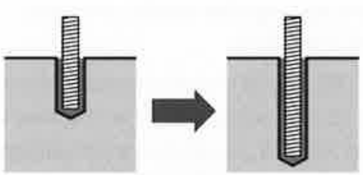
Hilti takes a revolutionary step forward with HIT-RE 500 V3 and the new TE-YRT roughening tool. This solution as well as the HIT-HY 200 adhesive with the HIT-Z Rod are the only ICC-ES approved systems in the industry and make installation in core drilled holes easy, productive and reliable.

Diamond cored hole with roughening

Diamond cored hole

Anchoring applications

HIT-RE 500 V3 delivers high performance in shorter embedment depths...



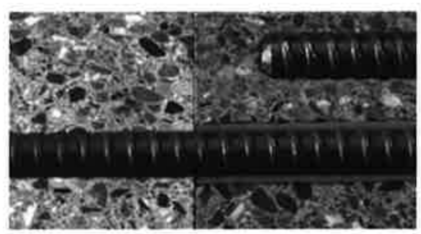
...and is backed by PROFIS Anchor software for easy design.

REV³OLUTIONARY

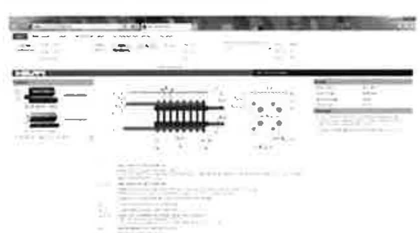
SYSTEM

Rebar applications

HIT-RE 500 V3 works like cast-in rebar...



...and is backed by PROFIS Rebar software for easy design.



3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Listings/Approvals

ICC-ES (International Code Council)
ESR-3814

NSF/ANSI Std 61
certification for use of HIT-RE 500 V3 in potable water

City of Los Angeles
Research Report No. 26028

Independent Code Evaluation

IBC®/IRC® 2015 (ICC-ES AC308/ACI 355.4)

IBC®/IRC® 2012 (ICC-ES AC308/ACI 355.4)

IBC®/IRC® 2009 (ICC-ES AC308)

IBC®/IRC® 2006 (ICC-ES AC308)

FBC 2014 w/ HVHZ

The Leadership in Energy and Environmental Design (LEED) Green Building Rating system™ is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.

Department of Transportation

Contact Hilti to get a current list of State Departments of Transportation that have added HIT-RE 500 V3 to their qualified product listing.

3.2.4.1 Product description

The new HIT-RE 500 V3 adhesive anchoring system is an injectable two-component epoxy adhesive. The two components are kept separate by means of a dual-cylinder foil pack attached to a manifold.

The two components combine and react when dispensed through a static mixing nozzle attached to the manifold.

HIT-RE 500 V3 adhesive anchoring system may be used with continuously threaded rod, HIS-N and HIS-RN internally-threaded inserts or deformed reinforcing bar installed in cracked or uncracked concrete. The primary components of the Hilti adhesive anchoring system are:

- HIT-RE 500 V3 adhesive packaged in foil packs
- Adhesive mixing and dispensing equipment
- Equipment for hole cleaning and adhesive injection

Product Features

- Superior bond performance in both cracked and uncracked concrete
- Seismic qualified in accordance with ICC-ES Acceptance Criteria AC308 and ACI 355.4
- Use in diamond cored holes with roughening tool for cracked and uncracked concrete in all seismic zones
- Use underwater up to 165 ft (50 m)
- Meets requirements of ASTM C881-14, Type I, II, IV, and V, Grade 3, Class A, B, and C except linear shrinkage
- Meets requirements of AASHTO specification M235, Type I, II, IV, and V, Grade 3, Class A, B, and C except linear shrinkage
- Mixing tube provides proper mixing, eliminates measuring errors and minimizes waste
- Contains no styrene and virtually odorless
- Extended installation temperature range from 23°F to 104°F (-5°C to 40°C)
- Excellent weathering resistance and resistant to elevated temperature.
- Hilti technical data available for larger diameters, oversized holes, and deeper embedments. Contact Hilti Technical Services for additional information.

HIT-RE 500 V3 adhesive can be installed using two cleaning options:

1. Traditional cleaning methods comprised of steel wire brushes and air nozzles,
2. Self-cleaning methods using the Hilti TE-CD or TE-YD hollow carbide drill bits used in conjunction of a Hilti vacuum cleaner that will remove drilling dust, automatically cleaning the hole.

Elements that are suitable for use with this system are as follows: threaded steel rods, Hilti HIS-(R)N steel internally threaded inserts, and steel reinforcing bars.

HIT-RE 500 V3 is approved for use with the TE-YRT roughening tool. The tool is used for hole preparation in conjunction with holes core drilled with a diamond core bit to allow diamond coring in cracked and uncracked concrete in all seismic zones.

Guide Specifications

Master Format Section:

Previous	**2004 Format**	
03250	**03 16 00**	Concrete Anchors

Related Sections:

03200	**03 20 00**	Concrete Reinforcing
05050	**05 50 00**	Metal Fabrications
05120	**05 10 00**	Structural Metal Framing

Injectable adhesive shall be used for installation of all reinforcing steel dowels or threaded anchor rods and inserts into existing concrete. Adhesive shall be furnished in side-by-side refill packs which keep component A and component B separate. Side-by-side packs shall be designed to compress during use to minimize waste volume. Side-by-side packs shall also be designed to accept static mixing nozzle which thoroughly blends component A and component B and allows injection directly into drilled hole. Only injection tools and static mixing nozzles as recommended by manufacturer shall be used. Manufacturer's instructions shall be followed. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness. Typical curing time at 68°F (20°C) shall be approximately 6.5 hours.

Injection adhesive shall be HIT-RE 500 V3, as furnished by Hilti.

Anchor rods shall be end stamped to show the grade of steel and overall rod length. Anchor rods shall be manufactured to meet the following requirements:

1. HAS-E carbon steel
2. ASTM A193, Grade B7 high strength carbon steel anchor
3. AISI Type 304 or AISI Type 316 stainless steel meeting the requirements of ASTM F593 condition CW

Special order HAS rods may vary from standard product.

Nuts and washers of other grades and styles having specified proof load strength greater than the specified grade and style are also suitable. Nuts must have specified proof load strength equal to or greater than the minimum tensile strength of the specified threaded rod.

3.2.4

3.2.4.2 Material specifications

Table 1 - Material properties of fully cured Hilti HIT-RE 500 V3

Bond Strength ASTM C882-13A[1] 2 day cure 14 day cure	 10.8 MPa 11.7 MPa	 1,560 psi 1,690 psi
Compressive Strength ASTM D695-10[1]	82.7 MPa	12,000 psi
Compressive Modulus ASTM D695-10[1]	2,600 MPa	0.38×10^6 psi
Tensile Strength 7 day ASTM D638-14	49.3 MPa	7,150 psi
Elongation at break ASTM D638-14	1.1%	1.1%
Heat Deflection Temperature ASTM D648-07	50°C	122°F
Absorption ASTM D570-98	0.18%	0.18%
Linear Coefficient of Shrinkage on Cure ASTM D2566-86	0.008	0.008

1 Minimum values obtained as the result of tests at 35°F, 50°F, 75°F and 110°F.

Material specifications for Hilti HIT-V threaded rods, Hilti HAS threaded rods, and Hilti HIS-N inserts are listed in section 3.2.8.

3.2.4.3 Technical data

3.2.4.3.1 ACI 318-14 Chapter 17 design

The load values contained in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the strength design parameters and variables of ESR-3814 and the equations within ACI 318-14 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables, refer to Section 3.1.8. Data tables from ESR-3814 are not contained in this section, but can be found at www.icc-es.org or at www.hilti.com.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

3.2.4.3.1 HIT-RE 500 V3 adhesive with deformed reinforcing bars (rebar)

Figure 1 - Rebar installed with Hilti HIT-RE 500 V3 adhesive

Cracked or uncracked concrete	Permissible drilling methods	Permissible concrete conditions
Cracked and uncracked concrete	Hammer drilling with carbide-tipped drill bit	Dry concrete Water-saturated concrete Water-filled holes Submerged (underwater)
	Hilti TE-CD or TE-YD hollow drill bit and VC 20/40 vacuum Diamond core drill bit with Hilti TE-YRT roughening tool	Dry concrete Water-saturated concrete
Uncracked concrete	Diamond core drill bit	Dry concrete Water-saturated concrete

Figure 2 - Rebar installed with Hilti HIT-RE 500 V3 adhesive

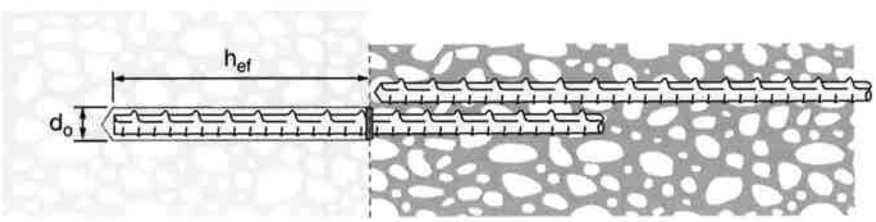


Table 2 - Specifications for rebar installed with Hilti HIT-RE 500 V3 adhesive

Setting information		Symbol	Units	Rebar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal bit diameter		d_o	in.	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2
Effective embedment	minimum	$h_{ef,min}$	in. (mm)	2-3/8 (60)	2-3/8 (60)	3 (76)	3 (76)	3-3/8 (85)	4 (102)	4-1/2 (114)	5 (127)
	maximum	$h_{ef,max}$	in. (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum concrete member thickness		h_{min}	in. (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)	(h_{ef} + 2d_o)						
Minimum edge distance[1]		c_{min}	in. (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)
Minimum anchor spacing		s_{min}	in. (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)	6-1/4 (159)

1 Edge distance of 1-3/4-inch (44mm) is permitted provided the rebar remains un-torqued.

Note: The installation specifications in table 2 above and the data in tables 3 through 23 pertain to the use of Hilti HIT-RE 500 V3 with rebar designed as a post-installed anchor using the provisions of ACI 318-14 Chapter 17. For the use of Hilti HIT-RE 500 V3 with rebar for typical development calculations according to ACI 318-14 Chapter 25 (formerly ACI 318-11 Chapter 12), refer to section 3.1.14 for the design method and tables 83 through 87 in section 3.2.4.3.8.

Table 3 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for US rebar in uncracked concrete [1,2,3,4,5,6,7,8,9,11]

		Tension — ϕN_n				Shear — ϕV_n			
Rebar size	Effective embedment in. (mm)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#3	3-3/8 (86)	4,575 (20.4)	4,790 (21.3)	5,145 (22.9)	5,695 (25.3)	9,855 (43.8)	10,310 (45.9)	11,080 (49.3)	12,265 (54.6)
	4-1/2 (114)	6,100 (27.1)	6,385 (28.4)	6,860 (30.5)	7,590 (33.8)	13,135 (58.4)	13,750 (61.2)	14,775 (65.7)	16,350 (72.7)
	7-1/2 (191)	10,165 (45.2)	10,640 (47.3)	11,435 (50.9)	12,655 (56.3)	21,895 (97.4)	22,915 (101.9)	24,625 (109.5)	27,250 (121.2)
#4	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	8,990 (40.0)	9,950 (44.3)	16,035 (71.3)	17,570 (78.2)	19,365 (86.1)	21,430 (95.3)
	6 (152)	10,660 (47.4)	11,155 (49.6)	11,990 (53.3)	13,265 (59.0)	22,960 (102.1)	24,030 (106.9)	25,820 (114.9)	28,575 (127.1)
	10 (254)	17,765 (79.0)	18,595 (82.7)	19,980 (88.9)	22,110 (98.3)	38,265 (170.2)	40,050 (178.2)	43,035 (191.4)	47,625 (211.8)
#5[10]	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	15,370 (68.4)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	33,105 (147.3)
	7-1/2 (191)	16,020 (71.3)	17,230 (76.6)	18,515 (82.4)	20,490 (91.1)	34,505 (153.5)	37,115 (165.1)	39,880 (177.4)	44,135 (196.3)
	12-1/2 (318)	27,440 (122.1)	28,720 (127.8)	30,860 (137.3)	34,155 (151.9)	59,100 (262.9)	61,855 (275.1)	66,470 (295.7)	73,560 (327.2)
#6[10]	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,200 (116.5)	28,995 (129.0)	45,360 (201.8)	49,690 (221.0)	56,430 (251.0)	62,450 (277.8)
	15 (381)	38,825 (172.7)	40,635 (180.8)	43,665 (194.2)	48,325 (215.0)	83,620 (372.0)	87,520 (389.3)	94,045 (418.3)	104,080 (463.0)
#7[10]	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	38,995 (173.5)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	83,995 (373.6)
	17-1/2 (445)	52,220 (232.3)	54,655 (243.1)	58,730 (261.2)	64,995 (289.1)	112,470 (500.3)	117,715 (523.6)	126,495 (562.7)	139,990 (622.7)
#8[10]	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	50,020 (222.5)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	107,735 (479.2)
	20 (508)	66,980 (297.9)	70,100 (311.8)	75,330 (335.1)	83,365 (370.8)	144,260 (641.7)	150,990 (671.6)	162,250 (721.7)	179,560 (798.7)
#9[10]	10-1/8 (257)	25,130 (111.8)	27,530 (122.5)	31,785 (141.4)	38,930 (173.2)	54,125 (240.8)	59,290 (263.7)	68,465 (304.5)	83,850 (373.0)
	13-1/2 (343)	38,690 (172.1)	42,380 (188.5)	48,940 (217.7)	59,940 (266.6)	83,330 (370.7)	91,285 (406.1)	105,405 (468.9)	129,095 (574.2)
	22-1/2 (572)	83,245 (370.3)	87,640 (389.8)	94,175 (418.9)	104,225 (463.6)	179,300 (797.6)	188,765 (839.7)	202,840 (902.3)	224,480 (998.5)
#10	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	70,200 (312.3)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	151,200 (672.6)
	25 (635)	97,500 (433.7)	106,195 (472.4)	114,115 (507.6)	126,290 (561.8)	210,000 (934.1)	228,730 (1017.4)	245,785 (1093.3)	272,005 (1209.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8-23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λa as follows:
For sand-lightweight, λa = 0.51. For all-lightweight, λa = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55.
Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with the Hilti TE-YRT roughening tool is permitted for #5, #6, #7, #8, and #9 rebar in dry and water-saturated concrete. See Table 5
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 4 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for US rebar in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Rebar size	Effective embedment in. (mm)	Tension — ϕN_n f'_c = 2,500 psi (17.2 MPa) lb (kN)	Tension — ϕN_n f'_c = 3,000 psi (20.7 MPa) lb (kN)	Tension — ϕN_n f'_c = 4,000 psi (27.6 MPa) lb (kN)	Tension — ϕN_n f'_c = 6,000 psi (41.4 MPa) lb (kN)	Shear — ϕV_n f'_c = 2,500 psi (17.2 MPa) lb (kN)	Shear — ϕV_n f'_c = 3,000 psi (20.7 MPa) lb (kN)	Shear — ϕV_n f'_c = 4,000 psi (27.6 MPa) lb (kN)	Shear — ϕV_n f'_c = 6,000 psi (41.4 MPa) lb (kN)
#3	3-3/8 (86)	3,425 (15.2)	3,585 (15.9)	3,745 (16.7)	3,980 (17.7)	7,380 (32.8)	7,725 (34.4)	8,065 (35.9)	8,570 (38.1)
	4-1/2 (114)	4,650 (20.7)	4,780 (21.3)	4,990 (22.2)	5,305 (23.6)	10,020 (44.6)	10,300 (45.8)	10,750 (47.8)	11,425 (50.8)
	7-1/2 (191)	7,755 (34.5)	7,970 (35.5)	8,320 (37.0)	8,840 (39.3)	16,700 (74.3)	17,165 (76.4)	17,920 (79.7)	19,045 (84.7)
#4	4-1/2 (114)	5,275 (23.5)	5,780 (25.7)	6,670 (29.7)	7,125 (31.7)	11,360 (50.5)	12,445 (55.4)	14,370 (63.9)	15,345 (68.3)
	6 (152)	8,120 (36.1)	8,560 (38.1)	8,940 (39.8)	9,500 (42.3)	17,490 (77.8)	18,440 (82.0)	19,255 (85.7)	20,465 (91.0)
	10 (254)	13,885 (61.8)	14,270 (63.5)	14,900 (66.3)	15,835 (70.4)	29,910 (133.0)	30,735 (136.7)	32,095 (142.8)	34,105 (151.7)
#5[10]	5-5/8 (143)	7,370 (32.8)	8,075 (35.9)	9,325 (41.5)	11,380 (50.6)	15,875 (70.6)	17,390 (77.4)	20,080 (89.3)	24,510 (109.0)
	7-1/2 (191)	11,350 (50.5)	12,430 (55.3)	14,275 (63.5)	15,170 (67.5)	24,440 (108.7)	26,775 (119.1)	30,750 (136.8)	32,680 (145.4)
	12-1/2 (318)	22,175 (98.6)	22,790 (101.4)	23,795 (105.8)	25,285 (112.5)	47,760 (212.4)	49,085 (218.3)	51,250 (228.0)	54,465 (242.3)
#6[10]	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	15,010 (66.8)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	32,330 (143.8)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,870 (83.9)	22,160 (98.6)	32,130 (142.9)	35,195 (156.6)	40,640 (180.8)	47,735 (212.3)
	15 (381)	32,095 (142.8)	33,290 (148.1)	34,760 (154.6)	36,935 (164.3)	69,135 (307.5)	71,700 (318.9)	74,865 (333.0)	79,560 (353.9)
#7[10]	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	15,445 (68.7)	18,915 (84.1)	26,300 (117.0)	28,810 (128.2)	33,265 (148.0)	40,740 (181.2)
	10-1/2 (267)	18,800 (83.6)	20,590 (91.6)	23,780 (105.8)	29,120 (129.5)	40,490 (180.1)	44,355 (197.3)	51,215 (227.8)	62,725 (279.0)
	17-1/2 (445)	40,445 (179.9)	44,310 (197.1)	47,310 (210.4)	50,275 (223.6)	87,115 (387.5)	95,430 (424.5)	101,895 (453.2)	108,285 (481.7)
#8[10]	9 (229)	14,920 (66.4)	16,340 (72.7)	18,870 (83.9)	23,110 (102.8)	32,130 (142.9)	35,195 (156.6)	40,640 (180.8)	49,775 (221.4)
	12 (305)	22,965 (102.2)	25,160 (111.9)	29,050 (129.2)	35,580 (158.3)	49,465 (220.0)	54,190 (241.0)	62,570 (278.3)	76,635 (340.9)
	20 (508)	49,415 (219.8)	54,135 (240.8)	62,230 (276.8)	66,130 (294.2)	106,435 (473.4)	116,595 (518.6)	134,035 (596.2)	142,440 (633.6)
#9[10]	10-1/8 (257)	17,800 (79.2)	19,500 (86.7)	22,515 (100.2)	27,575 (122.7)	38,340 (170.5)	42,000 (186.8)	48,495 (215.7)	59,395 (264.2)
	13-1/2 (343)	27,405 (121.9)	30,020 (133.5)	34,665 (154.2)	42,455 (188.8)	59,025 (262.6)	64,660 (287.6)	74,665 (332.1)	91,445 (406.8)
	22-1/2 (572)	58,965 (262.3)	64,595 (287.3)	74,585 (331.8)	81,930 (364.4)	127,005 (564.9)	139,125 (618.9)	160,650 (714.6)	176,465 (785.0)
#10	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	26,370 (117.3)	32,295 (143.7)	44,905 (199.7)	49,190 (218.8)	56,800 (252.7)	69,565 (309.4)
	15 (381)	32,095 (142.8)	35,160 (156.4)	40,600 (180.6)	49,725 (221.2)	69,135 (307.5)	75,730 (336.9)	87,445 (389.0)	107,100 (476.4)
	25 (635)	69,060 (307.2)	75,655 (336.5)	87,360 (388.6)	97,510 (433.7)	148,750 (661.7)	162,945 (724.8)	188,155 (837.0)	210,020 (934.2)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8-23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling with the Hilti TE-YRT roughening tool is permitted for #5, #6, #7, #8, and #9 rebar in dry and water-saturated concrete. See Table 6
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.68. See section 3.1.8.7 for additional information on seismic applications.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 5 - Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for US rebar in uncracked concrete[1,2,3,4,5,6,7,8,9]

		Tension — ϕN_n				Shear — ϕV_n			
Rebar size	Effective embedment in. (mm)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
#5	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	12,350 (54.9)	12,350 (54.9)	22,415 (99.7)	24,550 (109.2)	26,595 (118.3)	26,595 (118.3)
	7-1/2 (191)	16,020 (71.3)	16,465 (73.2)	16,465 (73.2)	16,465 (73.2)	34,505 (153.5)	35,460 (157.7)	35,460 (157.7)	35,460 (157.7)
	12-1/2 (318)	27,440 (122.1)	27,440 (122.1)	27,440 (122.1)	27,440 (122.1)	59,100 (262.9)	59,100 (262.9)	59,100 (262.9)	59,100 (262.9)
#6	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	17,470 (77.7)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	37,630 (167.4)
	9 (229)	21,060 (93.7)	23,070 (102.6)	23,295 (103.6)	23,295 (103.6)	45,360 (201.8)	49,690 (221.0)	50,175 (223.2)	50,175 (223.2)
	11-1/4 (286)	29,120 (129.5)	29,120 (129.5)	29,120 (129.5)	29,120 (129.5)	62,715 (279.0)	62,715 (279.0)	62,715 (279.0)	62,715 (279.0)
#7	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	23,500 (104.5)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	50,610 (225.1)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	31,330 (139.4)	31,330 (139.4)	57,160 (254.3)	62,615 (278.5)	67,485 (300.2)	67,485 (300.2)
	17-1/2 (445)	52,220 (232.3)	52,220 (232.3)	52,220 (232.3)	52,220 (232.3)	112,470 (500.3)	112,470 (500.3)	112,470 (500.3)	112,470 (500.3)
#8	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	30,140 (134.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	64,920 (288.8)
	12 (305)	32,425 (144.2)	35,520 (158.0)	40,185 (178.8)	40,185 (178.8)	69,835 (310.6)	76,500 (340.3)	86,555 (385.0)	86,555 (385.0)
	20 (508)	66,980 (297.9)	66,980 (297.9)	66,980 (297.9)	66,980 (297.9)	144,260 (641.7)	144,260 (641.7)	144,260 (641.7)	144,260 (641.7)
#9	10-1/8 (257)	25,130 (111.8)	27,530 (122.5)	31,785 (141.4)	37,680 (167.6)	54,125 (240.8)	59,290 (263.7)	68,465 (304.5)	81,160 (361.0)
	13-1/2 (343)	38,690 (172.1)	42,380 (188.5)	48,940 (217.7)	50,240 (223.5)	83,330 (370.7)	91,285 (406.1)	105,405 (468.9)	108,215 (481.4)
	22-1/2 (572)	83,245 (370.3)	83,735 (372.5)	83,735 (372.5)	83,735 (372.5)	179,300 (797.6)	180,355 (802.3)	180,355 (802.3)	180,355 (802.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8 - 23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension by α_{seis} = 0.68. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 6 - Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for US rebar in cracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension — ϕN_n f'_c = 2,500 psi (17.2 MPa) lb (kN)	Tension — ϕN_n f'_c = 3,000 psi (20.7 MPa) lb (kN)	Tension — ϕN_n f'_c = 4,000 psi (27.6 MPa) lb (kN)	Tension — ϕN_n f'_c = 6,000 psi (41.4 MPa) lb (kN)	Shear — ϕV_n f'_c = 2,500 psi (17.2 MPa) lb (kN)	Shear — ϕV_n f'_c = 3,000 psi (20.7 MPa) lb (kN)	Shear — ϕV_n f'_c = 4,000 psi (27.6 MPa) lb (kN)	Shear — ϕV_n f'_c = 6,000 psi (41.4 MPa) lb (kN)
#5	5-5/8 (143)	6,965 (31.0)	6,965 (31.0)	6,965 (31.0)	6,965 (31.0)	15,000 (66.7)	15,000 (66.7)	15,000 (66.7)	15,000 (66.7)
	7-1/2 (191)	9,285 (41.3)	9,285 (41.3)	9,285 (41.3)	9,285 (41.3)	20,000 (89.0)	20,000 (89.0)	20,000 (89.0)	20,000 (89.0)
	12-1/2 (318)	15,475 (68.8)	15,475 (68.8)	15,475 (68.8)	15,475 (68.8)	33,330 (148.3)	33,330 (148.3)	33,330 (148.3)	33,330 (148.3)
#6	6-3/4 (171)	9,690 (43.1)	10,235 (45.5)	10,235 (45.5)	10,235 (45.5)	20,870 (92.8)	22,045 (98.1)	22,045 (98.1)	22,045 (98.1)
	9 (229)	13,645 (60.7)	13,645 (60.7)	13,645 (60.7)	13,645 (60.7)	29,390 (130.7)	29,390 (130.7)	29,390 (130.7)	29,390 (130.7)
	11-1/4 (286)	17,055 (75.9)	17,055 (75.9)	17,055 (75.9)	17,055 (75.9)	36,740 (163.4)	36,740 (163.4)	36,740 (163.4)	36,740 (163.4)
#7	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	13,930 (62.0)	13,930 (62.0)	26,300 (117.0)	28,810 (128.2)	30,005 (133.5)	30,005 (133.5)
	10-1/2 (267)	18,575 (82.6)	18,575 (82.6)	18,575 (82.6)	18,575 (82.6)	40,005 (178.0)	40,005 (178.0)	40,005 (178.0)	40,005 (178.0)
	17-1/2 (445)	30,955 (137.7)	30,955 (137.7)	30,955 (137.7)	30,955 (137.7)	66,675 (296.6)	66,675 (296.6)	66,675 (296.6)	66,675 (296.6)
#8	9 (229)	14,920 (66.4)	16,340 (72.7)	18,285 (81.3)	18,285 (81.3)	32,130 (142.9)	35,195 (156.6)	39,385 (175.2)	39,385 (175.2)
	12 (305)	22,965 (102.2)	24,380 (108.4)	24,380 (108.4)	24,380 (108.4)	49,465 (220.0)	52,515 (233.6)	52,515 (233.6)	52,515 (233.6)
	20 (508)	40,635 (180.8)	40,635 (180.8)	40,635 (180.8)	40,635 (180.8)	87,525 (389.3)	87,525 (389.3)	87,525 (389.3)	87,525 (389.3)
#9	10-1/8 (257)	17,800 (79.2)	19,500 (86.7)	22,515 (100.2)	22,560 (100.4)	38,340 (170.5)	42,000 (186.8)	48,495 (215.7)	48,595 (216.2)
	13-1/2 (343)	27,405 (121.9)	30,020 (133.5)	30,085 (133.8)	30,085 (133.8)	59,025 (262.6)	64,660 (287.6)	64,795 (288.2)	64,795 (288.2)
	22-1/2 (572)	50,140 (223.0)	50,140 (223.0)	50,140 (223.0)	50,140 (223.0)	107,990 (480.4)	107,990 (480.4)	107,990 (480.4)	107,990 (480.4)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 8 - 23 as necessary to the above values. Compare to the steel values in table 7. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 **Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:**
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension by α_{seis} = 0.68. See section 3.1.8.7 for additional information on seismic applications.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 7 - Steel design strength for US rebar[1]

	ASTM A 615 Grade 40[2]			ASTM A 615 Grade 60[2]			ASTM A 706 Grade 60[2]		
Rebar size	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic Shear[5] $\phi V_{sa,eq}$ lb (kN)
#3	4,290 (19.1)	2,375 (10.6)	1,665 (7.4)	6,435 (28.6)	3,565 (15.9)	2,495 (11.1)	6,600 (29.4)	3,430 (15.3)	2,400 (10.7)
#4	7,800 (34.7)	4,320 (19.2)	3,025 (13.5)	11,700 (52.0)	6,480 (28.8)	4,535 (20.2)	12,000 (53.4)	6,240 (27.8)	4,370 (19.4)
#5	12,090 (53.8)	6,695 (29.8)	4,685 (20.8)	18,135 (80.7)	10,045 (44.7)	7,030 (31.3)	18,600 (82.7)	9,670 (43.0)	6,770 (30.1)
#6	17,160 (76.3)	9,505 (42.3)	6,655 (29.6)	25,740 (114.5)	14,255 (63.4)	9,980 (44.4)	26,400 (117.4)	13,730 (61.1)	9,610 (42.7)
#7	23,400 (104.1)	12,960 (57.6)	9,070 (40.3)	35,100 (156.1)	19,440 (86.5)	13,610 (60.5)	36,000 (160.1)	18,720 (83.3)	13,105 (58.3)
#8	30,810 (137.0)	17,065 (75.9)	11,945 (53.1)	46,215 (205.6)	25,595 (113.9)	17,915 (79.7)	47,400 (210.8)	24,650 (109.6)	17,255 (76.8)
#9	39,000 (173.5)	21,600 (96.1)	15,120 (67.3)	58,500 (260.2)	32,400 (144.1)	22,680 (100.9)	60,000 (266.9)	31,200 (138.8)	21,840 (97.1)
#10	49,530 (220.3)	27,430 (122.0)	19,200 (85.4)	74,295 (330.5)	41,150 (183.0)	28,805 (128.1)	76,200 (339.0)	39,625 (176.3)	27,740 (123.4)

1 See Section 3.1.8.6 to convert design strength value to ASD value.
2 ASTM A706 Grade 60 rebar are considered ductile steel elements. ASTM A 615 Grade 40 and 60 rebar are considered brittle steel elements.
3 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318-14 Chapter 17
4 Shear = $\phi\ 0.60\ A_{se,N} f_{uta}$ as noted in ACI 318-14 Chapter 17
5 Seismic Shear = $\alpha_{V,seis}\ \phi V_{sa}$: Reduction for seismic shear only. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 8 - Load adjustment factors for #3 rebar in uncracked concrete[1,2,3]

#3 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.29	0.22	0.13	n/a	n/a	n/a	0.07	0.06	0.03	0.15	0.11	0.07	n/a	n/a	n/a
1-7/8	(48)	0.59	0.57	0.54	0.30	0.22	0.13	0.53	0.53	0.52	0.08	0.06	0.04	0.17	0.12	0.07	n/a	n/a	n/a
2	(51)	0.59	0.57	0.54	0.31	0.23	0.13	0.53	0.53	0.52	0.09	0.07	0.04	0.18	0.14	0.08	n/a	n/a	n/a
3	(76)	0.64	0.61	0.57	0.38	0.28	0.16	0.55	0.54	0.53	0.17	0.13	0.08	0.34	0.25	0.15	n/a	n/a	n/a
4	(102)	0.69	0.65	0.59	0.45	0.33	0.19	0.57	0.56	0.54	0.26	0.19	0.12	0.45	0.33	0.19	n/a	n/a	n/a
4-5/8	(117)	0.72	0.67	0.60	0.50	0.37	0.22	0.58	0.56	0.55	0.32	0.24	0.14	0.50	0.37	0.22	0.56	n/a	n/a
5	(127)	0.74	0.69	0.61	0.54	0.39	0.23	0.58	0.57	0.55	0.36	0.27	0.16	0.54	0.39	0.23	0.58	n/a	n/a
5-3/4	(146)	0.77	0.71	0.63	0.61	0.45	0.26	0.60	0.58	0.56	0.45	0.33	0.20	0.61	0.45	0.26	0.62	0.57	n/a
6	(152)	0.78	0.72	0.63	0.64	0.47	0.27	0.60	0.58	0.56	0.47	0.36	0.21	0.64	0.47	0.27	0.64	0.58	n/a
7	(178)	0.83	0.76	0.66	0.75	0.54	0.32	0.62	0.60	0.57	0.60	0.45	0.27	0.75	0.54	0.32	0.69	0.63	n/a
8	(203)	0.88	0.80	0.68	0.85	0.62	0.36	0.64	0.61	0.58	0.73	0.55	0.33	0.85	0.62	0.36	0.74	0.67	n/a
8-3/4	(222)	0.91	0.82	0.69	0.93	0.68	0.39	0.65	0.62	0.59	0.84	0.63	0.38	0.93	0.68	0.39	0.77	0.70	0.59
9	(229)	0.92	0.83	0.70	0.96	0.70	0.41	0.65	0.63	0.59	0.87	0.65	0.39	0.96	0.70	0.41	0.78	0.71	0.60
10	(254)	0.97	0.87	0.72	1.00	0.78	0.45	0.67	0.64	0.60	1.00	0.77	0.46	1.00	0.78	0.45	0.82	0.75	0.63
11	(279)	1.00	0.91	0.74		0.85	0.50	0.69	0.65	0.61		0.88	0.53		0.85	0.50	0.86	0.78	0.66
12	(305)		0.94	0.77		0.93	0.54	0.70	0.67	0.62		1.00	0.60		0.93	0.54	0.90	0.82	0.69
14	(356)		1.00	0.81		1.00	0.63	0.74	0.70	0.64			0.76		1.00	0.63	0.97	0.88	0.75
16	(406)			0.86			0.72	0.77	0.72	0.66			0.93			0.72	1.00	0.95	0.80
18	(457)			0.90			0.81	0.80	0.75	0.68			1.00			0.81		1.00	0.85
24	(610)			1.00			1.00	0.91	0.83	0.74						1.00			0.98
30	(762)							1.00	0.92	0.80									1.00
36	(914)								1.00	0.86									
> 48	(1219)									0.98									

Table 9 - Load adjustment factors for #3 rebar in cracked concrete[1,2,3]

#3 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.53	0.49	0.43	n/a	n/a	n/a	0.07	0.05	0.03	0.14	0.11	0.06	n/a	n/a	n/a
1-7/8	(48)	0.59	0.57	0.54	0.55	0.50	0.44	0.53	0.53	0.52	0.08	0.06	0.03	0.16	0.12	0.07	n/a	n/a	n/a
2	(51)	0.59	0.57	0.54	0.56	0.51	0.44	0.53	0.53	0.52	0.09	0.06	0.04	0.17	0.13	0.08	n/a	n/a	n/a
3	(76)	0.64	0.61	0.57	0.68	0.60	0.49	0.55	0.54	0.53	0.16	0.12	0.07	0.32	0.24	0.14	n/a	n/a	n/a
4	(102)	0.69	0.65	0.59	0.81	0.70	0.55	0.57	0.55	0.54	0.25	0.18	0.11	0.49	0.36	0.22	n/a	n/a	n/a
4-5/8	(117)	0.72	0.67	0.60	0.90	0.76	0.58	0.58	0.56	0.54	0.31	0.23	0.14	0.61	0.45	0.27	0.55	n/a	n/a
5	(127)	0.74	0.69	0.61	0.95	0.80	0.60	0.58	0.57	0.55	0.34	0.25	0.15	0.69	0.51	0.30	0.57	n/a	n/a
5-3/4	(146)	0.77	0.71	0.63	1.00	0.88	0.64	0.59	0.58	0.55	0.42	0.31	0.19	0.85	0.63	0.38	0.61	0.55	n/a
6	(152)	0.78	0.72	0.63		0.91	0.66	0.60	0.58	0.56	0.45	0.33	0.20	0.91	0.67	0.40	0.63	0.57	n/a
7	(178)	0.83	0.76	0.66		1.00	0.72	0.61	0.59	0.57	0.57	0.42	0.25	1.00	0.84	0.50	0.68	0.61	n/a
8	(203)	0.88	0.80	0.68			0.78	0.63	0.61	0.58	0.70	0.51	0.31		1.00	0.62	0.72	0.65	n/a
8-3/4	(222)	0.91	0.82	0.69			0.83	0.64	0.62	0.58	0.80	0.59	0.35			0.70	0.76	0.68	0.58
9	(229)	0.92	0.83	0.70			0.85	0.65	0.62	0.59	0.83	0.61	0.37			0.74	0.77	0.69	0.58
10	(254)	0.97	0.87	0.72			0.91	0.66	0.63	0.60	0.97	0.72	0.43			0.86	0.81	0.73	0.62
11	(279)	1.00	0.91	0.74			0.98	0.68	0.65	0.60	1.00	0.83	0.50			0.98	0.85	0.77	0.65
12	(305)		0.94	0.77			1.00	0.70	0.66	0.61		0.94	0.57			1.00	0.89	0.80	0.68
14	(356)		1.00	0.81				0.73	0.69	0.63		1.00	0.71				0.96	0.86	0.73
16	(406)			0.86				0.76	0.71	0.65			0.87				1.00	0.92	0.78
18	(457)			0.90				0.79	0.74	0.67			1.00					0.98	0.83
24	(610)			1.00				0.89	0.82	0.73			1.00					1.00	0.96
30	(762)							0.99	0.90	0.79			1.00						1.00
36	(914)							1.00	0.98	0.84			1.00						
> 48	(1219)								1.00	0.96			1.00						

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

Table 10 - Load adjustment factors for #4 rebar in uncracked concrete[1,2,3]

#4 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.26	0.20	0.11	n/a	n/a	n/a	0.05	0.04	0.02	0.11	0.07	0.04	n/a	n/a	n/a
2-1/2	(64)	0.59	0.57	0.54	0.29	0.22	0.13	0.53	0.53	0.52	0.09	0.06	0.04	0.18	0.13	0.08	n/a	n/a	n/a
3	(76)	0.61	0.58	0.55	0.32	0.24	0.14	0.54	0.53	0.52	0.12	0.08	0.05	0.24	0.17	0.10	n/a	n/a	n/a
4	(102)	0.64	0.61	0.57	0.37	0.28	0.16	0.55	0.54	0.53	0.18	0.13	0.08	0.37	0.26	0.15	n/a	n/a	n/a
5	(127)	0.68	0.64	0.58	0.42	0.32	0.18	0.57	0.55	0.54	0.26	0.18	0.11	0.42	0.32	0.18	n/a	n/a	n/a
5-3/4	(146)	0.70	0.66	0.60	0.47	0.35	0.20	0.58	0.56	0.54	0.32	0.22	0.13	0.47	0.35	0.20	0.56	n/a	n/a
6	(152)	0.71	0.67	0.60	0.48	0.36	0.21	0.58	0.56	0.55	0.34	0.24	0.14	0.48	0.36	0.21	0.57	n/a	n/a
7	(178)	0.75	0.69	0.62	0.55	0.40	0.24	0.59	0.57	0.55	0.42	0.30	0.18	0.55	0.40	0.24	0.61	n/a	n/a
7-1/4	(184)	0.76	0.70	0.62	0.57	0.42	0.24	0.60	0.58	0.55	0.45	0.31	0.19	0.57	0.42	0.24	0.62	0.55	n/a
8	(203)	0.79	0.72	0.63	0.63	0.46	0.27	0.61	0.58	0.56	0.52	0.36	0.22	0.63	0.46	0.27	0.66	0.58	n/a
9	(229)	0.82	0.75	0.65	0.70	0.52	0.30	0.62	0.60	0.57	0.62	0.43	0.26	0.70	0.52	0.30	0.70	0.62	n/a
10	(254)	0.86	0.78	0.67	0.78	0.57	0.34	0.63	0.61	0.58	0.72	0.51	0.30	0.78	0.57	0.34	0.73	0.65	n/a
11-1/4	(286)	0.90	0.81	0.69	0.88	0.65	0.38	0.65	0.62	0.58	0.86	0.60	0.36	0.88	0.65	0.38	0.78	0.69	0.58
12	(305)	0.93	0.83	0.70	0.94	0.69	0.40	0.66	0.63	0.59	0.95	0.67	0.40	0.94	0.69	0.40	0.80	0.71	0.60
14	(356)	1.00	0.89	0.73	1.00	0.80	0.47	0.69	0.65	0.61	1.00	0.84	0.50	1.00	0.80	0.47	0.87	0.77	0.65
16	(406)		0.94	0.77		0.92	0.54	0.72	0.67	0.62		1.00	0.61		0.92	0.54	0.93	0.82	0.69
18	(457)		1.00	0.80		1.00	0.60	0.74	0.69	0.64			0.73		1.00	0.60	0.98	0.87	0.74
20	(508)			0.83			0.67	0.77	0.71	0.65			0.86			0.67	1.00	0.92	0.78
22	(559)			0.87			0.74	0.80	0.73	0.67			0.99			0.74		0.97	0.81
24	(610)			0.90			0.81	0.82	0.75	0.68			1.00			0.81		1.00	0.85
30	(762)			1.00			1.00	0.90	0.82	0.73						1.00			0.95
36	(914)							0.98	0.88	0.77									1.00
> 48	(1219)							1.00	1.00	0.86									

3.2.4

Table 11 - Load adjustment factors for #4 rebar in cracked concrete[1,2,3]

#4 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)	4-1/2 (114)	6 (152)	10 (254)
Spacing (s) / edge eistance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.48	0.45	0.41	n/a	n/a	n/a	0.05	0.03	0.02	0.11	0.07	0.04	n/a	n/a	n/a
2-1/2	(64)	0.59	0.57	0.54	0.55	0.50	0.44	0.53	0.53	0.52	0.09	0.06	0.03	0.18	0.12	0.07	n/a	n/a	n/a
3	(76)	0.61	0.58	0.55	0.59	0.53	0.46	0.54	0.53	0.52	0.12	0.08	0.05	0.24	0.16	0.09	n/a	n/a	n/a
4	(102)	0.64	0.61	0.57	0.68	0.60	0.49	0.55	0.54	0.53	0.18	0.12	0.07	0.37	0.24	0.14	n/a	n/a	n/a
5	(127)	0.68	0.64	0.58	0.78	0.67	0.53	0.57	0.55	0.54	0.26	0.17	0.10	0.52	0.34	0.20	n/a	n/a	n/a
5-3/4	(146)	0.70	0.66	0.60	0.86	0.73	0.56	0.58	0.56	0.54	0.32	0.21	0.12	0.64	0.41	0.24	0.56	n/a	n/a
6	(152)	0.71	0.67	0.60	0.89	0.75	0.57	0.58	0.56	0.54	0.34	0.22	0.13	0.68	0.44	0.26	0.57	n/a	n/a
7	(178)	0.75	0.69	0.62	1.00	0.83	0.62	0.59	0.57	0.55	0.43	0.28	0.16	0.86	0.56	0.33	0.62	n/a	n/a
7-1/4	(184)	0.76	0.70	0.62		0.85	0.63	0.60	0.57	0.55	0.45	0.29	0.17	0.90	0.59	0.34	0.63	0.54	n/a
8	(203)	0.79	0.72	0.63		0.91	0.66	0.61	0.58	0.56	0.52	0.34	0.20	1.00	0.68	0.40	0.66	0.57	n/a
9	(229)	0.82	0.75	0.65		1.00	0.70	0.62	0.59	0.56	0.62	0.41	0.24		0.81	0.47	0.70	0.60	n/a
10	(254)	0.86	0.78	0.67			0.75	0.64	0.60	0.57	0.73	0.47	0.28		0.95	0.56	0.74	0.64	n/a
11-1/4	(286)	0.90	0.81	0.69			0.81	0.65	0.61	0.58	0.87	0.57	0.33		1.00	0.66	0.78	0.68	0.56
12	(305)	0.93	0.83	0.70			0.85	0.66	0.62	0.59	0.96	0.62	0.36			0.73	0.81	0.70	0.58
14	(356)	1.00	0.89	0.73			0.95	0.69	0.64	0.60	1.00	0.79	0.46			0.92	0.87	0.75	0.63
16	(406)		0.94	0.77			1.00	0.72	0.66	0.61		0.96	0.56			1.00	0.93	0.81	0.67
18	(457)		1.00	0.80				0.74	0.68	0.63		1.00	0.67				0.99	0.85	0.71
20	(508)			0.83				0.77	0.70	0.64			0.79				1.00	0.90	0.75
22	(559)			0.87				0.80	0.72	0.66			0.91					0.94	0.79
24	(610)			0.90				0.82	0.74	0.67			1.00					0.99	0.83
30	(762)			1.00				0.91	0.80	0.71								1.00	0.92
36	(914)							0.99	0.87	0.76									1.00
> 48	(1219)							1.00	0.99	0.84									

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 12 - Load adjustment factors for #5 rebar in uncracked concrete[1,2,3]

#5 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.18	0.11	n/a	n/a	n/a	0.04	0.03	0.02	0.08	0.06	0.03	n/a	n/a	n/a
3-1/8	(79)	0.59	0.57	0.54	0.29	0.22	0.13	0.54	0.53	0.52	0.10	0.07	0.04	0.20	0.13	0.08	n/a	n/a	n/a
4	(102)	0.61	0.59	0.55	0.33	0.25	0.14	0.55	0.53	0.52	0.15	0.10	0.06	0.29	0.19	0.11	n/a	n/a	n/a
5	(127)	0.64	0.61	0.57	0.37	0.28	0.16	0.56	0.54	0.53	0.21	0.13	0.08	0.37	0.27	0.16	n/a	n/a	n/a
6	(152)	0.67	0.63	0.58	0.41	0.31	0.18	0.57	0.55	0.54	0.27	0.18	0.10	0.41	0.31	0.18	n/a	n/a	n/a
7	(178)	0.70	0.66	0.59	0.46	0.34	0.20	0.58	0.56	0.54	0.34	0.22	0.13	0.46	0.34	0.20	n/a	n/a	n/a
7-1/8	(181)	0.70	0.66	0.60	0.46	0.34	0.20	0.58	0.56	0.54	0.35	0.23	0.13	0.46	0.34	0.20	0.57	n/a	n/a
8	(203)	0.73	0.68	0.61	0.51	0.38	0.22	0.59	0.57	0.55	0.41	0.27	0.16	0.51	0.38	0.22	0.61	n/a	n/a
9	(229)	0.76	0.70	0.62	0.56	0.41	0.24	0.60	0.58	0.55	0.50	0.32	0.19	0.56	0.41	0.24	0.65	0.56	n/a
10	(254)	0.79	0.72	0.63	0.63	0.46	0.27	0.62	0.59	0.56	0.58	0.38	0.22	0.63	0.46	0.27	0.68	0.59	n/a
11	(279)	0.82	0.74	0.65	0.69	0.51	0.30	0.63	0.60	0.57	0.67	0.43	0.25	0.69	0.51	0.30	0.71	0.62	n/a
12	(305)	0.84	0.77	0.66	0.75	0.55	0.32	0.64	0.60	0.57	0.76	0.50	0.29	0.75	0.55	0.32	0.75	0.65	n/a
14	(356)	0.90	0.81	0.69	0.88	0.64	0.38	0.66	0.62	0.59	0.96	0.62	0.36	0.88	0.64	0.38	0.81	0.70	0.58
16	(406)	0.96	0.86	0.71	1.00	0.74	0.43	0.69	0.64	0.60	1.00	0.76	0.45	1.00	0.74	0.43	0.86	0.75	0.62
18	(457)	1.00	0.90	0.74		0.83	0.49	0.71	0.66	0.61		0.91	0.53		0.83	0.49	0.91	0.79	0.66
20	(508)		0.94	0.77		0.92	0.54	0.73	0.67	0.62		1.00	0.62		0.92	0.54	0.96	0.83	0.70
22	(559)		0.99	0.79		1.00	0.59	0.75	0.69	0.63			0.72		1.00	0.59	1.00	0.87	0.73
24	(610)		1.00	0.82			0.65	0.78	0.71	0.65			0.82			0.65		0.91	0.76
26	(660)			0.85			0.70	0.80	0.73	0.66			0.92			0.70		0.95	0.79
28	(711)			0.87			0.75	0.82	0.74	0.67			1.00			0.75		0.99	0.82
30	(762)			0.90			0.81	0.85	0.76	0.68						0.81		1.00	0.85
36	(914)			0.98			0.97	0.92	0.81	0.72						0.97			0.94
> 48	(1219)			1.00			1.00	1.00	0.92	0.79						1.00			1.00

Table 13 - Load adjustment factors for #5 rebar in cracked concrete[1,2,3]

#5 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.46	0.43	0.40	n/a	n/a	n/a	0.04	0.03	0.01	0.09	0.06	0.03	n/a	n/a	n/a
3-1/8	(79)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.10	0.07	0.03	0.20	0.13	0.07	n/a	n/a	n/a
4	(102)	0.61	0.59	0.55	0.61	0.55	0.46	0.55	0.53	0.52	0.15	0.10	0.05	0.30	0.19	0.10	n/a	n/a	n/a
5	(127)	0.64	0.61	0.57	0.69	0.60	0.49	0.56	0.54	0.53	0.21	0.13	0.07	0.41	0.27	0.14	n/a	n/a	n/a
6	(152)	0.67	0.63	0.58	0.77	0.66	0.53	0.57	0.55	0.53	0.27	0.18	0.09	0.54	0.35	0.18	n/a	n/a	n/a
7	(178)	0.70	0.66	0.59	0.85	0.72	0.56	0.58	0.56	0.54	0.34	0.22	0.11	0.68	0.44	0.23	n/a	n/a	n/a
7-1/8	(181)	0.70	0.66	0.60	0.86	0.73	0.56	0.58	0.56	0.54	0.35	0.23	0.12	0.70	0.46	0.23	0.58	n/a	n/a
8	(203)	0.73	0.68	0.61	0.93	0.78	0.59	0.59	0.57	0.54	0.42	0.27	0.14	0.84	0.54	0.28	0.61	n/a	n/a
9	(229)	0.76	0.70	0.62	1.00	0.85	0.62	0.60	0.58	0.55	0.50	0.32	0.17	1.00	0.65	0.33	0.65	0.56	n/a
10	(254)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.56	0.58	0.38	0.19		0.76	0.39	0.68	0.59	n/a
11	(279)	0.82	0.74	0.65		0.98	0.69	0.63	0.60	0.56	0.67	0.44	0.22		0.88	0.45	0.72	0.62	n/a
12	(305)	0.84	0.77	0.66		1.00	0.73	0.64	0.60	0.57	0.77	0.50	0.26		1.00	0.51	0.75	0.65	n/a
14	(356)	0.90	0.81	0.69			0.81	0.66	0.62	0.58	0.97	0.63	0.32			0.64	0.81	0.70	0.56
16	(406)	0.96	0.86	0.71			0.89	0.69	0.64	0.59	1.00	0.77	0.39			0.79	0.86	0.75	0.60
18	(457)	1.00	0.90	0.74			0.97	0.71	0.66	0.60		0.92	0.47			0.94	0.92	0.79	0.63
20	(508)		0.94	0.77			1.00	0.73	0.67	0.61		1.00	0.55			1.00	0.97	0.84	0.67
22	(559)		0.99	0.79				0.76	0.69	0.62			0.63				1.00	0.88	0.70
24	(610)		1.00	0.82				0.78	0.71	0.63			0.72					0.92	0.73
26	(660)			0.85				0.80	0.73	0.65			0.81					0.95	0.76
28	(711)			0.87				0.83	0.74	0.66			0.91					0.99	0.79
30	(762)			0.90				0.85	0.76	0.67			1.00					1.00	0.82
36	(914)			0.98				0.92	0.81	0.70									0.90
> 48	(1219)			1.00				1.00	0.92	0.77									1.00

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

Table 14 - Load adjustment factors for #6 rebar in uncracked concrete[1,2,3]

#6 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.24	0.18	0.10	n/a	n/a	n/a	0.03	0.02	0.01	0.07	0.05	0.02	n/a	n/a	n/a
3-3/4	(95)	0.59	0.57	0.54	0.30	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.04	0.22	0.14	0.08	n/a	n/a	n/a
4	(102)	0.60	0.57	0.54	0.31	0.23	0.13	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.08	n/a	n/a	n/a
5	(127)	0.62	0.59	0.56	0.34	0.25	0.15	0.55	0.54	0.53	0.17	0.11	0.06	0.33	0.22	0.12	n/a	n/a	n/a
6	(152)	0.64	0.61	0.57	0.38	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.08	0.38	0.28	0.16	n/a	n/a	n/a
7	(178)	0.67	0.63	0.58	0.41	0.30	0.18	0.57	0.55	0.54	0.28	0.18	0.10	0.41	0.30	0.18	n/a	n/a	n/a
8	(203)	0.69	0.65	0.59	0.45	0.33	0.19	0.58	0.56	0.54	0.34	0.22	0.12	0.45	0.33	0.19	n/a	n/a	n/a
8-1/2	(216)	0.70	0.66	0.59	0.47	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.13	0.47	0.34	0.20	0.59	n/a	n/a
9	(229)	0.72	0.67	0.60	0.49	0.36	0.21	0.59	0.57	0.55	0.40	0.26	0.14	0.49	0.36	0.21	0.60	n/a	n/a
10	(254)	0.74	0.69	0.61	0.53	0.39	0.23	0.60	0.58	0.55	0.47	0.31	0.17	0.53	0.39	0.23	0.64	n/a	n/a
10-3/4	(273)	0.76	0.70	0.62	0.57	0.41	0.24	0.61	0.58	0.55	0.53	0.34	0.19	0.57	0.41	0.24	0.66	0.57	n/a
12	(305)	0.79	0.72	0.63	0.64	0.46	0.27	0.62	0.59	0.56	0.62	0.40	0.22	0.64	0.46	0.27	0.70	0.60	n/a
14	(356)	0.84	0.76	0.66	0.74	0.54	0.32	0.64	0.61	0.57	0.78	0.51	0.28	0.74	0.54	0.32	0.75	0.65	n/a
16	(406)	0.89	0.80	0.68	0.85	0.62	0.36	0.66	0.62	0.58	0.96	0.62	0.34	0.85	0.62	0.36	0.80	0.70	n/a
16-3/4	(425)	0.90	0.81	0.69	0.89	0.65	0.38	0.67	0.63	0.58	1.00	0.67	0.36	0.89	0.65	0.38	0.82	0.71	0.58
18	(457)	0.93	0.83	0.70	0.96	0.69	0.41	0.68	0.64	0.59		0.74	0.40	0.96	0.69	0.41	0.85	0.74	0.60
20	(508)	0.98	0.87	0.72	1.00	0.77	0.45	0.70	0.65	0.60		0.87	0.47	1.00	0.77	0.45	0.90	0.78	0.64
22	(559)	1.00	0.91	0.74		0.85	0.50	0.72	0.67	0.61		1.00	0.54		0.85	0.50	0.94	0.82	0.67
24	(610)		0.94	0.77		0.93	0.54	0.74	0.68	0.62			0.62		0.93	0.54	0.99	0.85	0.70
26	(660)		0.98	0.79		1.00	0.59	0.76	0.70	0.63			0.70		1.00	0.59	1.00	0.89	0.72
28	(711)		1.00	0.81			0.63	0.78	0.71	0.64			0.78			0.63		0.92	0.75
30	(762)			0.83			0.68	0.80	0.73	0.65			0.87			0.68		0.95	0.78
36	(914)			0.90			0.81	0.86	0.77	0.68			1.00			0.81		1.00	0.85
> 48	(1219)			1.00			1.00	0.99	0.86	0.74						1.00			0.98

3.2.4

Table 15 - Load adjustment factors for #6 rebar in cracked concrete[1,2,3]

#6 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.44	0.42	0.39	n/a	n/a	n/a	0.03	0.02	0.01	0.07	0.05	0.02	n/a	n/a	n/a
3-3/4	(95)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
4	(102)	0.60	0.57	0.54	0.57	0.51	0.44	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
5	(127)	0.62	0.59	0.56	0.63	0.56	0.47	0.55	0.54	0.52	0.17	0.11	0.05	0.34	0.22	0.10	n/a	n/a	n/a
6	(152)	0.64	0.61	0.57	0.69	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
7	(178)	0.67	0.63	0.58	0.76	0.65	0.52	0.57	0.55	0.53	0.28	0.18	0.08	0.56	0.36	0.17	n/a	n/a	n/a
8	(203)	0.69	0.65	0.59	0.82	0.70	0.55	0.58	0.56	0.54	0.34	0.22	0.10	0.68	0.44	0.21	n/a	n/a	n/a
8-1/2	(216)	0.70	0.66	0.59	0.86	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.75	0.49	0.23	0.59	n/a	n/a
9	(229)	0.72	0.67	0.60	0.90	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
10	(254)	0.74	0.69	0.61	0.97	0.80	0.60	0.60	0.58	0.55	0.48	0.31	0.14	0.95	0.62	0.29	0.64	n/a	n/a
10-3/4	(273)	0.76	0.70	0.62	1.00	0.84	0.62	0.61	0.58	0.55	0.53	0.35	0.16	1.00	0.69	0.32	0.66	0.57	n/a
12	(305)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
14	(356)	0.84	0.76	0.66		1.00	0.72	0.64	0.61	0.56	0.79	0.51	0.24		1.00	0.48	0.76	0.65	n/a
16	(406)	0.89	0.80	0.68			0.78	0.66	0.62	0.57	0.97	0.63	0.29			0.58	0.81	0.70	n/a
16-3/4	(425)	0.90	0.81	0.69			0.81	0.67	0.63	0.58	1.00	0.67	0.31			0.62	0.83	0.72	0.55
18	(457)	0.93	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
20	(508)	0.98	0.87	0.72			0.91	0.70	0.65	0.59		0.88	0.41			0.82	0.90	0.78	0.61
22	(559)	1.00	0.91	0.74			0.98	0.72	0.67	0.60		1.00	0.47			0.94	0.95	0.82	0.63
24	(610)		0.94	0.77			1.00	0.74	0.68	0.61			0.54			1.00	0.99	0.86	0.66
26	(660)		0.98	0.79				0.76	0.70	0.62			0.60				1.00	0.89	0.69
28	(711)		1.00	0.81				0.79	0.71	0.63			0.68					0.92	0.72
30	(762)			0.83				0.81	0.73	0.64			0.75					0.96	0.74
36	(914)			0.90				0.87	0.77	0.66			0.98					1.00	0.81
> 48	(1219)			1.00				0.99	0.87	0.72			1.00						0.94

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 16 - Load adjustment factors for #7 rebar in uncracked concrete[1,2,3]

#7 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.03	0.02	0.01	0.05	0.04	0.02	n/a	n/a	n/a
4-3/8	(111)	0.59	0.57	0.54	0.31	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.04	0.22	0.14	0.07	n/a	n/a	n/a
5	(127)	0.60	0.58	0.55	0.33	0.23	0.14	0.54	0.53	0.52	0.13	0.09	0.04	0.27	0.17	0.09	n/a	n/a	n/a
6	(152)	0.62	0.60	0.56	0.36	0.25	0.15	0.55	0.54	0.52	0.17	0.11	0.06	0.35	0.23	0.12	n/a	n/a	n/a
7	(178)	0.65	0.61	0.57	0.39	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.39	0.28	0.15	n/a	n/a	n/a
8	(203)	0.67	0.63	0.58	0.42	0.30	0.18	0.57	0.55	0.53	0.27	0.17	0.09	0.42	0.30	0.18	n/a	n/a	n/a
9	(229)	0.69	0.64	0.59	0.45	0.32	0.19	0.58	0.56	0.54	0.32	0.21	0.11	0.45	0.32	0.19	n/a	n/a	n/a
9-7/8	(251)	0.71	0.66	0.59	0.48	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.12	0.48	0.34	0.20	0.59	n/a	n/a
10	(254)	0.71	0.66	0.60	0.49	0.35	0.20	0.59	0.57	0.54	0.38	0.24	0.12	0.49	0.35	0.20	0.59	n/a	n/a
11	(279)	0.73	0.67	0.60	0.52	0.37	0.22	0.60	0.57	0.55	0.43	0.28	0.14	0.52	0.37	0.22	0.62	n/a	n/a
12	(305)	0.75	0.69	0.61	0.56	0.40	0.23	0.60	0.58	0.55	0.49	0.32	0.16	0.56	0.40	0.23	0.65	n/a	n/a
12-1/2	(318)	0.76	0.70	0.62	0.59	0.41	0.24	0.61	0.58	0.55	0.52	0.34	0.17	0.59	0.41	0.24	0.66	0.57	n/a
14	(356)	0.79	0.72	0.63	0.66	0.46	0.27	0.62	0.59	0.56	0.62	0.40	0.21	0.66	0.46	0.27	0.70	0.60	n/a
16	(406)	0.83	0.75	0.65	0.75	0.53	0.31	0.64	0.60	0.57	0.76	0.49	0.25	0.75	0.53	0.31	0.75	0.65	n/a
18	(457)	0.87	0.79	0.67	0.84	0.60	0.35	0.66	0.62	0.57	0.91	0.59	0.30	0.84	0.60	0.35	0.79	0.68	n/a
19-1/2	(495)	0.91	0.81	0.69	0.92	0.65	0.38	0.67	0.63	0.58	1.00	0.66	0.34	0.92	0.65	0.38	0.82	0.71	0.57
20	(508)	0.92	0.82	0.69	0.94	0.66	0.39	0.67	0.63	0.58		0.69	0.35	0.94	0.66	0.39	0.83	0.72	0.58
22	(559)	0.96	0.85	0.71	1.00	0.73	0.43	0.69	0.64	0.59		0.80	0.40	1.00	0.73	0.43	0.87	0.76	0.60
24	(610)	1.00	0.88	0.73		0.80	0.47	0.71	0.66	0.60		0.91	0.46		0.80	0.47	0.91	0.79	0.63
26	(660)		0.91	0.75		0.86	0.51	0.73	0.67	0.61		1.00	0.52		0.86	0.51	0.95	0.82	0.66
28	(711)		0.94	0.77		0.93	0.54	0.74	0.68	0.62			0.58		0.93	0.54	0.99	0.85	0.68
30	(762)		0.98	0.79		1.00	0.58	0.76	0.70	0.62			0.64		1.00	0.58	1.00	0.88	0.71
36	(914)		1.00	0.84			0.70	0.81	0.73	0.65			0.85			0.70		0.97	0.77
> 48	(1219)			0.96			0.93	0.92	0.81	0.70			1.00			0.93		1.00	0.89

Table 17 - Load adjustment factors for #7 rebar in cracked concrete[1,2,3]

#7 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.43	0.41	0.38	n/a	n/a	n/a	0.03	0.02	0.01	0.06	0.04	0.02	n/a	n/a	n/a
4-3/8	(111)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
5	(127)	0.60	0.58	0.55	0.58	0.52	0.45	0.54	0.53	0.52	0.13	0.09	0.04	0.27	0.17	0.08	n/a	n/a	n/a
6	(152)	0.62	0.60	0.56	0.64	0.56	0.47	0.55	0.54	0.52	0.18	0.11	0.05	0.35	0.23	0.11	n/a	n/a	n/a
7	(178)	0.65	0.61	0.57	0.69	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
8	(203)	0.67	0.63	0.58	0.75	0.64	0.52	0.57	0.55	0.53	0.27	0.18	0.08	0.54	0.35	0.16	n/a	n/a	n/a
9	(229)	0.69	0.64	0.59	0.81	0.68	0.54	0.58	0.56	0.54	0.32	0.21	0.10	0.65	0.42	0.20	n/a	n/a	n/a
9-7/8	(251)	0.71	0.66	0.59	0.86	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.74	0.48	0.22	0.59	n/a	n/a
10	(254)	0.71	0.66	0.60	0.87	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.76	0.49	0.23	0.59	n/a	n/a
11	(279)	0.73	0.67	0.60	0.93	0.77	0.59	0.60	0.57	0.54	0.44	0.28	0.13	0.87	0.57	0.26	0.62	n/a	n/a
12	(305)	0.75	0.69	0.61	1.00	0.82	0.61	0.60	0.58	0.55	0.50	0.32	0.15	1.00	0.65	0.30	0.65	n/a	n/a
12-1/2	(318)	0.76	0.70	0.62		0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16		0.69	0.32	0.66	0.57	n/a
14	(356)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
16	(406)	0.83	0.75	0.65		1.00	0.71	0.64	0.60	0.56	0.77	0.50	0.23		1.00	0.46	0.75	0.65	n/a
18	(457)	0.87	0.79	0.67			0.76	0.66	0.62	0.57	0.91	0.59	0.28			0.55	0.79	0.69	n/a
19-1/2	(495)	0.91	0.81	0.69			0.80	0.67	0.63	0.58	1.00	0.67	0.31			0.62	0.82	0.71	0.55
20	(508)	0.92	0.82	0.69			0.82	0.67	0.63	0.58		0.70	0.32			0.65	0.84	0.72	0.56
22	(559)	0.96	0.85	0.71			0.87	0.69	0.64	0.59		0.80	0.37			0.75	0.88	0.76	0.59
24	(610)	1.00	0.88	0.73			0.93	0.71	0.66	0.59		0.91	0.43			0.85	0.92	0.79	0.61
26	(660)		0.91	0.75			0.99	0.73	0.67	0.60		1.00	0.48			0.96	0.95	0.82	0.64
28	(711)		0.94	0.77			1.00	0.74	0.68	0.61			0.54			1.00	0.99	0.86	0.66
30	(762)		0.98	0.79				0.76	0.70	0.62			0.59				1.00	0.89	0.69
36	(914)		1.00	0.84				0.81	0.74	0.64			0.78					0.97	0.75
> 48	(1219)			0.96				0.92	0.81	0.69			1.00					1.00	0.87

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

Table 18 - Load adjustment factors for #8 rebar in uncracked concrete[1,2,3]

#8 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.03	0.01	n/a	n/a	n/a
5	(127)	0.59	0.57	0.54	0.32	0.22	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.61	0.58	0.55	0.34	0.24	0.14	0.55	0.53	0.52	0.14	0.09	0.04	0.29	0.19	0.09	n/a	n/a	n/a
7	(178)	0.63	0.60	0.56	0.37	0.26	0.15	0.55	0.54	0.52	0.18	0.12	0.06	0.36	0.23	0.11	n/a	n/a	n/a
8	(203)	0.65	0.61	0.57	0.40	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.40	0.28	0.14	n/a	n/a	n/a
9	(229)	0.67	0.63	0.58	0.43	0.30	0.17	0.57	0.55	0.53	0.26	0.17	0.08	0.43	0.30	0.17	n/a	n/a	n/a
10	(254)	0.68	0.64	0.58	0.46	0.32	0.19	0.58	0.56	0.54	0.31	0.20	0.10	0.46	0.32	0.19	n/a	n/a	n/a
11	(279)	0.70	0.65	0.59	0.49	0.34	0.20	0.58	0.56	0.54	0.35	0.23	0.11	0.49	0.34	0.20	n/a	n/a	n/a
11-1/4	(286)	0.71	0.66	0.59	0.50	0.34	0.20	0.59	0.56	0.54	0.37	0.24	0.12	0.50	0.34	0.20	0.58	n/a	n/a
12	(305)	0.72	0.67	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.40	0.26	0.13	0.52	0.36	0.21	0.60	n/a	n/a
13	(330)	0.74	0.68	0.61	0.55	0.38	0.22	0.60	0.57	0.55	0.46	0.30	0.14	0.55	0.38	0.22	0.63	n/a	n/a
14	(356)	0.76	0.69	0.62	0.59	0.41	0.24	0.61	0.58	0.55	0.51	0.33	0.16	0.59	0.41	0.24	0.65	n/a	n/a
14-1/4	(362)	0.76	0.70	0.62	0.60	0.42	0.24	0.61	0.58	0.55	0.52	0.34	0.16	0.60	0.42	0.24	0.66	0.57	n/a
16	(406)	0.79	0.72	0.63	0.67	0.47	0.27	0.62	0.59	0.56	0.62	0.40	0.20	0.67	0.47	0.27	0.70	0.60	n/a
18	(457)	0.83	0.75	0.65	0.76	0.53	0.31	0.64	0.60	0.56	0.74	0.48	0.23	0.76	0.53	0.31	0.74	0.64	n/a
20	(508)	0.87	0.78	0.67	0.84	0.58	0.34	0.65	0.61	0.57	0.87	0.56	0.27	0.84	0.58	0.34	0.78	0.67	n/a
22	(559)	0.90	0.81	0.68	0.93	0.64	0.38	0.67	0.63	0.58	1.00	0.65	0.32	0.93	0.64	0.38	0.82	0.71	n/a
22-1/4	(565)	0.91	0.81	0.69	0.94	0.65	0.38	0.67	0.63	0.58		0.66	0.32	0.94	0.65	0.38	0.82	0.71	0.56
24	(610)	0.94	0.83	0.70	1.00	0.70	0.41	0.68	0.64	0.58		0.74	0.36	1.00	0.70	0.41	0.85	0.74	0.58
26	(660)	0.98	0.86	0.72		0.76	0.45	0.70	0.65	0.59		0.84	0.41		0.76	0.45	0.89	0.77	0.60
28	(711)	1.00	0.89	0.73		0.82	0.48	0.71	0.66	0.60		0.94	0.45		0.82	0.48	0.92	0.80	0.63
30	(762)		0.92	0.75		0.88	0.51	0.73	0.67	0.61		1.00	0.50		0.88	0.51	0.95	0.83	0.65
36	(914)		1.00	0.80		1.00	0.62	0.77	0.70	0.63			0.66		1.00	0.62	1.00	0.91	0.71
> 48	(1219)			0.90			0.82	0.86	0.77	0.67			1.00			0.82		1.00	0.82

Table 19 - Load adjustment factors for #8 rebar in cracked concrete[1,2,3]

#8 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in. (mm)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)	9 (229)	12 (305)	20 (508)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.42	0.40	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.03	0.01	n/a	n/a	n/a
5	(127)	0.59	0.57	0.54	0.55	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.61	0.58	0.55	0.60	0.53	0.46	0.55	0.53	0.52	0.14	0.09	0.04	0.29	0.19	0.09	n/a	n/a	n/a
7	(178)	0.63	0.60	0.56	0.65	0.57	0.47	0.55	0.54	0.52	0.18	0.12	0.05	0.36	0.24	0.11	n/a	n/a	n/a
8	(203)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
9	(229)	0.67	0.63	0.58	0.75	0.64	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.53	0.34	0.16	n/a	n/a	n/a
10	(254)	0.68	0.64	0.58	0.80	0.67	0.53	0.58	0.56	0.53	0.31	0.20	0.09	0.62	0.40	0.19	n/a	n/a	n/a
11	(279)	0.70	0.65	0.59	0.85	0.71	0.55	0.58	0.56	0.54	0.36	0.23	0.11	0.72	0.46	0.22	n/a	n/a	n/a
11-1/4	(286)	0.71	0.66	0.59	0.87	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.74	0.48	0.22	0.59	n/a	n/a
12	(305)	0.72	0.67	0.60	0.91	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
13	(330)	0.74	0.68	0.61	0.96	0.79	0.59	0.60	0.57	0.54	0.46	0.30	0.14	0.92	0.60	0.28	0.63	n/a	n/a
14	(356)	0.76	0.69	0.62	1.00	0.83	0.62	0.61	0.58	0.55	0.51	0.33	0.16	1.00	0.67	0.31	0.65	n/a	n/a
14-1/4	(362)	0.76	0.70	0.62		0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16		0.69	0.32	0.66	0.57	n/a
16	(406)	0.79	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
18	(457)	0.83	0.75	0.65		1.00	0.70	0.64	0.60	0.56	0.75	0.49	0.23		0.97	0.45	0.74	0.64	n/a
20	(508)	0.87	0.78	0.67			0.75	0.65	0.61	0.57	0.88	0.57	0.26		1.00	0.53	0.78	0.68	n/a
22	(559)	0.90	0.81	0.68			0.80	0.67	0.63	0.58	1.00	0.66	0.31			0.61	0.82	0.71	n/a
22-1/4	(565)	0.91	0.81	0.69			0.80	0.67	0.63	0.58		0.67	0.31			0.62	0.82	0.71	0.55
24	(610)	0.94	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
26	(660)	0.98	0.86	0.72			0.90	0.70	0.65	0.59		0.84	0.39			0.78	0.89	0.77	0.60
28	(711)	1.00	0.89	0.73			0.95	0.71	0.66	0.60		0.94	0.44			0.88	0.92	0.80	0.62
30	(762)		0.92	0.75			1.00	0.73	0.67	0.60		1.00	0.49			0.97	0.96	0.83	0.64
36	(914)		1.00	0.80				0.77	0.71	0.62			0.64			1.00	1.00	0.91	0.70
> 48	(1219)			0.90				0.87	0.77	0.66			0.98					1.00	0.81

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 20 - Load adjustment factors for #9 rebar in uncracked concrete[1,2,3]

#9 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{el}	in. (mm)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-5/8	(143)	0.59	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.60	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
7	(178)	0.61	0.59	0.55	0.36	0.25	0.14	0.55	0.54	0.52	0.15	0.10	0.05	0.30	0.20	0.09	n/a	n/a	n/a
8	(203)	0.63	0.60	0.56	0.38	0.27	0.15	0.55	0.54	0.52	0.18	0.12	0.06	0.37	0.24	0.11	n/a	n/a	n/a
9	(229)	0.65	0.61	0.57	0.41	0.28	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.41	0.28	0.13	n/a	n/a	n/a
10	(254)	0.66	0.62	0.57	0.44	0.30	0.17	0.57	0.55	0.53	0.26	0.17	0.08	0.44	0.30	0.16	n/a	n/a	n/a
11	(279)	0.68	0.64	0.58	0.46	0.32	0.18	0.57	0.56	0.53	0.30	0.19	0.09	0.46	0.32	0.18	n/a	n/a	n/a
12	(305)	0.70	0.65	0.59	0.49	0.34	0.20	0.58	0.56	0.54	0.34	0.22	0.10	0.49	0.34	0.20	n/a	n/a	n/a
12-7/8	(327)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.38	0.24	0.11	0.52	0.36	0.21	0.59	n/a	n/a
13	(330)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.57	0.54	0.38	0.25	0.12	0.52	0.36	0.21	0.59	n/a	n/a
14	(356)	0.73	0.67	0.60	0.55	0.38	0.22	0.59	0.57	0.54	0.43	0.28	0.13	0.55	0.38	0.22	0.61	n/a	n/a
16	(406)	0.76	0.70	0.62	0.62	0.43	0.25	0.61	0.58	0.55	0.52	0.34	0.16	0.62	0.43	0.25	0.66	n/a	n/a
16-1/4	(413)	0.77	0.70	0.62	0.63	0.43	0.25	0.61	0.58	0.55	0.53	0.35	0.16	0.63	0.43	0.25	0.66	0.57	n/a
18	(457)	0.80	0.72	0.63	0.69	0.48	0.28	0.62	0.59	0.55	0.62	0.40	0.19	0.69	0.48	0.28	0.70	0.60	n/a
20	(508)	0.83	0.75	0.65	0.77	0.54	0.31	0.63	0.60	0.56	0.73	0.47	0.22	0.77	0.54	0.31	0.73	0.64	n/a
22	(559)	0.86	0.77	0.66	0.85	0.59	0.34	0.65	0.61	0.57	0.84	0.55	0.25	0.85	0.59	0.34	0.77	0.67	n/a
24	(610)	0.89	0.80	0.68	0.93	0.64	0.37	0.66	0.62	0.57	0.96	0.62	0.29	0.93	0.64	0.37	0.80	0.70	n/a
25-1/4	(641)	0.91	0.81	0.69	0.97	0.68	0.39	0.67	0.63	0.58	1.00	0.67	0.31	0.97	0.68	0.39	0.83	0.71	0.55
26	(660)	0.93	0.82	0.69	1.00	0.70	0.40	0.68	0.63	0.58		0.70	0.33	1.00	0.70	0.40	0.84	0.73	0.56
28	(711)	0.96	0.85	0.71		0.75	0.43	0.69	0.64	0.59		0.78	0.36		0.75	0.43	0.87	0.75	0.58
30	(762)	0.99	0.87	0.72		0.80	0.46	0.70	0.65	0.59		0.87	0.40		0.80	0.46	0.90	0.78	0.60
36	(914)	1.00	0.94	0.77		0.96	0.55	0.74	0.68	0.61		1.00	0.53		0.96	0.55	0.99	0.85	0.66
> 48	(1219)		1.00	0.86		1.00	0.74	0.82	0.74	0.65			0.82		1.00	0.74	1.00	0.99	0.76

Table 21 - Load adjustment factors for #9 rebar in cracked concrete[1,2,3]

#9 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{el}	in. (mm)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)	10-1/8 (257)	13-1/2 (343)	22-1/2 (572)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.41	0.39	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-5/8	(143)	0.59	0.57	0.54	0.56	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
6	(152)	0.60	0.57	0.54	0.57	0.51	0.44	0.54	0.53	0.52	0.12	0.08	0.04	0.24	0.16	0.07	n/a	n/a	n/a
7	(178)	0.61	0.59	0.55	0.61	0.54	0.46	0.55	0.54	0.52	0.15	0.10	0.05	0.30	0.20	0.09	n/a	n/a	n/a
8	(203)	0.63	0.60	0.56	0.65	0.57	0.48	0.55	0.54	0.52	0.19	0.12	0.06	0.37	0.24	0.11	n/a	n/a	n/a
9	(229)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
10	(254)	0.66	0.62	0.57	0.74	0.63	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.52	0.34	0.16	n/a	n/a	n/a
11	(279)	0.68	0.64	0.58	0.79	0.67	0.53	0.57	0.56	0.53	0.30	0.19	0.09	0.60	0.39	0.18	n/a	n/a	n/a
12	(305)	0.70	0.65	0.59	0.84	0.70	0.55	0.58	0.56	0.54	0.34	0.22	0.10	0.68	0.44	0.21	n/a	n/a	n/a
12-7/8	(327)	0.71	0.66	0.60	0.88	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.76	0.49	0.23	0.59	n/a	n/a
13	(330)	0.71	0.66	0.60	0.89	0.73	0.56	0.59	0.57	0.54	0.39	0.25	0.12	0.77	0.50	0.23	0.59	n/a	n/a
14	(356)	0.73	0.67	0.60	0.94	0.77	0.58	0.60	0.57	0.54	0.43	0.28	0.13	0.86	0.56	0.26	0.62	n/a	n/a
16	(406)	0.76	0.70	0.62	1.00	0.84	0.62	0.61	0.58	0.55	0.53	0.34	0.16	1.00	0.68	0.32	0.66	n/a	n/a
16-1/4	(413)	0.77	0.70	0.62	1.00	0.85	0.63	0.61	0.58	0.55	0.54	0.35	0.16	1.00	0.70	0.32	0.66	0.58	n/a
18	(457)	0.80	0.72	0.63	1.00	0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19	1.00	0.82	0.38	0.70	0.61	n/a
20	(508)	0.83	0.75	0.65	1.00	0.99	0.70	0.64	0.60	0.56	0.73	0.48	0.22	1.00	0.95	0.44	0.74	0.64	n/a
22	(559)	0.86	0.77	0.66	1.00	1.00	0.74	0.65	0.61	0.57	0.85	0.55	0.26	1.00	1.00	0.51	0.77	0.67	n/a
24	(610)	0.89	0.80	0.68	1.00	1.00	0.78	0.66	0.62	0.57	0.97	0.63	0.29	1.00	1.00	0.58	0.81	0.70	n/a
25-1/4	(641)	0.91	0.81	0.69	1.00	1.00	0.81	0.67	0.63	0.58	1.00	0.68	0.31	1.00	1.00	0.63	0.83	0.72	0.56
26	(660)	0.93	0.82	0.69	1.00	1.00	0.82	0.68	0.63	0.58	1.00	0.71	0.33	1.00	1.00	0.66	0.84	0.73	0.56
28	(711)	0.96	0.85	0.71	1.00	1.00	0.87	0.69	0.64	0.59	1.00	0.79	0.37	1.00	1.00	0.73	0.87	0.76	0.58
30	(762)	0.99	0.87	0.72	1.00	1.00	0.91	0.70	0.65	0.59	1.00	0.88	0.41	1.00	1.00	0.82	0.90	0.78	0.61
36	(914)	1.00	0.94	0.77	1.00	1.00	1.00	0.74	0.68	0.61	1.00	1.00	0.54	1.00	1.00	1.00	0.99	0.86	0.66
> 48	(1219)	1.00	1.00	0.86	1.00	1.00	1.00	0.83	0.74	0.65	1.00	1.00	0.82	1.00	1.00	1.00	1.00	0.99	0.77

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

Table 22 - Load adjustment factors for #10 rebar in uncracked concrete[1,2,3]

#10 uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25
	(mm)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.24	0.17	0.09	n/a	n/a	n/a	0.02	0.01	0.00	0.03	0.02	0.01	n/a	n/a	n/a
6-1/4	(159)	0.59	0.57	0.54	0.33	0.23	0.13	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
7	(178)	0.60	0.58	0.55	0.35	0.24	0.14	0.54	0.53	0.52	0.13	0.08	0.04	0.26	0.17	0.08	n/a	n/a	n/a
8	(203)	0.62	0.59	0.55	0.37	0.26	0.15	0.55	0.54	0.52	0.16	0.10	0.05	0.31	0.20	0.10	n/a	n/a	n/a
9	(229)	0.63	0.60	0.56	0.39	0.27	0.15	0.55	0.54	0.52	0.19	0.12	0.06	0.38	0.24	0.11	n/a	n/a	n/a
10	(254)	0.65	0.61	0.57	0.42	0.29	0.16	0.56	0.55	0.53	0.22	0.14	0.07	0.42	0.29	0.13	n/a	n/a	n/a
11	(279)	0.66	0.62	0.57	0.44	0.31	0.17	0.57	0.55	0.53	0.25	0.16	0.08	0.44	0.31	0.15	n/a	n/a	n/a
12	(305)	0.68	0.63	0.58	0.47	0.32	0.18	0.57	0.55	0.53	0.29	0.19	0.09	0.47	0.32	0.17	n/a	n/a	n/a
13	(330)	0.69	0.64	0.59	0.49	0.34	0.19	0.58	0.56	0.54	0.33	0.21	0.10	0.49	0.34	0.19	n/a	n/a	n/a
14	(356)	0.71	0.66	0.59	0.52	0.36	0.20	0.59	0.56	0.54	0.36	0.24	0.11	0.52	0.36	0.20	n/a	n/a	n/a
14-1/4	(362)	0.71	0.66	0.60	0.52	0.36	0.21	0.59	0.56	0.54	0.37	0.24	0.11	0.52	0.36	0.21	0.59	n/a	n/a
15	(381)	0.72	0.67	0.60	0.54	0.38	0.21	0.59	0.57	0.54	0.40	0.26	0.12	0.54	0.38	0.21	0.60	n/a	n/a
16	(406)	0.74	0.68	0.61	0.57	0.40	0.22	0.60	0.57	0.54	0.45	0.29	0.13	0.57	0.40	0.22	0.62	n/a	n/a
17	(432)	0.75	0.69	0.61	0.60	0.42	0.24	0.60	0.58	0.55	0.49	0.32	0.15	0.60	0.42	0.24	0.64	n/a	n/a
18	(457)	0.77	0.70	0.62	0.64	0.44	0.25	0.61	0.58	0.55	0.53	0.35	0.16	0.64	0.44	0.25	0.66	0.57	n/a
20	(508)	0.80	0.72	0.63	0.71	0.49	0.28	0.62	0.59	0.55	0.62	0.40	0.19	0.71	0.49	0.28	0.70	0.60	n/a
22	(559)	0.83	0.74	0.65	0.78	0.54	0.31	0.63	0.60	0.56	0.72	0.47	0.22	0.78	0.54	0.31	0.73	0.63	n/a
24	(610)	0.86	0.77	0.66	0.85	0.59	0.33	0.65	0.61	0.57	0.82	0.53	0.25	0.85	0.59	0.33	0.76	0.66	n/a
26	(660)	0.89	0.79	0.67	0.92	0.64	0.36	0.66	0.62	0.57	0.92	0.60	0.28	0.92	0.64	0.36	0.79	0.69	n/a
28	(711)	0.91	0.81	0.69	0.99	0.69	0.39	0.67	0.63	0.58	1.00	0.67	0.31	0.99	0.69	0.39	0.82	0.71	0.55
30	(762)	0.94	0.83	0.70	1.00	0.74	0.42	0.68	0.64	0.58		0.74	0.35	1.00	0.74	0.42	0.85	0.74	0.57
36	(914)	1.00	0.90	0.74		0.88	0.50	0.72	0.66	0.60		0.98	0.45		0.88	0.50	0.94	0.81	0.63
> 48	(1219)		1.00	0.82		1.00	0.67	0.79	0.72	0.63		1.00	0.70		1.00	0.67	1.00	0.94	0.72

3.2.4

Table 23 - Load adjustment factors for #10 rebar in cracked concrete[1,2,3]

#10 cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef}	in.	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25	11-1/4	15	25
	(mm)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)	(286)	(381)	(635)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.40	0.39	0.37	n/a	n/a	n/a	0.02	0.01	0.00	0.03	0.02	0.01	n/a	n/a	n/a
6-1/4	(159)	0.59	0.57	0.54	0.56	0.50	0.44	0.54	0.53	0.52	0.11	0.07	0.03	0.22	0.14	0.07	n/a	n/a	n/a
7	(178)	0.60	0.58	0.55	0.58	0.52	0.45	0.54	0.53	0.52	0.13	0.08	0.04	0.26	0.17	0.08	n/a	n/a	n/a
8	(203)	0.62	0.59	0.55	0.62	0.55	0.46	0.55	0.54	0.52	0.16	0.10	0.05	0.32	0.21	0.10	n/a	n/a	n/a
9	(229)	0.63	0.60	0.56	0.66	0.57	0.48	0.55	0.54	0.52	0.19	0.12	0.06	0.38	0.25	0.11	n/a	n/a	n/a
10	(254)	0.65	0.61	0.57	0.70	0.60	0.49	0.56	0.55	0.53	0.22	0.14	0.07	0.44	0.29	0.13	n/a	n/a	n/a
11	(279)	0.66	0.62	0.57	0.74	0.63	0.51	0.57	0.55	0.53	0.26	0.17	0.08	0.51	0.33	0.15	n/a	n/a	n/a
12	(305)	0.68	0.63	0.58	0.78	0.66	0.53	0.57	0.55	0.53	0.29	0.19	0.09	0.58	0.38	0.18	n/a	n/a	n/a
13	(330)	0.69	0.64	0.59	0.82	0.69	0.54	0.58	0.56	0.54	0.33	0.21	0.10	0.66	0.43	0.20	n/a	n/a	n/a
14	(356)	0.71	0.66	0.59	0.87	0.72	0.56	0.59	0.56	0.54	0.37	0.24	0.11	0.73	0.48	0.22	n/a	n/a	n/a
14-1/4	(362)	0.71	0.66	0.60	0.88	0.73	0.56	0.59	0.57	0.54	0.38	0.25	0.11	0.75	0.49	0.23	0.59	n/a	n/a
15	(381)	0.72	0.67	0.60	0.91	0.75	0.57	0.59	0.57	0.54	0.41	0.26	0.12	0.82	0.53	0.25	0.61	n/a	n/a
16	(406)	0.74	0.68	0.61	0.96	0.78	0.59	0.60	0.57	0.54	0.45	0.29	0.14	0.90	0.58	0.27	0.63	n/a	n/a
17	(432)	0.75	0.69	0.61	1.00	0.81	0.61	0.60	0.58	0.55	0.49	0.32	0.15	0.98	0.64	0.30	0.64	n/a	n/a
18	(457)	0.77	0.70	0.62		0.85	0.62	0.61	0.58	0.55	0.54	0.35	0.16	1.00	0.70	0.32	0.66	0.57	n/a
20	(508)	0.80	0.72	0.63		0.91	0.66	0.62	0.59	0.55	0.63	0.41	0.19		0.82	0.38	0.70	0.61	n/a
22	(559)	0.83	0.74	0.65		0.98	0.69	0.63	0.60	0.56	0.72	0.47	0.22		0.94	0.44	0.73	0.63	n/a
24	(610)	0.86	0.77	0.66		1.00	0.73	0.65	0.61	0.57	0.82	0.54	0.25		1.00	0.50	0.77	0.66	n/a
26	(660)	0.89	0.79	0.67			0.77	0.66	0.62	0.57	0.93	0.60	0.28			0.56	0.80	0.69	n/a
28	(711)	0.91	0.81	0.69			0.81	0.67	0.63	0.58	1.00	0.68	0.31			0.63	0.83	0.72	0.55
30	(762)	0.94	0.83	0.70			0.85	0.68	0.64	0.58		0.75	0.35			0.70	0.86	0.74	0.57
36	(914)	1.00	0.90	0.74			0.97	0.72	0.66	0.60		0.98	0.46			0.91	0.94	0.81	0.63
> 48	(1219)		1.00	0.82			1.00	0.79	0.72	0.63		1.00	0.70			1.00	1.00	0.94	0.73

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318-14 Chapter 17.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

3.2.4.3.4 HIT-RE 500 V3 adhesive with HAS/HIT-V threaded rod


Hilti HAS threaded rod


Hilti HIT-V threaded rod

Figure 4 - Hilti HAS/HIT-V threaded rod installation conditions

Cracked or uncracked concrete	Permissible drilling methods	Permissible concrete conditions
Cracked and uncracked concrete	Hammer drilling with carbide-tipped drill bit	Dry concrete; Water-saturated concrete; Water-filled holes; Submerged (underwater)
	Hilti TE-CD or TE-YD hollow drill bit and VC 20/40 Vacuum; Diamond core drill bit with Hilti TE-YRT roughening tool	Dry concrete; Water-saturated concrete
Uncracked concrete	Diamond core drill bit	Dry concrete; Water-saturated concrete

Table 24 - Hilti HAS/HIT-V threaded rod installation specifications

Setting information		Symbol	Units	Nominal rod diameter, d						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Nominal bit diameter		d_o	in.	7/16	9/16	3/4	7/8	1	1-1/8	1-3/8
Effective embedment	minimum	$h_{ef,min}$	in. (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
	maximum	$h_{ef,max}$	in. (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Diameter of fixture hole	through-set		in.	1/2	5/8	13/16[1]	15/16[1]	1-1/8[1]	1-1/4[1]	1-1/2[1]
	preset		in.	7/16	9/16	11/16	13/16	15/16	1-1/8	1-3/8
Installation torque		T_{inst}	ft-lb (Nm)	15 (20)	30 (40)	60 (80)	100 (136)	125 (169)	150 (203)	200 (271)
Minimum concrete thickness		h_{min}	in. (mm)	h_{ef}+1-1/4 (h_{ef}+30)		$h_{ef}+2d_o$				
Minimum edge distance[2]		c_{min}	in. (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)
Minimum anchor spacing		s_{min}	in. (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-3/4 (95)	4-3/8 (111)	5 (127)	5-5/8 (143)

1 Install using (2) washers. See Figure 5.
2 Edge distance of 1-3/4-inch (44mm) is permitted provided the installation torque is reduced to 0.30 T_{inst} for 5d < s < 16-in. and to $0.5T_{inst}$ for s >16-in.

Figure 4 - Hilti HAS/HIT-V threaded rods

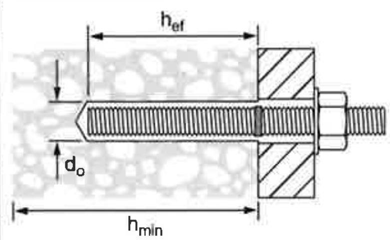


Figure 5 - Installation with (2) washers

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 25 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8	2-3/8 (60)	2,855 (12.7)	3,125 (13.9)	3,610 (16.1)	4,425 (19.7)	3,075 (13.7)	3,370 (15.0)	3,890 (17.3)	4,765 (21.2)
	3-3/8 (86)	4,835 (21.5)	5,300 (23.6)	6,115 (27.2)	7,490 (33.3)	10,415 (46.3)	11,410 (50.8)	13,175 (58.6)	16,135 (71.8)
	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	9,225 (41.0)	10,210 (45.4)	16,035 (71.3)	17,570 (78.2)	19,865 (88.4)	21,985 (97.8)
	7-1/2 (191)	13,670 (60.8)	14,305 (63.6)	15,375 (68.4)	17,015 (75.7)	29,440 (131.0)	30,815 (137.1)	33,110 (147.3)	36,645 (163.0)
1/2	2-3/4 (70)	3,555 (15.8)	3,895 (17.3)	4,500 (20.0)	5,510 (24.5)	7,660 (34.1)	8,395 (37.3)	9,690 (43.1)	11,870 (52.8)
	4-1/2 (114)	7,445 (33.1)	8,155 (36.3)	9,420 (41.9)	11,535 (51.3)	16,035 (71.3)	17,570 (78.2)	20,285 (90.2)	24,845 (110.5)
	6 (152)	11,465 (51.0)	12,560 (55.9)	14,500 (64.5)	17,535 (78.0)	24,690 (109.8)	27,045 (120.3)	31,230 (138.9)	37,775 (168.0)
	10 (254)	23,485 (104.5)	24,580 (109.3)	26,410 (117.5)	29,230 (130.0)	50,580 (225.0)	52,940 (235.5)	56,885 (253.0)	62,955 (280.0)
5/8[10]	3-1/8 (79)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	16,120 (71.7)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	34,720 (154.4)
	7-1/2 (191)	16,020 (71.3)	17,550 (78.1)	20,265 (90.1)	24,820 (110.4)	34,505 (153.5)	37,800 (168.1)	43,650 (194.2)	53,455 (237.8)
	12-1/2 (318)	34,470 (153.3)	36,900 (164.1)	39,655 (176.4)	43,885 (195.2)	74,245 (330.3)	79,480 (353.5)	85,405 (379.9)	94,520 (420.4)
3/4[10]	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	15 (381)	45,315 (201.6)	49,640 (220.8)	55,035 (244.8)	60,905 (270.9)	97,600 (434.1)	106,915 (475.6)	118,535 (527.3)	131,180 (583.5)
7/8[10]	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	41,115 (182.9)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	88,550 (393.9)
	17-1/2 (445)	57,100 (254.0)	62,550 (278.2)	71,740 (319.1)	79,395 (353.2)	122,990 (547.1)	134,730 (599.3)	154,520 (687.3)	171,005 (760.7)
1[10]	4 (102)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	50,230 (223.4)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	108,190 (481.3)
	20 (508)	69,765 (310.3)	76,425 (340.0)	88,245 (392.5)	99,635 (443.2)	150,265 (668.4)	164,605 (732.2)	190,070 (845.5)	214,595 (954.6)
1-1/4[10]	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	70,200 (312.3)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	151,200 (672.6)
	25 (635)	97,500 (433.7)	106,805 (475.1)	123,330 (548.6)	142,175 (632.4)	210,000 (934.1)	230,045 (1023.3)	265,630 (1181.6)	306,220 (1362.1)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in Tables 30-41 as necessary to the above values. Compare to the steel values in Table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55.
Diamond core drilling is not permitted for water-filled or underwater (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1 1/4" diameter anchors for dry and water-saturated concrete conditions. See Table 27.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

3.2.4

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 26 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8	2-3/8 (60)	2,020 (9.0)	2,215 (9.9)	2,500 (11.1)	2,655 (11.8)	2,180 (9.7)	2,385 (10.6)	2,690 (12.0)	2,860 (12.7)
	3-3/8 (86)	3,310 (14.7)	3,400 (15.1)	3,550 (15.8)	3,770 (16.8)	7,125 (31.7)	7,325 (32.6)	7,645 (34.0)	8,125 (36.1)
	4-1/2 (114)	4,410 (19.6)	4,535 (20.2)	4,735 (21.1)	5,030 (22.4)	9,500 (42.3)	9,765 (43.4)	10,195 (45.3)	10,835 (48.2)
	7-1/2 (191)	7,350 (32.7)	7,555 (33.6)	7,890 (35.1)	8,385 (37.3)	15,835 (70.4)	16,275 (72.4)	16,990 (75.6)	18,055 (80.3)
1/2	2-3/4 (70)	2,520 (11.2)	2,760 (12.3)	3,185 (14.2)	3,905 (17.4)	5,425 (24.1)	5,945 (26.4)	6,865 (30.5)	8,405 (37.4)
	4-1/2 (114)	5,275 (23.5)	5,780 (25.7)	6,260 (27.8)	6,655 (29.6)	11,360 (50.5)	12,445 (55.4)	13,485 (60.0)	14,330 (63.7)
	6 (152)	7,780 (34.6)	7,995 (35.6)	8,350 (37.1)	8,870 (39.5)	16,755 (74.5)	17,220 (76.6)	17,980 (80.0)	19,110 (85.0)
	10 (254)	12,965 (57.7)	13,325 (59.3)	13,915 (61.9)	14,785 (65.8)	27,930 (124.2)	28,705 (127.7)	29,970 (133.3)	31,850 (141.7)
5/8[10]	3-1/8 (79)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	5-5/8 (143)	7,370 (32.8)	8,075 (35.9)	9,325 (41.5)	10,315 (45.9)	15,875 (70.6)	17,390 (77.4)	20,080 (89.3)	22,215 (98.8)
	7-1/2 (191)	11,350 (50.5)	12,395 (55.1)	12,940 (57.6)	13,755 (61.2)	24,440 (108.7)	26,695 (118.7)	27,875 (124.0)	29,620 (131.8)
	12-1/2 (318)	20,100 (89.4)	20,660 (91.9)	21,570 (95.9)	22,920 (102.0)	43,295 (192.6)	44,495 (197.9)	46,460 (206.7)	49,370 (219.6)
3/4[10]	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	14,735 (65.5)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	31,740 (141.2)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,490 (82.2)	19,650 (87.4)	32,130 (142.9)	35,195 (156.6)	39,820 (177.1)	42,320 (188.2)
	15 (381)	28,715 (127.7)	29,510 (131.3)	30,815 (137.1)	32,745 (145.7)	61,850 (275.1)	63,565 (282.7)	66,370 (295.2)	70,530 (313.7)
7/8[10]	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,605 (24.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	12,070 (53.7)
	7-7/8 (200)	12,210 (54.3)	13,375 (59.5)	15,445 (68.7)	18,915 (84.1)	26,300 (117.0)	28,810 (128.2)	33,265 (148.0)	40,740 (181.2)
	10-1/2 (267)	18,800 (83.6)	20,590 (91.6)	23,780 (105.8)	26,530 (118.0)	40,490 (180.1)	44,355 (197.3)	51,215 (227.8)	57,140 (254.2)
	17-1/2 (445)	38,775 (172.5)	39,850 (177.3)	41,605 (185.1)	44,215 (196.7)	83,510 (371.5)	85,825 (381.8)	89,610 (398.6)	95,230 (423.6)
1[10]	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,920 (66.4)	16,340 (72.7)	18,870 (83.9)	23,110 (102.8)	32,130 (142.9)	35,195 (156.6)	40,640 (180.8)	49,775 (221.4)
	12 (305)	22,965 (102.2)	25,160 (111.9)	29,050 (129.2)	34,650 (154.1)	49,465 (220.0)	54,190 (241.0)	62,570 (278.3)	74,630 (332.0)
	20 (508)	49,415 (219.8)	52,045 (231.5)	54,340 (241.7)	57,750 (256.9)	106,435 (473.4)	112,100 (498.6)	117,045 (520.6)	124,385 (553.3)
1-1/4[10]	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	26,370 (117.3)	32,295 (143.7)	44,905 (199.7)	49,190 (218.8)	56,800 (252.7)	69,565 (309.4)
	15 (381)	32,095 (142.8)	35,160 (156.4)	40,600 (180.6)	49,725 (221.2)	69,135 (307.5)	75,730 (336.9)	87,445 (389.0)	107,100 (476.4)
	25 (635)	69,060 (307.2)	75,655 (336.5)	80,800 (359.4)	85,865 (381.9)	148,750 (661.7)	162,945 (724.8)	174,030 (774.1)	184,945 (822.7)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete conditions except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8" 3/4", 7/8", 1", and 1 1/4" diameter anchors for dry and water-saturated concrete conditions. See Table 28
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} indicated below.
See section 3.1.8.7 for additional information on seismic applications.
3/8-in. diameter - α_{seis} = 0.69
1/2-in. diameter - α_{seis} = 0.70
5/8-in. diameter - α_{seis} = 0.71
3/4-in. diameter and larger - α_{seis} = 0.75

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 27 - Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
5/8	3-1/8 (79)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	5-5/8 (143)	10,405 (46.3)	11,400 (50.7)	13,165 (58.6)	15,865 (70.6)	22,415 (99.7)	24,550 (109.2)	28,350 (126.1)	34,170 (152.0)
	7-1/2 (191)	16,020 (71.3)	17,550 (78.1)	20,265 (90.1)	21,155 (94.1)	34,505 (153.5)	37,800 (168.1)	43,650 (194.2)	45,565 (202.7)
	12-1/2 (318)	34,470 (153.3)	35,255 (156.8)	35,255 (156.8)	35,255 (156.8)	74,245 (330.3)	75,940 (337.8)	75,940 (337.8)	75,940 (337.8)
3/4	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	29,360 (130.6)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	63,235 (281.3)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	36,700 (163.2)	36,700 (163.2)	63,395 (282.0)	69,445 (308.9)	79,045 (351.6)	79,045 (351.6)
7/8	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	21,805 (97.0)	26,705 (118.8)	37,125 (165.1)	40,670 (180.9)	46,960 (208.9)	57,515 (255.8)
	10-1/2 (267)	26,540 (118.1)	29,070 (129.3)	33,570 (149.3)	38,275 (170.3)	57,160 (254.3)	62,615 (278.5)	72,300 (321.6)	82,435 (366.7)
	17-1/2 (445)	57,100 (254.0)	62,550 (278.2)	63,790 (283.8)	63,790 (283.8)	122,990 (547.1)	134,730 (599.3)	137,390 (611.1)	137,390 (611.1)
1	4 (102)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	9 (229)	21,060 (93.7)	23,070 (102.6)	26,640 (118.5)	32,625 (145.1)	45,360 (201.8)	49,690 (221.0)	57,375 (255.2)	70,270 (312.6)
	12 (305)	32,425 (144.2)	35,520 (158.0)	41,015 (182.4)	48,030 (213.6)	69,835 (310.6)	76,500 (340.3)	88,335 (392.9)	103,445 (460.1)
	20 (508)	69,765 (310.3)	76,425 (340.0)	80,050 (356.1)	80,050 (356.1)	150,265 (668.4)	164,605 (732.2)	172,410 (766.9)	172,410 (766.9)
1-1/4	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
	11-1/4 (286)	29,430 (130.9)	32,240 (143.4)	37,230 (165.6)	45,595 (202.8)	63,395 (282.0)	69,445 (308.9)	80,185 (356.7)	98,205 (436.8)
	15 (381)	45,315 (201.6)	49,640 (220.8)	57,320 (255.0)	68,535 (304.9)	97,600 (434.1)	106,915 (475.6)	123,455 (549.2)	147,615 (656.6)
	25 (635)	97,500 (433.7)	106,805 (475.1)	114,225 (508.1)	114,225 (508.1)	210,000 (934.1)	230,045 (1023.3)	246,025 (1094.4)	246,025 (1094.4)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 **Tabular values are for dry or water saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.**
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis}=0.75. See section 3.1.8.7 for additional information on seismic applications.

3.2.4

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 28 - Hilti HIT-RE 500 V3 for Core Drilled Holes with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
5/8	3-1/8 (79)	3,050 (13.6)	3,345 (14.9)	3,510 (15.6)	3,510 (15.6)	6,575 (29.2)	7,200 (32.0)	7,560 (33.6)	7,560 (33.6)
	5-5/8 (143)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	13,605 (60.5)	13,605 (60.5)	13,605 (60.5)	13,605 (60.5)
	7-1/2 (191)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	18,145 (80.7)	18,145 (80.7)	18,145 (80.7)	18,145 (80.7)
	12-1/2 (318)	14,040 (62.5)	14,040 (62.5)	14,040 (62.5)	14,040 (62.5)	30,240 (134.5)	30,240 (134.5)	30,240 (134.5)	30,240 (134.5)
3/4	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	4,690 (20.9)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	10,100 (44.9)
	6-3/4 (171)	9,045 (40.2)	9,045 (40.2)	9,045 (40.2)	9,045 (40.2)	19,485 (86.7)	19,485 (86.7)	19,485 (86.7)	19,485 (86.7)
	9 (229)	12,060 (53.6)	12,060 (53.6)	12,060 (53.6)	12,060 (53.6)	25,975 (115.5)	25,975 (115.5)	25,975 (115.5)	25,975 (115.5)
	11-1/4 (286)	15,075 (67.1)	15,075 (67.1)	15,075 (67.1)	15,075 (67.1)	32,470 (144.4)	32,470 (144.4)	32,470 (144.4)	32,470 (144.4)
7/8	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,440 (24.2)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	11,720 (52.1)
	7-7/8 (200)	12,210 (54.3)	12,240 (54.4)	12,240 (54.4)	12,240 (54.4)	26,300 (117.0)	26,365 (117.3)	26,365 (117.3)	26,365 (117.3)
	10-1/2 (267)	16,320 (72.6)	16,320 (72.6)	16,320 (72.6)	16,320 (72.6)	35,155 (156.4)	35,155 (156.4)	35,155 (156.4)	35,155 (156.4)
	17-1/2 (445)	27,205 (121.0)	27,205 (121.0)	27,205 (121.0)	27,205 (121.0)	58,595 (260.6)	58,595 (260.6)	58,595 (260.6)	58,595 (260.6)
1	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,920 (66.4)	15,990 (71.1)	15,990 (71.1)	15,990 (71.1)	32,130 (142.9)	34,440 (153.2)	34,440 (153.2)	34,440 (153.2)
	12 (305)	21,320 (94.8)	21,320 (94.8)	21,320 (94.8)	21,320 (94.8)	45,920 (204.3)	45,920 (204.3)	45,920 (204.3)	45,920 (204.3)
	20 (508)	35,530 (158.0)	35,530 (158.0)	35,530 (158.0)	35,530 (158.0)	76,530 (340.4)	76,530 (340.4)	76,530 (340.4)	76,530 (340.4)
1-1/4	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
	11-1/4 (286)	20,850 (92.7)	22,840 (101.6)	23,690 (105.4)	23,690 (105.4)	44,905 (199.7)	49,190 (218.8)	51,025 (227.0)	51,025 (227.0)
	15 (381)	31,590 (140.5)	31,590 (140.5)	31,590 (140.5)	31,590 (140.5)	68,035 (302.6)	68,035 (302.6)	68,035 (302.6)	68,035 (302.6)
	25 (635)	52,645 (234.2)	52,645 (234.2)	52,645 (234.2)	52,645 (234.2)	113,390 (504.4)	113,390 (504.4)	113,390 (504.4)	113,390 (504.4)

1 See Section 3.1.8 for explanation on development of load values.

2 See Section 3.1.8.6 to convert design strength value to ASD value.

3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.

5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

6 **Tabular values are for dry or water saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.**

7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.

8 **Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:**
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.

9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis}=0.75. See section 3.1.8.7 for additional information on seismic applications.

Table 29 - Steel design strength for Hilti HIT-V and HAS threaded rods[1]

Nominal anchor diameter in.	HIT-V ASTM A307 Grade A[2]			HAS-E ISO 898 Class 5.8[2]			HAS-E-B ASTM A193 B7[3]			HAS-R stainless steel ASTM F593 - AISI 304/316 SS[2]		
	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)
3/8	3,025 (13.5)	1,675 (7.5)	1,175 (5.2)	3,655 (16.3)	2,020 (9.0)	2,020 (9.0)	7,265 (32.3)	3,775 (16.8)	3,775 (16.8)	5,040 (22.4)	2,790 (12.4)	2,230 (9.9)
1/2	5,535 (24.6)	3,065 (13.6)	2,145 (9.5)	6,690 (29.8)	3,705 (16.5)	3,705 (16.5)	13,300 (59.2)	6,915 (30.8)	6,915 (30.8)	9,225 (41.0)	5,110 (22.7)	4,090 (18.2)
5/8	8,815 (39.2)	4,880 (21.7)	3,415 (15.2)	10,650 (47.4)	5,900 (26.2)	5,900 (26.2)	21,190 (94.3)	11,020 (49.0)	11,020 (49.0)	14,690 (65.3)	8,135 (36.2)	6,510 (29.0)
3/4	13,045 (58.0)	7,225 (32.1)	5,060 (22.5)	15,765 (70.1)	8,730 (38.8)	8,730 (38.8)	31,360 (139.5)	16,305 (72.5)	16,305 (72.5)	18,480 (82.2)	10,235 (45.5)	8,190 (36.4)
7/8	-	-	-	21,755 (96.8)	12,050 (53.6)	12,050 (53.6)	43,285 (192.5)	22,505 (100.1)	22,505 (100.1)	25,510 (113.5)	14,125 (62.8)	11,300 (50.3)
1	23,620 (105.1)	13,085 (58.2)	9,160 (40.7)	28,540 (127.0)	15,805 (70.3)	15,805 (70.3)	56,785 (252.6)	29,525 (131.3)	29,525 (131.3)	33,465 (148.9)	18,535 (82.4)	14,830 (66.0)
1-1/4	-	-	-	45,670 (203.1)	25,295 (112.5)	25,295 (112.5)	90,850 (404.1)	47,240 (210.1)	47,240 (210.1)	53,540 (238.2)	29,655 (131.9)	23,725 (105.5)

1 See Section 3.1.8.6 to convert design strength value to ASD value.
2 HIT-V, HAS-E, and HAS-R threaded rods are considered brittle steel elements. HIT-V does not comply with % elongation requirements of ASTM A307 Grade A steel. HAS-E does not comply with % elongation requirements of ISO 898-1.
3 HAS-E-B7 rods are considered ductile steel elements.
4 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17.
5 Shear = ϕ 0.60 $A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.
6 Seismic Shear = $\alpha_{V,seis} \phi V_{Vsa}$: Reduction for seismic shear only. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 30 - Load adjustment factors for 3/8-in. diameter threaded rods in uncracked concrete[1,2,3]

3/8-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.35	0.26	0.21	0.12	n/a	n/a	n/a	n/a	0.23	0.07	0.05	0.03	0.35	0.14	0.09	0.05	n/a	n/a	n/a	n/a
1-7/8 (48)	0.58	0.58	0.57	0.54	0.36	0.27	0.22	0.13	0.57	0.53	0.52	0.52	0.25	0.08	0.05	0.03	0.36	0.16	0.10	0.06	n/a	n/a	n/a	n/a
2 (51)	0.58	0.58	0.57	0.54	0.37	0.28	0.23	0.13	0.57	0.53	0.52	0.52	0.28	0.09	0.06	0.03	0.37	0.17	0.11	0.06	n/a	n/a	n/a	n/a
3 (76)	0.62	0.62	0.61	0.57	0.48	0.34	0.27	0.16	0.61	0.55	0.54	0.52	0.51	0.16	0.10	0.06	0.48	0.32	0.21	0.11	n/a	n/a	n/a	n/a
3-5/8 (92)	0.65	0.65	0.63	0.58	0.56	0.38	0.30	0.17	0.63	0.56	0.54	0.53	0.68	0.21	0.14	0.07	0.56	0.38	0.27	0.15	0.72	n/a	n/a	n/a
4 (102)	0.66	0.66	0.65	0.59	0.62	0.41	0.31	0.18	0.64	0.57	0.55	0.53	0.79	0.24	0.16	0.09	0.62	0.41	0.31	0.17	0.75	n/a	n/a	n/a
4-5/8 (117)	0.69	0.69	0.67	0.60	0.71	0.45	0.35	0.20	0.66	0.58	0.56	0.54	0.98	0.30	0.20	0.11	0.71	0.45	0.35	0.20	0.81	0.55	n/a	n/a
5 (127)	0.70	0.70	0.69	0.61	0.77	0.48	0.36	0.21	0.68	0.58	0.56	0.54	1.00	0.34	0.22	0.12	0.77	0.48	0.36	0.21	0.84	0.57	n/a	n/a
5-3/4 (146)	0.73	0.73	0.71	0.63	0.89	0.55	0.40	0.23	0.70	0.59	0.57	0.55		0.42	0.27	0.15	0.89	0.55	0.40	0.23	0.91	0.61	0.53	n/a
6 (152)	0.74	0.74	0.72	0.63	0.92	0.58	0.42	0.24	0.71	0.60	0.57	0.55		0.45	0.29	0.16	0.92	0.58	0.42	0.24	0.92	0.63	0.54	n/a
7 (178)	0.78	0.78	0.76	0.66	1.00	0.67	0.48	0.28	0.75	0.61	0.59	0.56		0.57	0.37	0.20	1.00	0.67	0.48	0.28	1.00	0.68	0.58	n/a
8 (203)	0.82	0.82	0.80	0.68		0.77	0.55	0.32	0.79	0.63	0.60	0.57		0.69	0.45	0.24		0.77	0.55	0.32		0.72	0.63	n/a
8-3/4 (222)	0.86	0.86	0.82	0.69		0.84	0.61	0.35	0.81	0.64	0.61	0.57		0.79	0.51	0.28		0.84	0.61	0.35		0.76	0.65	0.53
9 (229)	0.87	0.87	0.83	0.70		0.86	0.62	0.36	0.82	0.65	0.61	0.57		0.83	0.54	0.29		0.86	0.62	0.36		0.77	0.66	0.54
10 (254)	0.91	0.91	0.87	0.72		0.96	0.69	0.40	0.86	0.66	0.62	0.58		0.97	0.63	0.34		0.96	0.69	0.40		0.81	0.70	0.57
11 (279)	0.95	0.95	0.91	0.74		1.00	0.76	0.44	0.89	0.68	0.63	0.59		1.00	0.72	0.39		1.00	0.76	0.44		0.85	0.73	0.60
12 (305)	0.99	0.99	0.94	0.77			0.83	0.48	0.93	0.70	0.65	0.60			0.83	0.45			0.83	0.48		0.88	0.77	0.63
14 (356)	1.00	1.00	1.00	0.81			0.97	0.56	1.00	0.73	0.67	0.61			1.00	0.57			0.97	0.56		0.96	0.83	0.68
16 (406)				0.86			1.00	0.64		0.76	0.70	0.63				0.69			1.00	0.64		1.00	0.88	0.72
18 (457)				0.90				0.72		0.79	0.72	0.65				0.83				0.72			0.94	0.77
24 (610)				1.00				0.96		0.89	0.79	0.70				1.00				0.96			1.00	0.88
30 (762)								1.00		0.99	0.87	0.74								1.00				0.99
36 (914)										1.00	0.94	0.79												1.00
> 48 (1219)											1.00	0.89												

Table 31 - Load adjustment factors for 3/8-in. diameter threaded rods in cracked concrete[1,2,3]

3/8-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)	2-3/8 (60)	3-3/8 (86)	4-1/2 (114)	7-1/2 (191)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.50	0.50	0.49	0.43	n/a	n/a	n/a	n/a	0.23	0.07	0.06	0.03	0.46	0.15	0.11	0.07	n/a	n/a	n/a	n/a
1-7/8 (48)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.57	0.53	0.53	0.52	0.26	0.08	0.06	0.04	0.51	0.16	0.12	0.07	n/a	n/a	n/a	n/a
2 (51)	0.58	0.58	0.57	0.54	0.53	0.53	0.51	0.44	0.57	0.53	0.53	0.52	0.28	0.09	0.07	0.04	0.53	0.18	0.14	0.08	n/a	n/a	n/a	n/a
3 (76)	0.62	0.62	0.61	0.57	0.63	0.63	0.60	0.49	0.61	0.55	0.54	0.53	0.52	0.17	0.12	0.07	0.63	0.33	0.25	0.15	n/a	n/a	n/a	n/a
3-5/8 (92)	0.65	0.65	0.63	0.58	0.70	0.70	0.66	0.53	0.63	0.56	0.55	0.54	0.69	0.22	0.17	0.10	0.70	0.44	0.33	0.20	0.72	n/a	n/a	n/a
4 (102)	0.66	0.66	0.65	0.59	0.74	0.74	0.70	0.55	0.64	0.57	0.56	0.54	0.80	0.26	0.19	0.11	0.74	0.51	0.38	0.23	0.76	n/a	n/a	n/a
4-5/8 (117)	0.69	0.69	0.67	0.60	0.81	0.81	0.76	0.58	0.67	0.58	0.56	0.55	0.99	0.32	0.24	0.14	0.81	0.63	0.48	0.29	0.81	0.56	n/a	n/a
5 (127)	0.70	0.70	0.69	0.61	0.86	0.86	0.80	0.60	0.68	0.58	0.57	0.55	1.00	0.36	0.27	0.16	0.86	0.71	0.54	0.32	0.85	0.58	n/a	n/a
5-3/4 (146)	0.73	0.73	0.71	0.63	0.95	0.95	0.88	0.64	0.71	0.60	0.58	0.56		0.44	0.33	0.20	0.95	0.88	0.66	0.40	0.91	0.62	0.56	n/a
6 (152)	0.74	0.74	0.72	0.63	0.98	0.98	0.91	0.66	0.71	0.60	0.58	0.56		0.47	0.35	0.21	0.98	0.94	0.70	0.42	0.93	0.63	0.58	n/a
7 (178)	0.78	0.78	0.76	0.66	1.00	1.00	1.00	0.72	0.75	0.62	0.60	0.57		0.59	0.44	0.27	1.00	1.00	0.89	0.53	1.00	0.69	0.62	n/a
8 (203)	0.82	0.82	0.80	0.68				0.78	0.79	0.63	0.61	0.58		0.72	0.54	0.32			1.00	0.65		0.73	0.67	n/a
8-3/4 (222)	0.86	0.86	0.82	0.69				0.83	0.81	0.65	0.62	0.59		0.83	0.62	0.37				0.74		0.77	0.70	0.59
9 (229)	0.87	0.87	0.83	0.70				0.85	0.82	0.65	0.62	0.59		0.86	0.65	0.39				0.78		0.78	0.71	0.60
10 (254)	0.91	0.91	0.87	0.72				0.91	0.86	0.67	0.64	0.60		1.00	0.76	0.45				0.91		0.82	0.74	0.63
11 (279)	0.95	0.95	0.91	0.74				0.98	0.89	0.68	0.65	0.61			0.87	0.52				0.98		0.86	0.78	0.66
12 (305)	0.99	0.99	0.94	0.77				1.00	0.93	0.70	0.67	0.62			1.00	0.60				1.00		0.90	0.82	0.69
14 (356)	1.00	1.00	1.00	0.81					1.00	0.73	0.69	0.64				0.75						0.97	0.88	0.74
16 (406)				0.86						0.77	0.72	0.66				0.92						1.00	0.94	0.79
18 (457)				0.90						0.80	0.75	0.68				1.00							1.00	0.84
24 (610)				1.00						0.90	0.83	0.74												0.97
30 (762)										1.00	0.92	0.80												1.00
36 (914)											1.00	0.85												
> 48 (1219)												0.97												

1 Linear interpolation not permitted
2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then f_{AV} = f_{AN}.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 32 - Load adjustment factors for 1/2-in. diameter threaded rods in uncracked concrete[1,2,3]

1/2-in. uncracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in.	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)	(mm)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)
1-3/4	(44)	n/a	n/a	n/a	n/a	0.34	0.24	0.19	0.11	n/a	n/a	n/a	n/a	0.10	0.05	0.03	0.02	0.21	0.11	0.07	0.03	n/a	n/a	n/a	n/a
2-1/2	(64)	0.58	0.58	0.57	0.54	0.41	0.28	0.22	0.13	0.55	0.53	0.53	0.52	0.18	0.09	0.06	0.03	0.35	0.18	0.12	0.06	n/a	n/a	n/a	n/a
3	(76)	0.59	0.59	0.58	0.55	0.46	0.30	0.23	0.14	0.56	0.54	0.53	0.52	0.23	0.12	0.08	0.04	0.46	0.24	0.15	0.08	n/a	n/a	n/a	n/a
4	(102)	0.62	0.62	0.61	0.57	0.57	0.35	0.26	0.15	0.58	0.55	0.54	0.53	0.36	0.18	0.12	0.06	0.57	0.35	0.24	0.12	0.58	n/a	n/a	n/a
5	(127)	0.65	0.65	0.64	0.58	0.71	0.40	0.30	0.17	0.60	0.57	0.55	0.53	0.50	0.26	0.17	0.08	0.71	0.40	0.31	0.16	0.65	n/a	n/a	n/a
5-3/4	(146)	0.68	0.68	0.66	0.60	0.78	0.44	0.33	0.19	0.62	0.58	0.56	0.54	0.61	0.32	0.21	0.10	0.81	0.44	0.34	0.20	0.69	0.56	n/a	n/a
6	(152)	0.69	0.69	0.67	0.60	0.80	0.46	0.33	0.20	0.63	0.58	0.56	0.54	0.65	0.34	0.22	0.11	0.85	0.46	0.35	0.21	0.71	0.57	n/a	n/a
7	(178)	0.72	0.72	0.69	0.62	0.90	0.52	0.37	0.22	0.65	0.59	0.57	0.54	0.82	0.42	0.28	0.13	0.99	0.52	0.38	0.27	0.77	0.61	n/a	n/a
7-1/4	(184)	0.72	0.72	0.70	0.62	0.92	0.54	0.38	0.22	0.65	0.60	0.57	0.55	0.87	0.45	0.29	0.14	1.00	0.54	0.39	0.28	0.78	0.62	0.54	n/a
8	(203)	0.75	0.75	0.72	0.63	0.99	0.59	0.41	0.24	0.67	0.61	0.58	0.55	1.00	0.52	0.34	0.16		0.59	0.42	0.30	0.82	0.66	0.57	n/a
9	(229)	0.78	0.78	0.75	0.65	1.00	0.67	0.46	0.27	0.69	0.62	0.59	0.56		0.62	0.40	0.20		0.67	0.46	0.32	0.87	0.70	0.60	n/a
10	(254)	0.81	0.81	0.78	0.67		0.74	0.52	0.30	0.71	0.63	0.60	0.56		0.72	0.47	0.23		0.74	0.52	0.34	0.92	0.73	0.64	n/a
11-1/4	(286)	0.85	0.85	0.81	0.69		0.83	0.58	0.34	0.74	0.65	0.61	0.57		0.86	0.56	0.27		0.83	0.58	0.37	0.97	0.78	0.67	0.53
12	(305)	0.87	0.87	0.83	0.70		0.89	0.62	0.36	0.75	0.66	0.62	0.58		0.95	0.62	0.30		0.89	0.62	0.38	1.00	0.80	0.70	0.55
14	(356)	0.93	0.93	0.89	0.73		1.00	0.72	0.42	0.79	0.69	0.64	0.59		1.00	0.78	0.38		1.00	0.72	0.43		0.87	0.75	0.59
16	(406)	1.00	1.00	0.94	0.77			0.82	0.48	0.83	0.72	0.66	0.60			0.95	0.47			0.82	0.48		0.93	0.80	0.63
18	(457)			1.00	0.80			0.93	0.54	0.88	0.74	0.68	0.61			1.00	0.56			0.93	0.54		0.98	0.85	0.67
20	(508)				0.83			1.00	0.60	0.92	0.77	0.70	0.63				0.65			1.00	0.60		1.00	0.90	0.71
22	(559)				0.87				0.66	0.96	0.80	0.72	0.64				0.75				0.66			0.94	0.74
24	(610)				0.90				0.72	1.00	0.82	0.74	0.65				0.85				0.72			0.98	0.77
30	(762)				1.00				0.90		0.90	0.80	0.69				1.00				0.90			1.00	0.87
36	(914)								1.00		0.98	0.86	0.73								1.00				0.95
> 48	(1219)										1.00	0.98	0.80												1.00

3.2.4

Table 33 - Load adjustment factors for 1/2-in. diameter threaded rods in cracked concrete[1,2,3]

1/2-in. cracked concrete		Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear ⊥ Toward edge f_{RV}				Edge distance in shear ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef}	in.	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10	2-3/4	4-1/2	6	10
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)	(mm)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)	(70)	(114)	(152)	(254)
1-3/4	(44)	n/a	n/a	n/a	n/a	0.47	0.47	0.45	0.41	n/a	n/a	n/a	n/a	0.10	0.05	0.04	0.02	0.21	0.11	0.07	0.04	n/a	n/a	n/a	n/a
2-1/2	(64)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.55	0.53	0.53	0.52	0.18	0.09	0.06	0.04	0.35	0.18	0.12	0.07	n/a	n/a	n/a	n/a
3	(76)	0.59	0.59	0.58	0.55	0.56	0.56	0.53	0.46	0.56	0.54	0.53	0.52	0.23	0.12	0.08	0.05	0.47	0.24	0.16	0.10	n/a	n/a	n/a	n/a
4	(102)	0.62	0.62	0.61	0.57	0.63	0.63	0.60	0.49	0.58	0.55	0.54	0.53	0.36	0.18	0.13	0.08	0.72	0.37	0.25	0.15	0.58	n/a	n/a	n/a
5	(127)	0.65	0.65	0.64	0.58	0.72	0.72	0.67	0.53	0.61	0.57	0.55	0.54	0.50	0.26	0.18	0.11	1.00	0.52	0.35	0.21	0.65	n/a	n/a	n/a
5-3/4	(146)	0.68	0.68	0.66	0.60	0.78	0.78	0.73	0.56	0.62	0.58	0.56	0.54	0.62	0.32	0.22	0.13		0.64	0.43	0.26	0.70	0.56	n/a	n/a
6	(152)	0.69	0.69	0.67	0.60	0.80	0.80	0.75	0.57	0.63	0.58	0.56	0.54	0.66	0.34	0.23	0.14		0.68	0.46	0.28	0.71	0.57	n/a	n/a
7	(178)	0.72	0.72	0.69	0.62	0.90	0.90	0.83	0.62	0.65	0.59	0.57	0.55	0.83	0.43	0.29	0.17		0.86	0.58	0.35	0.77	0.62	n/a	n/a
7-1/4	(184)	0.72	0.72	0.70	0.62	0.92	0.92	0.85	0.63	0.65	0.60	0.58	0.55	0.88	0.45	0.31	0.18		0.90	0.61	0.37	0.78	0.63	0.55	n/a
8	(203)	0.75	0.75	0.72	0.63	0.99	0.99	0.91	0.66	0.67	0.61	0.58	0.56	1.00	0.52	0.35	0.21		1.00	0.71	0.43	0.82	0.66	0.58	n/a
9	(229)	0.78	0.78	0.75	0.65	1.00	1.00	1.00	0.70	0.69	0.62	0.59	0.57		0.62	0.42	0.25			0.85	0.51	0.87	0.70	0.61	n/a
10	(254)	0.81	0.81	0.78	0.67				0.75	0.71	0.64	0.60	0.57		0.73	0.50	0.30			0.99	0.59	0.92	0.74	0.65	n/a
11-1/4	(286)	0.85	0.85	0.81	0.69				0.81	0.74	0.65	0.62	0.58		0.87	0.59	0.35			1.00	0.71	0.97	0.78	0.69	0.58
12	(305)	0.87	0.87	0.83	0.70				0.85	0.75	0.66	0.63	0.59		0.96	0.65	0.39				0.78	1.00	0.81	0.71	0.60
14	(356)	0.93	0.93	0.89	0.73				0.95	0.79	0.69	0.65	0.60		1.00	0.82	0.49				0.95		0.87	0.76	0.64
16	(406)	1.00	1.00	0.94	0.77				1.00	0.84	0.72	0.67	0.62			1.00	0.60				1.00		0.93	0.82	0.69
18	(457)			1.00	0.80					0.88	0.74	0.69	0.63				0.72						0.99	0.87	0.73
20	(508)				0.83					0.92	0.77	0.71	0.65				0.84						1.00	0.91	0.77
22	(559)				0.87					0.96	0.80	0.73	0.66				0.97							0.96	0.81
24	(610)				0.90					1.00	0.82	0.75	0.68				1.00							1.00	0.84
30	(762)				1.00						0.91	0.81	0.72												0.94
36	(914)										0.99	0.88	0.77												1.00
> 48	(1219)										1.00	1.00	0.86												

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 34 - Load adjustment factors for 5/8-in. diameter threaded rods in uncracked concrete[1,2,3]

5/8-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.35	0.24	0.19	0.11	n/a	n/a	n/a	n/a	0.09	0.04	0.03	0.01	0.19	0.08	0.06	0.03	n/a	n/a	n/a	n/a
3-1/8 (79)	0.58	0.58	0.57	0.54	0.47	0.29	0.22	0.13	0.56	0.54	0.53	0.52	0.22	0.10	0.07	0.03	0.45	0.20	0.13	0.06	n/a	n/a	n/a	n/a
4 (102)	0.60	0.60	0.59	0.55	0.56	0.32	0.24	0.14	0.58	0.55	0.53	0.52	0.32	0.15	0.10	0.04	0.56	0.29	0.19	0.09	n/a	n/a	n/a	n/a
4-5/8 (117)	0.62	0.62	0.60	0.56	0.62	0.35	0.26	0.15	0.59	0.55	0.54	0.52	0.40	0.18	0.12	0.06	0.62	0.35	0.24	0.11	0.60	n/a	n/a	n/a
5 (127)	0.63	0.63	0.61	0.57	0.64	0.36	0.27	0.16	0.60	0.56	0.54	0.53	0.45	0.21	0.13	0.06	0.67	0.36	0.27	0.12	0.63	n/a	n/a	n/a
6 (152)	0.65	0.65	0.63	0.58	0.71	0.41	0.30	0.17	0.62	0.57	0.55	0.53	0.59	0.27	0.18	0.08	0.80	0.41	0.32	0.16	0.69	n/a	n/a	n/a
7 (178)	0.68	0.68	0.66	0.59	0.78	0.45	0.33	0.19	0.64	0.58	0.56	0.54	0.75	0.34	0.22	0.10	0.94	0.45	0.35	0.21	0.74	n/a	n/a	n/a
7-1/8 (181)	0.68	0.68	0.66	0.60	0.79	0.46	0.33	0.19	0.64	0.58	0.56	0.54	0.77	0.35	0.23	0.11	0.95	0.46	0.35	0.21	0.75	0.57	n/a	n/a
8 (203)	0.70	0.70	0.68	0.61	0.85	0.50	0.36	0.21	0.66	0.59	0.57	0.54	0.91	0.41	0.27	0.13	1.00	0.50	0.38	0.25	0.79	0.61	n/a	n/a
9 (229)	0.73	0.73	0.70	0.62	0.93	0.56	0.39	0.22	0.68	0.60	0.58	0.55	1.00	0.50	0.32	0.15		0.56	0.41	0.29	0.84	0.65	0.56	n/a
10 (254)	0.75	0.75	0.72	0.63	1.00	0.62	0.43	0.24	0.70	0.62	0.59	0.55		0.58	0.38	0.18		0.62	0.44	0.30	0.89	0.68	0.59	n/a
11 (279)	0.78	0.78	0.74	0.65		0.68	0.47	0.27	0.72	0.63	0.60	0.56		0.67	0.43	0.20		0.68	0.47	0.32	0.93	0.71	0.62	n/a
12 (305)	0.80	0.80	0.77	0.66		0.74	0.51	0.29	0.74	0.64	0.60	0.56		0.76	0.50	0.23		0.74	0.51	0.34	0.97	0.75	0.65	n/a
14 (356)	0.85	0.85	0.81	0.69		0.86	0.60	0.34	0.77	0.66	0.62	0.57		0.96	0.62	0.29		0.86	0.60	0.37	1.00	0.81	0.70	0.54
16 (406)	0.90	0.90	0.86	0.71		0.99	0.68	0.39	0.81	0.69	0.64	0.58		1.00	0.76	0.35		0.99	0.68	0.41		0.86	0.75	0.58
18 (457)	0.96	0.96	0.90	0.74		1.00	0.77	0.44	0.85	0.71	0.66	0.59			0.91	0.42		1.00	0.77	0.44		0.91	0.79	0.61
20 (508)	1.00	1.00	0.94	0.77			0.86	0.49	0.89	0.73	0.67	0.60			1.00	0.50			0.86	0.49		0.96	0.83	0.65
22 (559)			0.99	0.79			0.94	0.54	0.93	0.75	0.69	0.61				0.57			0.94	0.54		1.00	0.87	0.68
24 (610)			1.00	0.82			1.00	0.59	0.97	0.78	0.71	0.63				0.65			1.00	0.59			0.91	0.71
26 (660)				0.85				0.64	1.00	0.80	0.73	0.64				0.73				0.64			0.95	0.74
28 (711)				0.87				0.68		0.82	0.74	0.65				0.82				0.68			0.99	0.76
30 (762)				0.90				0.73		0.85	0.76	0.66				0.91				0.73			1.00	0.79
36 (914)				0.98				0.88		0.92	0.81	0.69				1.00				0.88				0.87
> 48 (1219)				1.00				1.00		1.00	0.92	0.75								1.00				1.00

Table 35 - Load adjustment factors for 5/8-in. diameter threaded rods in cracked concrete[1,2,3]

5/8-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)	3-1/8 (79)	5-5/8 (143)	7-1/2 (191)	12-1/2 (318)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4 (44)	n/a	n/a	n/a	n/a	0.44	0.44	0.43	0.40	n/a	n/a	n/a	n/a	0.09	0.04	0.03	0.02	0.19	0.09	0.06	0.03	n/a	n/a	n/a	n/a
3-1/8 (79)	0.58	0.58	0.57	0.54	0.52	0.52	0.50	0.44	0.56	0.54	0.53	0.52	0.22	0.10	0.07	0.04	0.45	0.20	0.13	0.07	n/a	n/a	n/a	n/a
4 (102)	0.60	0.60	0.59	0.55	0.58	0.58	0.55	0.46	0.58	0.55	0.53	0.52	0.33	0.15	0.10	0.05	0.65	0.30	0.19	0.11	n/a	n/a	n/a	n/a
4-5/8 (117)	0.62	0.62	0.60	0.56	0.62	0.62	0.58	0.48	0.59	0.55	0.54	0.53	0.40	0.18	0.12	0.07	0.81	0.37	0.24	0.13	0.60	n/a	n/a	n/a
5 (127)	0.63	0.63	0.61	0.57	0.64	0.64	0.60	0.49	0.60	0.56	0.54	0.53	0.45	0.21	0.13	0.08	0.91	0.41	0.27	0.15	0.63	n/a	n/a	n/a
6 (152)	0.65	0.65	0.63	0.58	0.71	0.71	0.66	0.53	0.62	0.57	0.55	0.54	0.60	0.27	0.18	0.10	1.00	0.54	0.35	0.20	0.69	n/a	n/a	n/a
7 (178)	0.68	0.68	0.66	0.59	0.78	0.78	0.72	0.56	0.64	0.58	0.56	0.54	0.75	0.34	0.22	0.13		0.68	0.44	0.25	0.74	n/a	n/a	n/a
7-1/8 (181)	0.68	0.68	0.66	0.60	0.79	0.79	0.73	0.56	0.64	0.58	0.56	0.54	0.77	0.35	0.23	0.13		0.70	0.46	0.26	0.75	0.58	n/a	n/a
8 (203)	0.70	0.70	0.68	0.61	0.85	0.85	0.78	0.59	0.66	0.59	0.57	0.55	0.92	0.42	0.27	0.15		0.84	0.54	0.31	0.79	0.61	n/a	n/a
9 (229)	0.73	0.73	0.70	0.62	0.93	0.93	0.85	0.62	0.68	0.60	0.58	0.55	1.00	0.50	0.32	0.18		1.00	0.65	0.37	0.84	0.65	0.56	n/a
10 (254)	0.75	0.75	0.72	0.63	1.00	1.00	0.91	0.66	0.70	0.62	0.59	0.56		0.58	0.38	0.21			0.76	0.43	0.89	0.68	0.59	n/a
11 (279)	0.78	0.78	0.74	0.65			0.98	0.69	0.72	0.63	0.60	0.57		0.67	0.44	0.25			0.88	0.49	0.93	0.72	0.62	n/a
12 (305)	0.80	0.80	0.77	0.66			1.00	0.73	0.74	0.64	0.60	0.57		0.77	0.50	0.28			1.00	0.56	0.97	0.75	0.65	n/a
14 (356)	0.85	0.85	0.81	0.69				0.81	0.78	0.66	0.62	0.58		0.97	0.63	0.36				0.71	1.00	0.81	0.70	0.58
16 (406)	0.90	0.90	0.86	0.71				0.89	0.82	0.69	0.64	0.60		1.00	0.77	0.43				0.87		0.86	0.75	0.62
18 (457)	0.96	0.96	0.90	0.74				0.97	0.85	0.71	0.66	0.61			0.92	0.52				0.97		0.92	0.79	0.66
20 (508)	1.00	1.00	0.94	0.77				1.00	0.89	0.73	0.67	0.62			1.00	0.61				1.00		0.97	0.84	0.69
22 (559)			0.99	0.79					0.93	0.76	0.69	0.63				0.70						1.00	0.88	0.72
24 (610)			1.00	0.82					0.97	0.78	0.71	0.64				0.80							0.92	0.76
26 (660)				0.85					1.00	0.80	0.73	0.66				0.90							0.95	0.79
28 (711)				0.87						0.83	0.74	0.67				1.00							0.99	0.82
30 (762)				0.90						0.85	0.76	0.68											1.00	0.85
36 (914)				0.98						0.92	0.81	0.71												0.93
> 48 (1219)				1.00						1.00	0.92	0.79												1.00

1 Linear interpolation not permitted
2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then f_{AV} = f_{AN}.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

Table 36 - Load adjustment factors for 3/4-in. diameter threaded rods in uncracked concrete[1,2,3]

3/4-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment in. (mm) h_{ef}	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.35	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.17	0.07	0.05	0.02	n/a	n/a	n/a	n/a
3-3/4 (95)	0.58	0.58	0.57	0.54	0.52	0.30	0.23	0.13	0.57	0.54	0.53	0.52	0.27	0.11	0.07	0.03	0.52	0.22	0.14	0.07	n/a	n/a	n/a	n/a
4 (102)	0.59	0.59	0.57	0.54	0.54	0.31	0.23	0.13	0.57	0.54	0.53	0.52	0.29	0.12	0.08	0.04	0.54	0.24	0.16	0.07	n/a	n/a	n/a	n/a
5 (127)	0.61	0.61	0.59	0.56	0.59	0.34	0.25	0.14	0.59	0.55	0.54	0.52	0.41	0.17	0.11	0.05	0.64	0.33	0.22	0.10	n/a	n/a	n/a	n/a
5-1/4 (133)	0.61	0.61	0.60	0.56	0.61	0.35	0.26	0.15	0.60	0.55	0.54	0.52	0.44	0.18	0.12	0.05	0.66	0.35	0.23	0.11	0.62	n/a	n/a	n/a
6 (152)	0.63	0.63	0.61	0.57	0.65	0.38	0.28	0.16	0.61	0.56	0.55	0.53	0.54	0.22	0.14	0.07	0.76	0.38	0.29	0.13	0.66	n/a	n/a	n/a
7 (178)	0.65	0.65	0.63	0.58	0.70	0.41	0.30	0.17	0.63	0.57	0.55	0.53	0.68	0.28	0.18	0.08	0.89	0.41	0.32	0.17	0.72	n/a	n/a	n/a
8 (203)	0.67	0.67	0.65	0.59	0.76	0.45	0.33	0.18	0.65	0.58	0.56	0.54	0.83	0.34	0.22	0.10	1.00	0.45	0.35	0.20	0.77	n/a	n/a	n/a
8-1/2 (216)	0.68	0.68	0.66	0.59	0.79	0.47	0.34	0.19	0.66	0.59	0.56	0.54	0.91	0.37	0.24	0.11		0.47	0.36	0.22	0.79	0.59	n/a	n/a
9 (229)	0.69	0.69	0.67	0.60	0.83	0.49	0.35	0.20	0.67	0.59	0.57	0.54	0.99	0.40	0.26	0.12		0.49	0.37	0.24	0.81	0.60	n/a	n/a
10 (254)	0.71	0.71	0.69	0.61	0.89	0.53	0.38	0.21	0.68	0.60	0.58	0.55	1.00	0.47	0.31	0.14		0.53	0.40	0.28	0.86	0.64	n/a	n/a
10-3/4 (273)	0.73	0.73	0.70	0.62	0.94	0.57	0.40	0.23	0.70	0.61	0.58	0.55		0.53	0.34	0.16		0.57	0.42	0.29	0.89	0.66	0.57	n/a
12 (305)	0.76	0.76	0.72	0.63	1.00	0.64	0.44	0.25	0.72	0.62	0.59	0.55		0.62	0.40	0.19		0.64	0.45	0.31	0.94	0.70	0.60	n/a
14 (356)	0.80	0.80	0.76	0.66		0.74	0.52	0.29	0.76	0.64	0.61	0.56		0.78	0.51	0.24		0.74	0.52	0.33	1.00	0.75	0.65	n/a
16 (406)	0.84	0.84	0.80	0.68		0.85	0.59	0.33	0.79	0.66	0.62	0.57		0.96	0.62	0.29		0.85	0.59	0.36		0.80	0.70	n/a
16-3/4 (425)	0.86	0.86	0.81	0.69		0.89	0.62	0.35	0.81	0.67	0.63	0.58		1.00	0.67	0.31		0.89	0.62	0.37		0.82	0.71	0.55
18 (457)	0.89	0.89	0.83	0.70		0.96	0.66	0.37	0.83	0.68	0.64	0.58			0.74	0.35		0.96	0.66	0.39		0.85	0.74	0.57
20 (508)	0.93	0.93	0.87	0.72		1.00	0.74	0.41	0.87	0.70	0.65	0.59			0.87	0.40		1.00	0.74	0.42		0.90	0.78	0.60
22 (559)	0.97	0.97	0.91	0.74			0.81	0.45	0.91	0.72	0.67	0.60			1.00	0.47			0.81	0.46		0.94	0.82	0.63
24 (610)	1.00	1.00	0.94	0.77			0.89	0.50	0.94	0.74	0.68	0.61				0.53			0.89	0.50		0.99	0.85	0.66
26 (660)			0.98	0.79			0.96	0.54	0.98	0.76	0.70	0.62				0.60			0.96	0.54		1.00	0.89	0.69
28 (711)			1.00	0.81			1.00	0.58	1.00	0.78	0.71	0.63				0.67			1.00	0.58			0.92	0.71
30 (762)				0.83				0.62		0.80	0.73	0.64				0.74				0.62			0.95	0.74
36 (914)				0.90				0.74		0.86	0.77	0.66				0.98				0.74			1.00	0.81
> 48 (1219)				1.00				0.99		0.99	0.86	0.72				1.00				0.99				0.94

Table 37 - Load adjustment factors for 3/4-in. diameter threaded rods in cracked concrete[1,2,3]

3/4-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment in. (mm) h_{ef}	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)	3-1/2 (89)	6-3/4 (171)	9 (229)	15 (381)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.43	0.43	0.42	0.39	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.17	0.07	0.05	0.02	n/a	n/a	n/a	n/a
3-3/4 (95)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.57	0.54	0.53	0.52	0.27	0.11	0.07	0.04	0.54	0.22	0.14	0.07	n/a	n/a	n/a	n/a
4 (102)	0.59	0.59	0.57	0.54	0.54	0.54	0.51	0.44	0.57	0.54	0.53	0.52	0.30	0.12	0.08	0.04	0.59	0.24	0.16	0.08	n/a	n/a	n/a	n/a
5 (127)	0.61	0.61	0.59	0.56	0.59	0.59	0.56	0.47	0.59	0.55	0.54	0.52	0.41	0.17	0.11	0.06	0.83	0.34	0.22	0.11	n/a	n/a	n/a	n/a
5-1/4 (133)	0.61	0.61	0.60	0.56	0.61	0.61	0.57	0.47	0.60	0.55	0.54	0.53	0.45	0.18	0.12	0.06	0.89	0.36	0.24	0.12	0.62	n/a	n/a	n/a
6 (152)	0.63	0.63	0.61	0.57	0.65	0.65	0.60	0.49	0.61	0.56	0.55	0.53	0.54	0.22	0.14	0.07	1.00	0.44	0.29	0.15	0.67	n/a	n/a	n/a
7 (178)	0.65	0.65	0.63	0.58	0.70	0.70	0.65	0.52	0.63	0.57	0.55	0.53	0.69	0.28	0.18	0.09		0.56	0.36	0.19	0.72	n/a	n/a	n/a
8 (203)	0.67	0.67	0.65	0.59	0.76	0.76	0.70	0.55	0.65	0.58	0.56	0.54	0.84	0.34	0.22	0.12		0.68	0.44	0.23	0.77	n/a	n/a	n/a
8-1/2 (216)	0.68	0.68	0.66	0.59	0.79	0.79	0.72	0.56	0.66	0.59	0.56	0.54	0.92	0.37	0.24	0.13		0.75	0.49	0.25	0.79	0.59	n/a	n/a
9 (229)	0.69	0.69	0.67	0.60	0.83	0.83	0.75	0.57	0.67	0.59	0.57	0.54	1.00	0.41	0.26	0.14		0.82	0.53	0.28	0.82	0.61	n/a	n/a
10 (254)	0.71	0.71	0.69	0.61	0.89	0.89	0.80	0.60	0.69	0.60	0.58	0.55		0.48	0.31	0.16		0.95	0.62	0.32	0.86	0.64	n/a	n/a
10-3/4 (273)	0.73	0.73	0.70	0.62	0.94	0.94	0.84	0.62	0.70	0.61	0.58	0.55		0.53	0.35	0.18		1.00	0.69	0.36	0.89	0.66	0.57	n/a
12 (305)	0.76	0.76	0.72	0.63	1.00	1.00	0.91	0.66	0.72	0.62	0.59	0.56		0.63	0.41	0.21			0.82	0.42	0.94	0.70	0.61	n/a
14 (356)	0.80	0.80	0.76	0.66			1.00	0.72	0.76	0.64	0.61	0.57		0.79	0.51	0.27			1.00	0.53	1.00	0.76	0.65	n/a
16 (406)	0.84	0.84	0.80	0.68				0.78	0.80	0.66	0.62	0.58		0.97	0.63	0.33				0.65		0.81	0.70	n/a
16-3/4 (425)	0.86	0.86	0.81	0.69				0.81	0.81	0.67	0.63	0.58		1.00	0.67	0.35				0.70		0.83	0.72	0.57
18 (457)	0.89	0.89	0.83	0.70				0.85	0.83	0.68	0.64	0.59			0.75	0.39				0.78		0.86	0.74	0.60
20 (508)	0.93	0.93	0.87	0.72				0.91	0.87	0.70	0.65	0.60			0.88	0.46				0.91		0.90	0.78	0.63
22 (559)	0.97	0.97	0.91	0.74				0.98	0.91	0.72	0.67	0.61			1.00	0.53				0.98		0.95	0.82	0.66
24 (610)	1.00	1.00	0.94	0.77				1.00	0.94	0.74	0.68	0.62				0.60				1.00		0.99	0.86	0.69
26 (660)			0.98	0.79					0.98	0.76	0.70	0.63				0.68						1.00	0.89	0.72
28 (711)			1.00	0.81					1.00	0.79	0.71	0.64				0.75							0.92	0.74
30 (762)				0.83						0.81	0.73	0.65				0.84							0.96	0.77
36 (914)				0.90						0.87	0.77	0.68				1.00							1.00	0.84
> 48 (1219)				1.00						0.99	0.87	0.74												0.97

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.
3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 38 - Load adjustment factors for 7/8-in. diameter threaded rods in uncracked concrete[1,2,3]

7/8-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.39	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.18	0.05	0.04	0.02	n/a	n/a	n/a	n/a
4-3/8 (111)	0.58	0.58	0.57	0.54	0.53	0.31	0.23	0.13	0.58	0.54	0.53	0.52	0.35	0.11	0.07	0.03	0.63	0.22	0.14	0.07	n/a	n/a	n/a	n/a
5 (127)	0.59	0.59	0.58	0.55	0.56	0.33	0.24	0.13	0.59	0.54	0.53	0.52	0.43	0.13	0.09	0.04	0.70	0.27	0.17	0.08	n/a	n/a	n/a	n/a
5-1/2 (140)	0.60	0.60	0.59	0.55	0.58	0.34	0.25	0.14	0.60	0.55	0.54	0.52	0.50	0.15	0.10	0.05	0.76	0.31	0.20	0.09	0.65	n/a	n/a	n/a
6 (152)	0.61	0.61	0.60	0.56	0.61	0.36	0.26	0.15	0.61	0.55	0.54	0.52	0.57	0.17	0.11	0.05	0.83	0.35	0.23	0.11	0.68	n/a	n/a	n/a
7 (178)	0.63	0.63	0.61	0.57	0.65	0.39	0.28	0.16	0.63	0.56	0.55	0.53	0.71	0.22	0.14	0.07	0.97	0.39	0.29	0.13	0.73	n/a	n/a	n/a
8 (203)	0.65	0.65	0.63	0.58	0.71	0.42	0.31	0.17	0.65	0.57	0.55	0.53	0.87	0.27	0.17	0.08	1.00	0.42	0.33	0.16	0.78	n/a	n/a	n/a
9 (229)	0.67	0.67	0.64	0.59	0.76	0.45	0.33	0.18	0.67	0.58	0.56	0.54	1.00	0.32	0.21	0.10		0.45	0.35	0.19	0.83	n/a	n/a	n/a
9-7/8 (251)	0.69	0.69	0.66	0.59	0.80	0.48	0.35	0.19	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.48	0.37	0.22	0.87	0.59	n/a	n/a
10 (254)	0.69	0.69	0.66	0.60	0.81	0.49	0.35	0.19	0.69	0.59	0.57	0.54		0.38	0.24	0.11		0.49	0.37	0.23	0.87	0.59	n/a	n/a
11 (279)	0.71	0.71	0.67	0.60	0.87	0.52	0.38	0.21	0.71	0.60	0.57	0.54		0.43	0.28	0.13		0.52	0.40	0.26	0.91	0.62	n/a	n/a
12 (305)	0.73	0.73	0.69	0.61	0.92	0.56	0.40	0.22	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.56	0.42	0.29	0.95	0.65	n/a	n/a
12-1/2 (318)	0.74	0.74	0.70	0.62	0.95	0.59	0.41	0.23	0.74	0.61	0.58	0.55		0.52	0.34	0.16		0.59	0.43	0.29	0.97	0.66	0.57	n/a
14 (356)	0.76	0.76	0.72	0.63	1.00	0.66	0.46	0.25	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.66	0.47	0.31	1.00	0.70	0.60	n/a
16 (406)	0.80	0.80	0.75	0.65		0.75	0.52	0.29	0.80	0.64	0.60	0.56		0.76	0.49	0.23		0.75	0.52	0.34		0.75	0.65	n/a
18 (457)	0.84	0.84	0.79	0.67		0.84	0.59	0.32	0.84	0.66	0.62	0.57		0.91	0.59	0.27		0.84	0.59	0.36		0.79	0.68	n/a
19-1/2 (495)	0.87	0.87	0.81	0.69		0.92	0.64	0.35	0.87	0.67	0.63	0.58		1.00	0.66	0.31		0.92	0.64	0.38		0.82	0.71	0.55
20 (508)	0.88	0.88	0.82	0.69		0.94	0.65	0.36	0.88	0.67	0.63	0.58			0.69	0.32		0.94	0.65	0.39		0.83	0.72	0.56
22 (559)	0.91	0.91	0.85	0.71		1.00	0.72	0.40	0.92	0.69	0.64	0.59			0.80	0.37		1.00	0.72	0.41		0.87	0.76	0.59
24 (610)	0.95	0.95	0.88	0.73			0.78	0.43	0.96	0.71	0.66	0.59			0.91	0.42			0.78	0.44		0.91	0.79	0.61
26 (660)	0.99	0.99	0.91	0.75			0.85	0.47	0.99	0.73	0.67	0.60			1.00	0.48			0.85	0.47		0.95	0.82	0.64
28 (711)	1.00	1.00	0.94	0.77			0.91	0.50	1.00	0.74	0.68	0.61				0.53			0.91	0.50		0.99	0.85	0.66
30 (762)			0.98	0.79			0.98	0.54		0.76	0.70	0.62				0.59			0.98	0.54		1.00	0.88	0.68
36 (914)			1.00	0.84			1.00	0.65		0.81	0.73	0.64				0.77			1.00	0.65			0.97	0.75
> 48 (1219)				0.96				0.86		0.92	0.81	0.69				1.00				0.86			1.00	0.87

Table 39 - Load adjustment factors for 7/8-in. diameter threaded rods in cracked concrete[1,2,3]

7/8-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)	3-1/2 (89)	7-7/8 (200)	10-1/2 (267)	17-1/2 (445)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.42	0.42	0.41	0.38	n/a	n/a	n/a	n/a	0.09	0.03	0.02	0.01	0.18	0.06	0.04	0.02	n/a	n/a	n/a	n/a
4-3/8 (111)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.58	0.54	0.53	0.52	0.36	0.11	0.07	0.03	0.71	0.22	0.14	0.07	n/a	n/a	n/a	n/a
5 (127)	0.59	0.59	0.58	0.55	0.56	0.56	0.52	0.45	0.60	0.54	0.53	0.52	0.43	0.13	0.09	0.04	0.87	0.27	0.17	0.08	n/a	n/a	n/a	n/a
5-1/2 (140)	0.60	0.60	0.59	0.55	0.58	0.58	0.54	0.46	0.61	0.55	0.54	0.52	0.50	0.15	0.10	0.05	1.00	0.31	0.20	0.10	0.65	n/a	n/a	n/a
6 (152)	0.61	0.61	0.60	0.56	0.61	0.61	0.56	0.47	0.61	0.55	0.54	0.52	0.57	0.18	0.11	0.06		0.35	0.23	0.11	0.68	n/a	n/a	n/a
7 (178)	0.63	0.63	0.61	0.57	0.65	0.65	0.60	0.49	0.63	0.56	0.55	0.53	0.72	0.22	0.14	0.07		0.44	0.29	0.14	0.73	n/a	n/a	n/a
8 (203)	0.65	0.65	0.63	0.58	0.71	0.71	0.64	0.52	0.65	0.57	0.55	0.53	0.88	0.27	0.18	0.09		0.54	0.35	0.17	0.78	n/a	n/a	n/a
9 (229)	0.67	0.67	0.64	0.59	0.76	0.76	0.68	0.54	0.67	0.58	0.56	0.54	1.00	0.32	0.21	0.10		0.65	0.42	0.20	0.83	n/a	n/a	n/a
9-7/8 (251)	0.69	0.69	0.66	0.59	0.80	0.80	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.12		0.74	0.48	0.23	0.87	0.59	n/a	n/a
10 (254)	0.69	0.69	0.66	0.60	0.81	0.81	0.73	0.56	0.69	0.59	0.57	0.54		0.38	0.25	0.12		0.76	0.49	0.24	0.87	0.59	n/a	n/a
11 (279)	0.71	0.71	0.67	0.60	0.87	0.87	0.77	0.59	0.71	0.60	0.57	0.54		0.44	0.28	0.14		0.87	0.57	0.28	0.92	0.62	n/a	n/a
12 (305)	0.73	0.73	0.69	0.61	0.92	0.92	0.82	0.61	0.73	0.60	0.58	0.55		0.50	0.32	0.16		1.00	0.65	0.31	0.96	0.65	n/a	n/a
12-1/2 (318)	0.74	0.74	0.70	0.62	0.95	0.95	0.84	0.62	0.74	0.61	0.58	0.55		0.53	0.34	0.17			0.69	0.33	0.98	0.66	0.57	n/a
14 (356)	0.76	0.76	0.72	0.63	1.00	1.00	0.91	0.66	0.77	0.62	0.59	0.56		0.63	0.41	0.20			0.82	0.40	1.00	0.70	0.61	n/a
16 (406)	0.80	0.80	0.75	0.65			1.00	0.71	0.81	0.64	0.60	0.56		0.77	0.50	0.24			1.00	0.48		0.75	0.65	n/a
18 (457)	0.84	0.84	0.79	0.67				0.76	0.84	0.66	0.62	0.57		0.91	0.59	0.29				0.58		0.79	0.69	n/a
19-1/2 (495)	0.87	0.87	0.81	0.69				0.80	0.87	0.67	0.63	0.58		1.00	0.67	0.32				0.65		0.82	0.71	0.56
20 (508)	0.88	0.88	0.82	0.69				0.82	0.88	0.67	0.63	0.58			0.70	0.34				0.67		0.84	0.72	0.57
22 (559)	0.91	0.91	0.85	0.71				0.87	0.92	0.69	0.64	0.59			0.80	0.39				0.78		0.88	0.76	0.60
24 (610)	0.95	0.95	0.88	0.73				0.93	0.96	0.71	0.66	0.60			0.91	0.44				0.89		0.92	0.79	0.62
26 (660)	0.99	0.99	0.91	0.75				0.99	1.00	0.73	0.67	0.61			1.00	0.50				0.99		0.95	0.82	0.65
28 (711)	1.00	1.00	0.94	0.77				1.00		0.74	0.68	0.61				0.56				1.00		0.99	0.86	0.67
30 (762)			0.98	0.79						0.76	0.70	0.62				0.62						1.00	0.89	0.70
36 (914)			1.00	0.84						0.81	0.74	0.65				0.81							0.97	0.76
> 48 (1219)				0.96						0.92	0.81	0.69				1.00							1.00	0.88

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 40 - Load adjustment factors for 1-in. diameter threaded rods in uncracked concrete[1,2,3]

1-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.38	0.24	0.18	0.10	n/a	n/a	n/a	n/a	0.08	0.02	0.01	0.01	0.15	0.05	0.03	0.01	n/a	n/a	n/a	n/a
5 (127)	0.58	0.58	0.57	0.54	0.53	0.32	0.23	0.13	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.65	0.22	0.14	0.07	n/a	n/a	n/a	n/a
6 (152)	0.60	0.60	0.58	0.55	0.58	0.34	0.25	0.14	0.60	0.55	0.53	0.52	0.48	0.14	0.09	0.04	0.74	0.29	0.19	0.09	n/a	n/a	n/a	n/a
6-1/4 (159)	0.60	0.60	0.59	0.55	0.59	0.35	0.26	0.14	0.61	0.55	0.54	0.52	0.51	0.15	0.10	0.05	0.77	0.30	0.20	0.09	0.65	n/a	n/a	n/a
7 (178)	0.62	0.62	0.60	0.56	0.62	0.37	0.27	0.15	0.62	0.55	0.54	0.52	0.61	0.18	0.12	0.05	0.87	0.36	0.23	0.11	0.69	n/a	n/a	n/a
8 (203)	0.63	0.63	0.61	0.57	0.66	0.40	0.29	0.16	0.64	0.56	0.55	0.53	0.74	0.22	0.14	0.07	0.99	0.40	0.29	0.13	0.74	n/a	n/a	n/a
9 (229)	0.65	0.65	0.63	0.58	0.71	0.43	0.31	0.17	0.65	0.57	0.55	0.53	0.89	0.26	0.17	0.08	1.00	0.43	0.34	0.16	0.78	n/a	n/a	n/a
10 (254)	0.67	0.67	0.64	0.58	0.75	0.46	0.33	0.18	0.67	0.58	0.56	0.53	1.00	0.31	0.20	0.09		0.46	0.35	0.19	0.83	n/a	n/a	n/a
11 (279)	0.68	0.68	0.65	0.59	0.80	0.49	0.35	0.19	0.69	0.58	0.56	0.54		0.35	0.23	0.11		0.49	0.37	0.21	0.87	n/a	n/a	n/a
11-1/4 (286)	0.69	0.69	0.66	0.59	0.81	0.50	0.35	0.19	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.50	0.38	0.22	0.88	0.58	n/a	n/a
12 (305)	0.70	0.70	0.67	0.60	0.85	0.52	0.37	0.20	0.70	0.59	0.57	0.54		0.40	0.26	0.12		0.52	0.39	0.24	0.91	0.60	n/a	n/a
13 (330)	0.72	0.72	0.68	0.61	0.90	0.55	0.39	0.21	0.72	0.60	0.57	0.54		0.46	0.30	0.14		0.55	0.42	0.28	0.94	0.63	n/a	n/a
14 (356)	0.73	0.73	0.69	0.62	0.95	0.59	0.41	0.23	0.74	0.61	0.58	0.55		0.51	0.33	0.15		0.59	0.44	0.30	0.98	0.65	n/a	n/a
14-1/4 (362)	0.74	0.74	0.70	0.62	0.97	0.60	0.42	0.23	0.74	0.61	0.58	0.55		0.52	0.34	0.16		0.60	0.44	0.30	0.99	0.66	0.57	n/a
16 (406)	0.77	0.77	0.72	0.63	1.00	0.67	0.47	0.26	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.67	0.48	0.32	1.00	0.70	0.60	n/a
18 (457)	0.80	0.80	0.75	0.65		0.76	0.53	0.29	0.81	0.64	0.60	0.56		0.74	0.48	0.22		0.76	0.53	0.34		0.74	0.64	n/a
20 (508)	0.84	0.84	0.78	0.67		0.84	0.58	0.32	0.84	0.65	0.61	0.57		0.87	0.56	0.26		0.84	0.58	0.36		0.78	0.67	n/a
22 (559)	0.87	0.87	0.81	0.68		0.93	0.64	0.35	0.88	0.67	0.63	0.58		1.00	0.65	0.30		0.93	0.64	0.38		0.82	0.71	n/a
22-1/4 (565)	0.87	0.87	0.81	0.69		0.94	0.65	0.36	0.88	0.67	0.63	0.58			0.66	0.31		0.94	0.65	0.39		0.82	0.71	0.55
24 (610)	0.90	0.90	0.83	0.70		1.00	0.70	0.38	0.91	0.68	0.64	0.58			0.74	0.35		1.00	0.70	0.41		0.85	0.74	0.57
26 (660)	0.94	0.94	0.86	0.72			0.76	0.42	0.94	0.70	0.65	0.59			0.84	0.39			0.76	0.43		0.89	0.77	0.60
28 (711)	0.97	0.97	0.89	0.73			0.82	0.45	0.98	0.71	0.66	0.60			0.94	0.43			0.82	0.45		0.92	0.80	0.62
30 (762)	1.00	1.00	0.92	0.75			0.88	0.48	1.00	0.73	0.67	0.60			1.00	0.48			0.88	0.48		0.95	0.83	0.64
36 (914)			1.00	0.80			1.00	0.58		0.77	0.70	0.62				0.63			1.00	0.58		1.00	0.91	0.70
> 48 (1219)				0.90				0.77		0.86	0.77	0.66				0.98				0.77			1.00	0.81

Table 41 - Load adjustment factors for 1-in. diameter threaded rods in cracked concrete[1,2,3]

1-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ‖ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)	4 (102)	9 (229)	12 (305)	20 (508)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)																								
1-3/4 (44)	n/a	n/a	n/a	n/a	0.41	0.41	0.40	0.38	n/a	n/a	n/a	n/a	0.08	0.02	0.01	0.01	0.15	0.05	0.03	0.01	n/a	n/a	n/a	n/a
5 (127)	0.58	0.58	0.57	0.54	0.53	0.53	0.50	0.44	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.74	0.22	0.14	0.07	n/a	n/a	n/a	n/a
6 (152)	0.60	0.60	0.58	0.55	0.58	0.58	0.53	0.46	0.60	0.55	0.53	0.52	0.49	0.14	0.09	0.04	0.97	0.29	0.19	0.09	n/a	n/a	n/a	n/a
6-1/4 (159)	0.60	0.60	0.59	0.55	0.59	0.59	0.54	0.46	0.61	0.55	0.54	0.52	0.52	0.15	0.10	0.05	1.00	0.31	0.20	0.09	0.66	n/a	n/a	n/a
7 (178)	0.62	0.62	0.60	0.56	0.62	0.62	0.57	0.47	0.62	0.55	0.54	0.52	0.61	0.18	0.12	0.05		0.36	0.24	0.11	0.69	n/a	n/a	n/a
8 (203)	0.63	0.63	0.61	0.57	0.66	0.66	0.60	0.49	0.64	0.56	0.55	0.53	0.75	0.22	0.14	0.07		0.44	0.29	0.13	0.74	n/a	n/a	n/a
9 (229)	0.65	0.65	0.63	0.58	0.71	0.71	0.64	0.51	0.65	0.57	0.55	0.53	0.89	0.26	0.17	0.08		0.53	0.34	0.16	0.79	n/a	n/a	n/a
10 (254)	0.67	0.67	0.64	0.58	0.75	0.75	0.67	0.53	0.67	0.58	0.56	0.53	1.00	0.31	0.20	0.09		0.62	0.40	0.19	0.83	n/a	n/a	n/a
11 (279)	0.68	0.68	0.65	0.59	0.80	0.80	0.71	0.55	0.69	0.58	0.56	0.54		0.36	0.23	0.11		0.72	0.46	0.22	0.87	n/a	n/a	n/a
11-1/4 (286)	0.69	0.69	0.66	0.59	0.81	0.81	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.74	0.48	0.22	0.88	0.59	n/a	n/a
12 (305)	0.70	0.70	0.67	0.60	0.85	0.85	0.75	0.57	0.71	0.59	0.57	0.54		0.41	0.26	0.12		0.82	0.53	0.25	0.91	0.61	n/a	n/a
13 (330)	0.72	0.72	0.68	0.61	0.90	0.90	0.79	0.59	0.72	0.60	0.57	0.54		0.46	0.30	0.14		0.92	0.60	0.28	0.95	0.63	n/a	n/a
14 (356)	0.73	0.73	0.69	0.62	0.95	0.95	0.83	0.62	0.74	0.61	0.58	0.55		0.51	0.33	0.16		1.00	0.67	0.31	0.98	0.65	n/a	n/a
14-1/4 (362)	0.74	0.74	0.70	0.62	0.97	0.97	0.84	0.62	0.74	0.61	0.58	0.55		0.53	0.34	0.16			0.69	0.32	0.99	0.66	0.57	n/a
16 (406)	0.77	0.77	0.72	0.63	1.00	1.00	0.91	0.66	0.77	0.62	0.59	0.55		0.63	0.41	0.19			0.82	0.38	1.00	0.70	0.61	n/a
18 (457)	0.80	0.80	0.75	0.65			1.00	0.70	0.81	0.64	0.60	0.56		0.75	0.49	0.23			0.97	0.45		0.74	0.64	n/a
20 (508)	0.84	0.84	0.78	0.67				0.75	0.84	0.65	0.61	0.57		0.88	0.57	0.26			1.00	0.53		0.78	0.68	n/a
22 (559)	0.87	0.87	0.81	0.68				0.80	0.88	0.67	0.63	0.58		1.00	0.66	0.31				0.61		0.82	0.71	n/a
22-1/4 (565)	0.87	0.87	0.81	0.69				0.80	0.88	0.67	0.63	0.58			0.67	0.31				0.62		0.82	0.71	0.55
24 (610)	0.90	0.90	0.83	0.70				0.85	0.91	0.68	0.64	0.58			0.75	0.35				0.70		0.86	0.74	0.57
26 (660)	0.94	0.94	0.86	0.72				0.90	0.95	0.70	0.65	0.59			0.84	0.39				0.78		0.89	0.77	0.60
28 (711)	0.97	0.97	0.89	0.73				0.95	0.98	0.71	0.66	0.60			0.94	0.44				0.88		0.92	0.80	0.62
30 (762)	1.00	1.00	0.92	0.75				1.00	1.00	0.73	0.67	0.60			1.00	0.49				0.97		0.96	0.83	0.64
36 (914)			1.00	0.80						0.77	0.71	0.62				0.64				1.00		1.00	0.91	0.70
> 48 (1219)				0.90						0.87	0.77	0.66				0.98							1.00	0.81

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

3.2.4

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 42 - Load adjustment factors for 1-1/4-in. diameter threaded rods in uncracked concrete[1,2,3]

1-1/4-in. uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm) / Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)
1-3/4 (44)	n/a	n/a	n/a	n/a	0.37	0.24	0.17	0.09	n/a	n/a	n/a	n/a	0.05	0.02	0.01	0.00	0.11	0.03	0.02	0.01	n/a	n/a	n/a	n/a
6-1/4 (159)	0.59	0.59	0.57	0.54	0.54	0.33	0.24	0.13	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.67	0.22	0.14	0.07	n/a	n/a	n/a	n/a
7 (178)	0.60	0.60	0.58	0.55	0.57	0.35	0.25	0.13	0.60	0.54	0.53	0.52	0.43	0.13	0.08	0.04	0.73	0.26	0.17	0.08	n/a	n/a	n/a	n/a
8 (203)	0.61	0.61	0.59	0.55	0.61	0.37	0.26	0.14	0.61	0.55	0.54	0.52	0.53	0.16	0.10	0.05	0.82	0.31	0.20	0.10	0.66	n/a	n/a	n/a
9 (229)	0.63	0.63	0.60	0.56	0.64	0.39	0.28	0.15	0.62	0.55	0.54	0.52	0.63	0.19	0.12	0.06	0.93	0.38	0.24	0.11	0.70	n/a	n/a	n/a
10 (254)	0.64	0.64	0.61	0.57	0.68	0.41	0.29	0.16	0.64	0.56	0.55	0.53	0.74	0.22	0.14	0.07	1.00	0.41	0.29	0.13	0.74	n/a	n/a	n/a
11 (279)	0.65	0.65	0.62	0.57	0.72	0.44	0.31	0.17	0.65	0.57	0.55	0.53	0.86	0.25	0.16	0.08		0.44	0.33	0.15	0.78	n/a	n/a	n/a
12 (305)	0.67	0.67	0.63	0.58	0.76	0.46	0.33	0.18	0.66	0.57	0.55	0.53	0.98	0.29	0.19	0.09		0.46	0.36	0.17	0.81	n/a	n/a	n/a
13 (330)	0.68	0.68	0.64	0.59	0.80	0.49	0.35	0.19	0.68	0.58	0.56	0.54	1.00	0.33	0.21	0.10		0.49	0.38	0.20	0.84	n/a	n/a	n/a
14 (356)	0.70	0.70	0.66	0.59	0.84	0.52	0.36	0.20	0.69	0.59	0.56	0.54		0.36	0.24	0.11		0.52	0.40	0.22	0.87	0.58	n/a	n/a
14-1/4 (362)	0.70	0.70	0.66	0.60	0.85	0.52	0.37	0.20	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.52	0.40	0.23	0.88	0.59	n/a	n/a
15 (381)	0.71	0.71	0.67	0.60	0.88	0.54	0.38	0.21	0.70	0.59	0.57	0.54		0.40	0.26	0.12		0.54	0.41	0.24	0.91	0.60	n/a	n/a
16 (406)	0.72	0.72	0.68	0.61	0.92	0.57	0.40	0.22	0.72	0.60	0.57	0.54		0.45	0.29	0.13		0.57	0.43	0.27	0.94	0.62	n/a	n/a
17 (432)	0.74	0.74	0.69	0.61	0.96	0.60	0.42	0.23	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.60	0.45	0.29	0.96	0.64	n/a	n/a
18 (457)	0.75	0.75	0.70	0.62	1.00	0.63	0.44	0.24	0.75	0.61	0.58	0.55		0.53	0.35	0.16		0.63	0.47	0.31	0.99	0.66	0.57	n/a
20 (508)	0.78	0.78	0.72	0.63		0.70	0.49	0.27	0.77	0.62	0.59	0.55		0.62	0.40	0.19		0.70	0.50	0.33	1.00	0.70	0.60	n/a
22 (559)	0.81	0.81	0.74	0.65		0.77	0.54	0.29	0.80	0.63	0.60	0.56		0.72	0.47	0.22		0.77	0.54	0.35		0.73	0.63	n/a
24 (610)	0.84	0.84	0.77	0.66		0.84	0.59	0.32	0.83	0.65	0.61	0.57		0.82	0.53	0.25		0.84	0.59	0.36		0.76	0.66	n/a
26 (660)	0.87	0.87	0.79	0.67		0.91	0.64	0.34	0.86	0.66	0.62	0.57		0.92	0.60	0.28		0.91	0.64	0.38		0.79	0.69	n/a
28 (711)	0.89	0.89	0.81	0.69		0.98	0.68	0.37	0.88	0.67	0.63	0.58		1.00	0.67	0.31		0.98	0.68	0.40		0.82	0.71	0.55
30 (762)	0.92	0.92	0.83	0.70		1.00	0.73	0.40	0.91	0.68	0.64	0.58			0.74	0.35		1.00	0.73	0.42		0.85	0.74	0.57
36 (914)	1.00	1.00	0.90	0.74			0.88	0.48	0.99	0.72	0.66	0.60			0.98	0.45			0.88	0.48		0.94	0.81	0.63
> 48 (1219)			1.00	0.82			1.00	0.64	1.00	0.79	0.72	0.63			1.00	0.70			1.00	0.64		1.00	0.94	0.72

Table 43 - Load adjustment factors for 1-1/4-in. diameter threaded rods in cracked concrete[1,2,3]

1-1/4-in. cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[4] f_{AV}				Edge distance in shear: ⊥ Toward edge f_{RV}				Edge distance in shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[5] f_{HV}			
Embedment h_{ef} in. (mm) / Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h), - in. (mm)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)	5 (127)	11-1/4 (286)	15 (381)	25 (635)
1-3/4 (44)	n/a	n/a	n/a	n/a	0.40	0.40	0.39	0.37	n/a	n/a	n/a	n/a	0.05	0.02	0.01	0.00	0.11	0.03	0.02	0.01	n/a	n/a	n/a	n/a
6-1/4 (159)	0.59	0.59	0.57	0.54	0.54	0.54	0.50	0.44	0.59	0.54	0.53	0.52	0.37	0.11	0.07	0.03	0.74	0.22	0.14	0.07	n/a	n/a	n/a	n/a
7 (178)	0.60	0.60	0.58	0.55	0.57	0.57	0.52	0.45	0.60	0.54	0.53	0.52	0.44	0.13	0.08	0.04	0.88	0.26	0.17	0.08	n/a	n/a	n/a	n/a
8 (203)	0.61	0.61	0.59	0.55	0.61	0.61	0.55	0.46	0.61	0.55	0.54	0.52	0.54	0.16	0.10	0.05	1.00	0.32	0.21	0.10	0.66	n/a	n/a	n/a
9 (229)	0.63	0.63	0.60	0.56	0.64	0.64	0.57	0.48	0.62	0.55	0.54	0.52	0.64	0.19	0.12	0.06		0.38	0.25	0.11	0.70	n/a	n/a	n/a
10 (254)	0.64	0.64	0.61	0.57	0.68	0.68	0.60	0.49	0.64	0.56	0.55	0.53	0.75	0.22	0.14	0.07		0.44	0.29	0.13	0.74	n/a	n/a	n/a
11 (279)	0.65	0.65	0.62	0.57	0.72	0.72	0.63	0.51	0.65	0.57	0.55	0.53	0.86	0.26	0.17	0.08		0.51	0.33	0.15	0.78	n/a	n/a	n/a
12 (305)	0.67	0.67	0.63	0.58	0.76	0.76	0.66	0.53	0.66	0.57	0.55	0.53	0.98	0.29	0.19	0.09		0.58	0.38	0.18	0.81	n/a	n/a	n/a
13 (330)	0.68	0.68	0.64	0.59	0.80	0.80	0.69	0.54	0.68	0.58	0.56	0.54	1.00	0.33	0.21	0.10		0.66	0.43	0.20	0.85	n/a	n/a	n/a
14 (356)	0.70	0.70	0.66	0.59	0.84	0.84	0.72	0.56	0.69	0.59	0.56	0.54		0.37	0.24	0.11		0.73	0.48	0.22	0.88	0.58	n/a	n/a
14-1/4 (362)	0.70	0.70	0.66	0.60	0.85	0.85	0.73	0.56	0.70	0.59	0.57	0.54		0.38	0.25	0.11		0.75	0.49	0.23	0.89	0.59	n/a	n/a
15 (381)	0.71	0.71	0.67	0.60	0.88	0.88	0.75	0.57	0.71	0.59	0.57	0.54		0.41	0.26	0.12		0.82	0.53	0.25	0.91	0.61	n/a	n/a
16 (406)	0.72	0.72	0.68	0.61	0.92	0.92	0.78	0.59	0.72	0.60	0.57	0.54		0.45	0.29	0.14		0.90	0.58	0.27	0.94	0.63	n/a	n/a
17 (432)	0.74	0.74	0.69	0.61	0.96	0.96	0.81	0.61	0.73	0.60	0.58	0.55		0.49	0.32	0.15		0.98	0.64	0.30	0.97	0.64	n/a	n/a
18 (457)	0.75	0.75	0.70	0.62	1.00	1.00	0.85	0.62	0.75	0.61	0.58	0.55		0.54	0.35	0.16		1.00	0.70	0.32	0.99	0.66	0.57	n/a
20 (508)	0.78	0.78	0.72	0.63			0.91	0.66	0.77	0.62	0.59	0.55		0.63	0.41	0.19			0.82	0.38	1.00	0.70	0.61	n/a
22 (559)	0.81	0.81	0.74	0.65			0.98	0.69	0.80	0.63	0.60	0.56		0.72	0.47	0.22			0.94	0.44		0.73	0.63	n/a
24 (610)	0.84	0.84	0.77	0.66			1.00	0.73	0.83	0.65	0.61	0.57		0.82	0.54	0.25			1.00	0.50		0.77	0.66	n/a
26 (660)	0.87	0.87	0.79	0.67				0.77	0.86	0.66	0.62	0.57		0.93	0.60	0.28				0.56		0.80	0.69	n/a
28 (711)	0.89	0.89	0.81	0.69				0.81	0.88	0.67	0.63	0.58		1.00	0.68	0.31				0.63		0.83	0.72	0.55
30 (762)	0.92	0.92	0.83	0.70				0.85	0.91	0.68	0.64	0.58			0.75	0.35				0.70		0.86	0.74	0.57
36 (914)	1.00	1.00	0.90	0.74				0.97	0.99	0.72	0.66	0.60			0.98	0.46				0.91		0.94	0.81	0.63
> 48 (1219)			1.00	0.82				1.00	1.00	0.79	0.72	0.63			1.00	0.70				1.00		1.00	0.94	0.73

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the installation torque is reduced to 0.30 T_{max} for 5d ≤ s ≤ 16-in. and to 0.5 T_{max} for s > 16-in.

3 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

3.2.4.3.6 HIT-RE 500 V3 adhesive with HIS-N and HIS-RN internally threaded insert

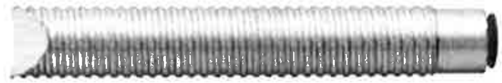


Figure 7 - Hilti HIS-N and HIS-RN internally threaded insert installation conditions

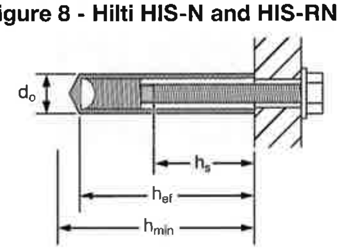
Cracked or uncracked concrete	Permissible drilling methods	Permissible concrete conditions
Cracked and uncracked concrete	Hammer drilling with carbide-tipped drill bit	Dry concrete Water-saturated concrete Water-filled holes Submerged (underwater)
	Hilti TE-CD or TE-YD hollow drill bit Diamond core drill bit with Hilti TE-YRT roughening tool	Dry concrete Water-saturated concrete
Uncracked concrete	Diamond core drill bit	Dry concrete Water-saturated concrete

3.2.4

Table 44 - HIS-N and HIS-RN specifications

Setting information		Symbol	Units	Thread size			
				3/8-16 UNC	1/2-13 UNC	5/8-11 UNC	3/4-10 UNC
Outside diameter of insert			in.	0.65	0.81	1.00	1.09
Nominal bit diameter		d_o	in.	11/16	7/8	1-1/8	1-1/4
Effective embedment		h_{ef}	in.	4-3/8	5	6-3/4	8-1/8
			(mm)	(110)	(125)	(170)	(205)
Thread engagement	minimum	h_s	in.	3/8	1/2	5/8	3/4
	maximum		in.	15/16	1-3/16	1-1/2	1-7/8
Installation torque		T_{inst}	ft-lb	15	30	60	100
			(Nm)	(20)	(40)	(81)	(136)
Minimum concrete thickness		h_{min}	in.	5.9	6.7	9.1	10.6
			(mm)	(150)	(170)	(230)	(270)
Minimum edge distance		c_{min}	in	3-1/4	4	5	5-1/2
			(mm)	(83)	(102)	(127)	(140)
Minimum anchor spacing		s_{min}	in	3-1/4	4	5	5-1/2
			(mm)	(83)	(102)	(127)	(140)

Figure 8 - Hilti HIS-N and HIS-RN specifications



3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 45 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8-16 UNC	4-3/8 (111)	7,140 (31.8)	7,820 (34.8)	9,030 (40.2)	11,060 (49.2)	15,375 (68.4)	16,840 (74.9)	19,445 (86.5)	23,815 (105.9)
1/2-13[10] UNC	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
5/8-11[10] UNC	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
3/4-10[10] UNC	8-1/8 (206)	18,065 (80.4)	19,790 (88.0)	22,850 (101.6)	27,985 (124.5)	38,910 (173.1)	42,620 (189.6)	49,215 (218.9)	60,275 (268.1)

Table 46 - Hilti HIT-RE 500 V3 adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
3/8-16 UNC	4-3/8 (111)	5,055 (22.5)	5,540 (24.6)	6,395 (28.4)	7,085 (31.5)	10,890 (48.4)	11,930 (53.1)	13,775 (61.3)	15,260 (67.9)
1/2-13[10] UNC	5 (127)	6,175 (27.5)	6,765 (30.1)	7,815 (34.8)	9,570 (42.6)	13,305 (59.2)	14,575 (64.8)	16,830 (74.9)	20,610 (91.7)
5/8-11[10] UNC	6-3/4 (171)	9,690 (43.1)	10,615 (47.2)	12,255 (54.5)	15,010 (66.8)	20,870 (92.8)	22,860 (101.7)	26,395 (117.4)	32,330 (143.8)
3/4-10[10] UNC	8-1/8 (206)	12,795 (56.9)	14,015 (62.3)	16,185 (72.0)	19,825 (88.2)	27,560 (122.6)	30,190 (134.3)	34,860 (155.1)	42,695 (189.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 and 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130° F (55° C), max. long term temperature = 110° F (43° C).
For temperature range B: Max. short term temperature = 176° F (80° C), max. long term temperature = 110° F (43° C) multiply above values by 0.69
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.52.
For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10. For diamond core drilling in uncracked concrete, except as indicated in note 10, multiply the above values by 0.57. Diamond core drilling is not permitted for water-filled or under-water (submerged) applications in uncracked concrete.
10 Diamond core drilling is permitted in uncracked and cracked concrete with use of the Hilti TE-YRT roughening tool for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Tables 47 and 48.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.75. See section 3.1.8.7 for additional information on seismic applications.

Table 47 - Hilti HIT-RE 500 V3 in Core Drilled Holes roughened with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
1/2-13 UNC	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	13,510 (60.1)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
5/8-11 UNC	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	17,305 (77.0)	21,190 (94.3)	29,460 (131.0)	32,275 (143.6)	37,265 (165.8)	45,645 (203.0)
3/4-10 UNC	8-1/8 (206)	18,065 (80.4)	19,790 (88.0)	22,850 (101.6)	27,985 (124.5)	38,910 (173.1)	42,620 (189.6)	49,215 (218.9)	60,275 (268.1)

Table 48 - Hilti HIT-RE 500 V3 in Core Drilled Holes roughened with TE-YRT Roughening Tool adhesive design strength with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9]

Thread size	Effective embedment in. (mm)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)	f'_c = 2,500 psi (17.2 MPa) lb (kN)	f'_c = 3,000 psi (20.7 MPa) lb (kN)	f'_c = 4,000 psi (27.6 MPa) lb (kN)	f'_c = 6,000 psi (41.4 MPa) lb (kN)
1/2-13 UNC	5 (127)	6,175 (27.5)	6,205 (27.6)	6,205 (27.6)	6,205 (27.6)	13,305 (59.2)	13,360 (59.4)	13,360 (59.4)	13,360 (59.4)
5/8-11 UNC	6-3/4 (171)	9,690 (43.1)	10,340 (46.0)	10,340 (46.0)	10,340 (46.0)	20,870 (92.8)	22,265 (99.0)	22,265 (99.0)	22,265 (99.0)
3/4-10 UNC	8-1/8 (206)	12,795 (56.9)	13,565 (60.3)	13,565 (60.3)	13,565 (60.3)	27,560 (122.6)	29,215 (130.0)	29,215 (130.0)	29,215 (130.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength (factored resistance) value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 and 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130° F (55° C), max. long term temperature = 110° F (43° C).
For temperature range B: Max. short term temperature = 176° F (80° C), max. long term temperature = 110° F (43° C) multiply above values by 0.69
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water saturated concrete conditions. Water-filled and submerged (underwater) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic loads, multiply cracked concrete tabular values in tension and shear by a_{seis} = 0.75. See section 3.1.8.7 for additional information on seismic applications.

Table 49 - Steel design strength for steel bolt / cap screw for Hilti HIS-N and HIS-RN internally threaded inserts[1,2,3]

Thread size	ASTM A 193 B7			ASTM A 193 Grade B8M stainless steel		
	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)	Tensile[4] ϕN_{sa} lb (kN)	Shear[5] ϕV_{sa} lb (kN)	Seismic Shear[6] $\phi V_{sa,eq}$ lb (kN)
3/8-16 UNC	6,300 (28.0)	3,490 (15.5)	2,445 (10.9)	5,540 (24.6)	3,070 (13.7)	2,150 (9.6)
1/2-13 UNC	10,525 (46.8)	6,385 (28.4)	4,470 (19.9)	10,145 (45.1)	5,620 (25.0)	3,935 (17.5)
5/8-11 UNC	17,500 (77.8)	10,170 (45.2)	7,120 (31.7)	16,160 (71.9)	8,950 (39.8)	6,265 (27.9)
3/4-10 UNC	17,785 (79.1)	15,055 (67.0)	10,540 (46.9)	23,915 (106.4)	13,245 (58.9)	9,270 (41.2)

1 See Section 3.1.8.6 to convert design strength value to ASD value.
2 Hilti HIS-N and HIS-RN inserts with steel bolts are considered brittle steel elements.
3 Table values are the lesser of steel failure in the HIS-N insert or inserted steel bolt.
4 Tensile = $\phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17.
5 Shear = ϕ 0.60 $A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.
6 Seismic Shear = $\alpha_{V,seis} \phi V_{sa}$: Reduction for seismic shear only. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 50 - Load adjustment factors for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2]

HIS-N and HIS-RN all diameters uncracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[3] f_{AV}				Edge Distance in Shear: ⊥ Toward edge f_{RV}				Edge Distance in Shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[4] f_{HV}			
Internal diameter in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
Embedment h_{ef} in. (mm)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
3-1/4 (83)	0.59	n/a	n/a	n/a	0.36	n/a	n/a	n/a	0.55	n/a	n/a	n/a	0.15	n/a	n/a	n/a	0.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4 (102)	0.61	0.59	n/a	n/a	0.41	0.40	n/a	n/a	0.56	0.55	n/a	n/a	0.21	0.19	n/a	n/a	0.41	0.38	n/a	n/a	n/a	n/a	n/a	n/a
5 (127)	0.64	0.61	0.59	n/a	0.47	0.45	0.39	n/a	0.57	0.57	0.55	n/a	0.29	0.26	0.17	n/a	0.47	0.45	0.33	n/a	n/a	n/a	n/a	n/a
5-1/2 (140)	0.65	0.62	0.60	0.59	0.50	0.48	0.41	0.37	0.58	0.58	0.56	0.55	0.34	0.30	0.19	0.15	0.50	0.48	0.39	0.29	n/a	n/a	n/a	n/a
6 (152)	0.66	0.63	0.61	0.60	0.53	0.51	0.43	0.39	0.59	0.58	0.56	0.55	0.39	0.35	0.22	0.17	0.53	0.51	0.43	0.33	0.60	n/a	n/a	n/a
7 (178)	0.69	0.65	0.62	0.61	0.61	0.57	0.48	0.42	0.60	0.60	0.57	0.56	0.49	0.43	0.28	0.21	0.61	0.57	0.48	0.42	0.64	0.62	n/a	n/a
8 (203)	0.72	0.67	0.64	0.63	0.70	0.65	0.52	0.45	0.62	0.61	0.58	0.57	0.60	0.53	0.34	0.26	0.70	0.65	0.52	0.45	0.69	0.66	n/a	n/a
9 (229)	0.74	0.70	0.66	0.65	0.78	0.73	0.57	0.49	0.63	0.62	0.59	0.58	0.71	0.63	0.40	0.31	0.78	0.73	0.57	0.49	0.73	0.70	n/a	n/a
10 (254)	0.77	0.72	0.68	0.66	0.87	0.81	0.62	0.53	0.65	0.64	0.60	0.58	0.83	0.74	0.47	0.36	0.87	0.81	0.62	0.53	0.77	0.74	0.64	n/a
11 (279)	0.80	0.74	0.69	0.68	0.96	0.89	0.68	0.56	0.66	0.65	0.61	0.59	0.96	0.86	0.55	0.41	0.96	0.89	0.68	0.56	0.81	0.78	0.67	0.61
12 (305)	0.82	0.76	0.71	0.69	1.00	0.97	0.74	0.60	0.68	0.66	0.62	0.60	1.00	0.98	0.62	0.47	1.00	0.97	0.74	0.60	0.84	0.81	0.70	0.64
14 (356)	0.88	0.80	0.75	0.73		1.00	0.86	0.70	0.71	0.69	0.64	0.62		1.00	0.78	0.59		1.00	0.86	0.70	0.91	0.87	0.75	0.69
16 (406)	0.93	0.85	0.78	0.76			0.98	0.80	0.74	0.72	0.66	0.63			0.96	0.73			0.98	0.80	0.97	0.94	0.80	0.73
18 (457)	0.99	0.89	0.82	0.79			1.00	0.90	0.77	0.75	0.68	0.65			1.00	0.87			1.00	0.90	1.00	0.99	0.85	0.78
24 (610)	1.00	1.00	0.92	0.89				1.00	0.85	0.83	0.74	0.70				1.00				1.00		1.00	0.99	0.90
30 (762)			1.00	0.98					0.94	0.91	0.80	0.75											1.00	1.00
36 (914)				1.00					1.00	0.99	0.86	0.80												
> 48 (1219)											0.99	0.90												

Table 51 - Load adjustment factors for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2]

HIS-N and HIS-RN all diameters cracked concrete	Spacing factor in tension f_{AN}				Edge distance factor in tension f_{RN}				Spacing factor in shear[3] f_{AV}				Edge Distance in Shear: ⊥ Toward edge f_{RV}				Edge Distance in Shear: ∥ To and away from edge f_{RV}				Concrete thickness factor in shear[4] f_{HV}			
Internal diameter in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
Embedment h_{ef} in. (mm)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)	4-3/8 (111)	5 (127)	6-3/4 (171)	8-1/8 (206)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																								
3-1/4 (83)	0.59	n/a	n/a	n/a	0.54	n/a	n/a	n/a	0.55	n/a	n/a	n/a	0.16	n/a	n/a	n/a	0.31	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4 (102)	0.61	0.59	n/a	n/a	0.59	0.54	n/a	n/a	0.56	0.55	n/a	n/a	0.21	0.19	n/a	n/a	0.42	0.38	n/a	n/a	n/a	n/a	n/a	n/a
5 (127)	0.64	0.61	0.59	n/a	0.66	0.60	0.54	n/a	0.57	0.57	0.55	n/a	0.30	0.26	0.17	n/a	0.59	0.53	0.34	n/a	n/a	n/a	n/a	n/a
5-1/2 (140)	0.65	0.62	0.60	0.59	0.70	0.62	0.57	0.55	0.58	0.58	0.56	0.55	0.34	0.31	0.19	0.15	0.69	0.61	0.39	0.29	n/a	n/a	n/a	n/a
6 (152)	0.66	0.63	0.61	0.60	0.74	0.65	0.59	0.57	0.59	0.58	0.56	0.55	0.39	0.35	0.22	0.17	0.74	0.65	0.44	0.34	0.60	n/a	n/a	n/a
7 (178)	0.69	0.65	0.62	0.61	0.81	0.71	0.63	0.61	0.60	0.60	0.57	0.56	0.49	0.44	0.28	0.21	0.81	0.71	0.56	0.42	0.64	0.62	n/a	n/a
8 (203)	0.72	0.67	0.64	0.63	0.89	0.77	0.68	0.65	0.62	0.61	0.58	0.57	0.60	0.54	0.34	0.26	0.89	0.77	0.68	0.52	0.69	0.66	n/a	n/a
9 (229)	0.74	0.70	0.66	0.65	0.98	0.83	0.73	0.69	0.63	0.62	0.59	0.58	0.72	0.64	0.41	0.31	0.98	0.83	0.73	0.62	0.73	0.70	n/a	n/a
10 (254)	0.77	0.72	0.68	0.66	1.00	0.90	0.78	0.73	0.65	0.64	0.60	0.58	0.84	0.75	0.48	0.36	1.00	0.90	0.78	0.72	0.77	0.74	0.64	n/a
11 (279)	0.80	0.74	0.69	0.68		0.96	0.83	0.78	0.66	0.65	0.61	0.59	0.97	0.86	0.55	0.42		0.96	0.83	0.78	0.81	0.78	0.67	0.61
12 (305)	0.82	0.76	0.71	0.69		1.00	0.88	0.83	0.68	0.66	0.62	0.60	1.00	0.98	0.63	0.48		1.00	0.88	0.83	0.84	0.81	0.70	0.64
14 (356)	0.88	0.80	0.75	0.73			0.99	0.92	0.71	0.69	0.64	0.62		1.00	0.79	0.60			0.99	0.92	0.91	0.88	0.76	0.69
16 (406)	0.93	0.85	0.78	0.76			1.00	1.00	0.74	0.72	0.66	0.64			0.97	0.73			1.00	1.00	0.97	0.94	0.81	0.74
18 (457)	0.99	0.89	0.82	0.79					0.77	0.75	0.68	0.65			1.00	0.87					1.00	0.99	0.86	0.78
24 (610)	1.00	1.00	0.92	0.89					0.86	0.83	0.74	0.70				1.00						1.00	0.99	0.90
30 (762)			1.00	0.98					0.95	0.91	0.81	0.75											1.00	1.00
36 (914)				1.00					1.00	0.99	0.87	0.80												
> 48 (1219)										1.00	0.99	0.91												

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with a thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using the design equations from ACI 318 Chapter 17.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4.3.7 Canadian Limit State design

Limit State Design of anchors is described in the provisions of CSA A23.3-14 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors and ACI 355.4 for adhesive anchors. This section contains the Limit State Design tables with unfactored characteristic loads that are based on the published loads in ICC Evaluation Services ESR-3814. These tables are followed by factored resistance tables. The factored resistance tables have characteristic design loads that are prefactored by the applicable reduction factors for a single anchor with no anchor-to-anchor spacing or edge distance adjustments for the convenience of the user of this document. All the figures in the previous ACI 318-14 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures.

For a detailed explanation of the tables developed in accordance with CSA A23.3-14 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.com.

Table 52 - Specifications for CA rebar installed with Hilti HIT-RE 500 V3

Setting information		Symbol	Units	Rebar size				
				10M	15M	20M	25M	30M
Nominal bit diameter		d_o	in.	9/16	3/4	1	1-1/4	1-1/2
Effective embedment	minimum	$h_{ef,min}$	mm	60	80	90	100	120
	maximum	$h_{ef,max}$	mm	226	320	390	504	598
Minimum concrete member thickness		h_{min}	mm	h_{ef} + 30	h_{ef} + $2d_o$			

Note: The installation specifications in table 52 above and the data in tables 53 through 67 pertain to the use of Hilti HIT-RE 500 V3 with rebar designed as a post-installed anchor using the provisions of CSA A23.3-14 Annex D. For the use of Hilti HIT-RE 500 V3 with rebar for typical development calculations according to CSA A23.3-14 Chapter 12, refer to section 3.1.8.14 for the design method and tables 88 through 92 in section 3.2.4.3.8.

Table 53 - Steel factored resistance for CA rebar[1]

Rebar size	CSA-G30.18 Grade 400[2]		
	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)
10M	7,245 (32.2)	4,035 (17.9)	2,825 (12.6)
15M	14,525 (64.6)	8,090 (36.0)	5,665 (25.2)
20M	21,570 (95.9)	12,020 (53.5)	8,415 (37.4)
25M	36,025 (160.2)	20,070 (89.3)	14,050 (62.5)
30M	50,715 (225.6)	28,255 (125.7)	19,780 (88.0)

1 See Section 3.1.8.6 to convert design strength value to ASD value.
2 CSA-G30.18 Grade 400 rebar are considered ductile steel elements.
3 Tensile = $A_{se,N}\ \phi_s\ f_{uta}$ R as noted in CSA A23.3-14 Annex D
4 Shear = $A_{se,V}\ \phi_s$ 0.60 f_{uta} R as noted in CSA A23.3-14 Annex D.
5 Seismic Shear = $\alpha_{V,seis}\ V_{sar}$: Reduction factor for seismic shear only. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 54 - Hilti HIT-RE 500 V3 adhesive design information with CA rebar in hammer drilled holes in accordance with CSA A23.3-14 Annex D[1,8]

Design parameter		Symbol	Units	Rebar size 10M	15M	20M	25M	30M	Ref A23.3-14
Anchor O.D.		d_a	-	11.3	16.0	19.5	25.2	29.9	
Effective minimum embedment[2]		h_{ef}	-	60	80	90	101	120	
Effective maximum embedment[2]		h_{ef}	-	226	320	390	504	598	
Min. concrete thickness[2]		h_{min}	-	h_{ef} + 30	$h_{ef} + 2d_0$				
Critical edge distance		c_{ac}	-	see ESR-3814, section 4.1.10					
Minimum edge distance		c_{min}[3]	-	57	80	98	126	150	
Minimum anchor spacing		s_{min}	-	57	80	98	126	150	
Coeff. for factored conc. breakout resistance, uncracked concrete		$k_{c,uncr}$[4]	-	10					D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete		$k_{c,cr}$[4]	-	7					D.6.2.2
Concrete material resistance factor		ϕc	-	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	-	1.00					D.5.3(c)
Dry concrete and water saturated									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	1,360	1,390	1,410	1,420	1,380	D.6.5.2
			(MPa)	(9.4)	(9.6)	(9.7)	(9.8)	(9.5)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	1,760	1,720	1,690	1,650	1,610	D.6.5.2
			(MPa)	(12.1)	(11.9)	(11.7)	(11.4)	(11.1)	
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	940	960	970	980	950	D.6.5.2
			(MPa)	(6.5)	(6.6)	(6.7)	(6.8)	(6.6)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	1,210	1,190	1,170	1,140	1,110	D.6.5.2
			(MPa)	(8.3)	(8.2)	(8.1)	(7.9)	(7.7)	
Anchor category, dry concrete		-	-	1	1	1	1	1	D.5.3(c)
Resistance modification factor		R_{dry}	-	1.00	1.00	1.00	1.00	1.00	
Water-filled hole									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	1,010	1,040	1,060	1,080	1,060	D.6.5.2
			(MPa)	(7.0)	(7.2)	(7.3)	(7.4)	(7.3)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	1,300	1,280	1,270	1,250	1,240	D.6.5.2
			(MPa)	(9.0)	(8.8)	(8.8)	(8.6)	(8.6)	
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	700	720	730	740	730	D.6.5.2
			(MPa)	(4.8)	(5.0)	(5.0)	(5.1)	(5.0)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	900	890	880	860	850	D.6.5.2
			(MPa)	(6.2)	(6.1)	(6.1)	(5.9)	(5.9)	
Anchor category, water-filled hole		-	-	3	3	3	3	3	D.5.3(c)
Resistance modification factor		R_{wf}	-	0.75	0.75	0.75	0.75	0.75	
Underwater application									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	880	920	940	980	960	D.6.5.2
			(MPa)	(6.1)	(6.3)	(6.5)	(6.8)	(6.6)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	1,130	1,140	1,140	1,140	1,130	D.6.5.2
			(MPa)	(7.8)	(7.9)	(7.9)	(7.9)	(7.8)	
Temp. range B[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{cr}	psi	610	630	650	680	660	D.6.5.2
			(MPa)	(4.2)	(4.3)	(4.5)	(4.7)	(4.6)	
	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	780	790	780	780	780	D.6.5.2
			(MPa)	(5.4)	(5.4)	(5.4)	(5.4)	(5.4)	
Anchor category, underwater		-	-	3	3	3	3	3	D.5.3(c)
Resistance modification factor		R_{uw}	-	0.75	0.75	0.75	0.75	0.75	
Resistance for seismic tension		$\alpha_{N,seis}$	-	0.90	0.90	0.90	0.90	0.90	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, table 23 and 24, and converted for use with CSA A23.3-14 Annex D.

2 See figure 2 of section 3.2.4.3.1.

3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

7 Bond stress values corresponding to concrete compressive stress f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete.

8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 55 - Hilti HIT-RE 500 V3 adhesive design information with CA rebar in diamond core drilled holes in accordance with CSA A23.3-14 Annex D[1]

Design parameter		Symbol	Units	Rebar size					Ref
				10M	15M	20M	25M	30M	A23.3-14
Anchor O.D.		d_a	-	11.3	16.0	19.5	25.2	29.9	
Effective minimum embedment[2]		h_{ef}	-	60	80	90	101	120	
Effective maximum embedment[2]		h_{ef}	-	226	320	390	504	598	
Min. concrete thickness[2]		h_{min}	-	h_{ef} + 30	$h_{ef} + 2d_0$				
Critical edge distance		c_{ac}	-	see ESR-3814, section 4.1.10					
Minimum edge distance		c_{min}[3]	-	57	80	98	126	150	
Minimum anchor spacing		s_{min}	-	57	80	98	126	150	
Coeff. for factored conc. breakout resistance, uncracked concrete		$k_{c,uncr}$[4]	-	10					D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete		$k_{c,cr}$[4]	-	7					D.6.2.2
Concrete material resistance factor		ϕc	-	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	-	1.00					D.5.3(c)
Dry concrete and water saturated concrete									
Temp. range A[6]	Characteristic bond stress in cracked concrete[7,8]	τ_{uncr}	psi	1,150	1,150	1,150	1,150	1,150	D.6.5.2
			(MPa)	(7.9)	(7.9)	(7.9)	(7.9)	(7.9)	
Temp. range B[6]	Characteristic bond stress in uncracked concrete[7,8]	τ_{uncr}	psi	800	800	800	800	800	D.6.5.2
			(MPa)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	
Anchor category, dry concrete		-	-	2	3	3	3	3	D.5.3(c)
Resistance modification factor		R_{dry}	-	0.85	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, table 23 and 25B, and converted for use with CSA A23.3-14 Annex D.
2 See figure 2 of section 3.2.4.3.1.
3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.
4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
7 Bond stress values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 56 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for CA rebar in uncracked concrete[1,2,3,4,5,6,7,8,9,10,11]

Rebar size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
10M	4-1/2 (115)	7,520 (33.4)	7,950 (35.4)	8,320 (37.0)	8,940 (39.8)	15,040 (66.9)	15,900 (70.7)	16,645 (74.0)	17,885 (79.6)
	7-1/16 (180)	11,770 (52.4)	12,445 (55.4)	13,025 (57.9)	13,995 (62.3)	23,540 (104.7)	24,890 (110.7)	26,050 (115.9)	27,990 (124.5)
	8-7/8 (226)	14,775 (65.7)	15,625 (69.5)	16,355 (72.7)	17,575 (78.2)	29,555 (131.5)	31,250 (139.0)	32,705 (145.5)	35,145 (156.3)
15M[10]	5-11/16 (145)	11,410 (50.8)	12,755 (56.7)	13,975 (62.2)	15,600 (69.4)	22,820 (101.5)	25,515 (113.5)	27,950 (124.3)	31,205 (138.8)
	9-13/16 (250)	22,620 (100.6)	23,915 (106.4)	25,030 (111.3)	26,900 (119.7)	45,240 (201.2)	47,835 (212.8)	50,065 (222.7)	53,800 (239.3)
	12-5/8 (320)	28,950 (128.8)	30,615 (136.2)	32,040 (142.5)	34,430 (153.2)	57,905 (257.6)	61,225 (272.3)	64,080 (285.1)	68,860 (306.3)
20M[10]	7-7/8 (200)	18,485 (82.2)	20,665 (91.9)	22,640 (100.7)	25,770 (114.6)	36,965 (164.4)	41,330 (183.8)	45,275 (201.4)	51,540 (229.3)
	14 (355)	38,460 (171.1)	40,670 (180.9)	42,565 (189.3)	45,740 (203.5)	76,925 (342.2)	81,340 (361.8)	85,130 (378.7)	91,480 (406.9)
	15-3/8 (390)	42,255 (188.0)	44,680 (198.7)	46,760 (208.0)	50,250 (223.5)	84,510 (375.9)	89,355 (397.5)	93,525 (416.0)	100,500 (447.0)
25M	9-1/16 (230)	22,795 (101.4)	25,485 (113.4)	27,920 (124.2)	32,235 (143.4)	45,590 (202.8)	50,970 (226.7)	55,835 (248.4)	64,475 (286.8)
	15-15/16 (405)	53,265 (236.9)	58,540 (260.4)	61,270 (272.5)	65,840 (292.9)	106,525 (473.9)	117,080 (520.8)	122,540 (545.1)	131,680 (585.7)
	19-13/16 (504)	68,895 (306.5)	72,850 (324.1)	76,245 (339.2)	81,935 (364.5)	137,795 (612.9)	145,700 (648.1)	152,495 (678.3)	163,865 (728.9)
30M	10-1/4 (260)	27,395 (121.9)	30,630 (136.3)	33,555 (149.3)	38,745 (172.3)	54,795 (243.7)	61,260 (272.5)	67,110 (298.5)	77,490 (344.7)
	17-15/16 (455)	63,425 (282.1)	70,910 (315.4)	77,680 (345.5)	85,635 (380.9)	126,850 (564.3)	141,825 (630.9)	155,360 (691.1)	171,270 (761.8)
	23-9/16 (598)	94,640 (421.0)	100,070 (445.1)	104,740 (465.9)	112,550 (500.6)	189,285 (842.0)	200,145 (890.3)	209,475 (931.8)	225,100 (1001.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.48.
Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 15M and 20M diameter anchors for dry and water-saturated concrete conditions. See Table 59.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 57 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for CA rebar in cracked concrete[1,2,3,4,5,6,7,8,9,10]

Rebar size	Effective embedment in. (mm)	Tension N_r: f'_c = 20 MPa (2,900 psi) lb (kN)	Tension N_r: f'_c = 25 MPa (3,625 psi) lb (kN)	Tension N_r: f'_c = 30 MPa (4,350 psi) lb (kN)	Tension N_r: f'_c = 40 MPa (5,800 psi) lb (kN)	Shear V_r: f'_c = 20 MPa (2,900 psi) lb (kN)	Shear V_r: f'_c = 25 MPa (3,625 psi) lb (kN)	Shear V_r: f'_c = 30 MPa (4,350 psi) lb (kN)	Shear V_r: f'_c = 40 MPa (5,800 psi) lb (kN)
10M	4-1/2 (115)	5,640 (25.1)	5,920 (26.3)	6,080 (27.1)	6,350 (28.2)	11,285 (50.2)	11,835 (52.7)	12,165 (54.1)	12,700 (56.5)
	7-1/16 (180)	8,960 (39.8)	9,265 (41.2)	9,520 (42.3)	9,940 (44.2)	17,915 (79.7)	18,525 (82.4)	19,040 (84.7)	19,880 (88.4)
	8-7/8 (226)	11,250 (50.0)	11,630 (51.7)	11,955 (53.2)	12,480 (55.5)	22,495 (100.1)	23,260 (103.5)	23,905 (106.3)	24,960 (111.0)
15M[10]	5-11/16 (145)	7,985 (35.5)	8,930 (39.7)	9,780 (43.5)	11,295 (50.2)	15,975 (71.1)	17,860 (79.4)	19,565 (87.0)	22,590 (100.5)
	9-13/16 (250)	18,005 (80.1)	18,620 (82.8)	19,135 (85.1)	19,980 (88.9)	36,010 (160.2)	37,235 (165.6)	38,270 (170.2)	39,955 (177.7)
	12-5/8 (320)	23,045 (102.5)	23,830 (106.0)	24,495 (108.9)	25,575 (113.8)	46,095 (205.0)	47,665 (212.0)	48,985 (217.9)	51,145 (227.5)
20M[10]	7-7/8 (200)	12,940 (57.6)	14,465 (64.3)	15,845 (70.5)	18,300 (81.4)	25,875 (115.1)	28,930 (128.7)	31,695 (141.0)	36,595 (162.8)
	14 (355)	30,595 (136.1)	32,685 (145.4)	33,590 (149.4)	35,075 (156.0)	61,195 (272.2)	65,370 (290.8)	67,185 (298.8)	70,145 (312.0)
	15-3/8 (390)	34,725 (154.5)	35,910 (159.7)	36,905 (164.2)	38,530 (171.4)	69,450 (308.9)	71,815 (319.5)	73,805 (328.3)	77,060 (342.8)
25M	9-1/16 (230)	15,955 (71.0)	17,840 (79.4)	19,540 (86.9)	22,565 (100.4)	31,915 (142.0)	35,680 (158.7)	39,085 (173.9)	45,130 (200.8)
	15-15/16 (405)	37,285 (165.8)	41,685 (185.4)	45,665 (203.1)	52,075 (231.6)	74,570 (331.7)	83,370 (370.8)	91,325 (406.2)	104,150 (463.3)
	19-13/16 (504)	51,760 (230.2)	57,870 (257.4)	62,070 (276.1)	64,805 (288.3)	103,520 (460.5)	115,735 (514.8)	124,135 (552.2)	129,610 (576.5)
30M	10-1/4 (260)	19,180 (85.3)	21,440 (95.4)	23,490 (104.5)	27,120 (120.6)	38,355 (170.6)	42,885 (190.8)	46,975 (209.0)	54,245 (241.3)
	17-15/16 (455)	44,400 (197.5)	49,640 (220.8)	54,375 (241.9)	62,790 (279.3)	88,795 (395.0)	99,275 (441.6)	108,750 (483.7)	125,575 (558.6)
	23-9/16 (598)	66,895 (297.6)	74,790 (332.7)	81,930 (364.4)	88,665 (394.4)	133,790 (595.1)	149,580 (665.4)	163,860 (728.9)	177,325 (788.8)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete and water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.45.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete conditions except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 15M and 20M diameter anchors for dry and water-saturated concrete conditions. See Table 60.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.68. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 58 - Hilti HIT-RE 500 V3 adhesive design information with CA rebar in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3-14 Annex D[1,9]

Design parameter		Symbol	Units	Rebar size 15M	Rebar size 20M	Ref A23.3-14
Anchor O.D.		d_a	-	16.0	19.5	
Effective minimum embedment[2]		h_{ef}	-	80	90	
Effective maximum embedment[2]		h_{ef}	-	320	390	
Min. concrete thickness[2]		h_{min}	-	$h_{ef} + 2d_0$		
Critical edge distance		c_{ac}	-			
Minimum edge distance		c_{min}[3]	-	80	98	
Minimum anchor spacing		s_{min}	-	80	98	
Coeff. for factored conc. breakout resistance, uncracked concrete		$k_{c,uncr}$[4]	-	10		D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete		$k_{c,cr}$[4]	-	7		D.6.2.2
Concrete material resistance factor		ϕc	-	0.65		8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	-	1.00		D.5.3 (c)
Dry concrete and water saturated concrete						
Temp. range A[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	970 (6.7)	985 (6.8)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,720 (11.9)	1,690 (11.7)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	670 (4.6)	680 (4.7)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,190 (8.2)	1,170 (8.1)	D.6.5.2
Anchor category, dry concrete		-	-	1	1	D.5.3(c)
Resistance modification factor		R_{dry}	-	1.00	1.00	
Reduction for Seismic Tension		$\alpha_{N,seis}$	-	0.90	0.90	

1 Design information in this table is taken from ICC-ES ESR-3814, dated November 2016, table 23 and 25A, and converted for use with CSA A23.3-14 Annex D.

2 See figure 2 of section 3.2.4.3.4.

3 Minimum edge distance may be reduced to 45mm provided rebar remains untorqued. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi c,N$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete (kc,cr) or uncracked concrete (kc,uncr) must be used.

5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

7 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f'c ≤ 8,000 psi.

8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

Table 59 - Hilti HIT-RE 500 V3 adhesive factored resistance for core drilled holes roughened with Hilti TE-YRT roughening tool with concrete / bond failure for CA rebar in uncracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
15M	5-11/16 (145)	11,410 (50.8)	12,635 (56.2)	12,635 (56.2)	12,635 (56.2)	22,820 (101.5)	25,265 (112.4)	25,265 (112.4)	25,265 (112.4)
	9-13/16 (250)	21,780 (96.9)	21,780 (96.9)	21,780 (96.9)	21,780 (96.9)	43,565 (193.8)	43,565 (193.8)	43,565 (193.8)	43,565 (193.8)
	12-5/8 (320)	27,880 (124.0)	27,880 (124.0)	27,880 (124.0)	27,880 (124.0)	55,760 (248.0)	55,760 (248.0)	55,760 (248.0)	55,760 (248.0)
20M	7-7/8 (200)	18,485 (82.2)	20,665 (91.9)	20,865 (92.8)	20,865 (92.8)	36,965 (164.4)	41,330 (183.8)	41,735 (185.6)	41,735 (185.6)
	14 (355)	37,040 (164.8)	37,040 (164.8)	37,040 (164.8)	37,040 (164.8)	74,080 (329.5)	74,080 (329.5)	74,080 (329.5)	74,080 (329.5)
	15-3/8 (390)	40,690 (181.0)	40,690 (181.0)	40,690 (181.0)	40,690 (181.0)	81,380 (362.0)	81,380 (362.0)	81,380 (362.0)	81,380 (362.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λa as follows:
For sand-lightweight, λa = 0.51. For all lightweight, λa = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 60 - Hilti HIT-RE 500 V3 adhesive factored resistance for core drilled holes roughened with Hilti TE-YRT roughening tool with concrete / bond failure for CA rebar in cracked concrete[1,2,3,4,5,6,7,8,9]

Rebar size	Effective embedment in. (mm)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
15M	5-11/16 (145)	7,125 (31.7)	7,125 (31.7)	7,125 (31.7)	7,125 (31.7)	14,250 (63.4)	14,250 (63.4)	14,250 (63.4)	14,250 (63.4)
	9-13/16 (250)	12,285 (54.6)	12,285 (54.6)	12,285 (54.6)	12,285 (54.6)	24,570 (109.3)	24,570 (109.3)	24,570 (109.3)	24,570 (109.3)
	12-5/8 (320)	15,725 (69.9)	15,725 (69.9)	15,725 (69.9)	15,725 (69.9)	31,445 (139.9)	31,445 (139.9)	31,445 (139.9)	31,445 (139.9)
20M	7-7/8 (200)	12,160 (54.1)	12,160 (54.1)	12,160 (54.1)	12,160 (54.1)	24,325 (108.2)	24,325 (108.2)	24,325 (108.2)	24,325 (108.2)
	14 (355)	21,590 (96.0)	21,590 (96.0)	21,590 (96.0)	21,590 (96.0)	43,175 (192.1)	43,175 (192.1)	43,175 (192.1)	43,175 (192.1)
	15-3/8 (390)	23,715 (105.5)	23,715 (105.5)	23,715 (105.5)	23,715 (105.5)	47,435 (211.0)	47,435 (211.0)	47,435 (211.0)	47,435 (211.0)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 61-70 as necessary to the above values. Compare to the steel values in table 53. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λa as follows:
For sand-lightweight, λa = 0.51. For all-lightweight, λa = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by αseis=0.675. See section 3.1.8.7 for additional information on seismic applications.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 61 - Load adjustment factors for 10M rebar in uncracked concrete[1,2,3]

10M uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-8/9 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.15	0.12	n/a	n/a	n/a	0.06	0.04	0.03	0.11	0.07	0.06	n/a	n/a	n/a
2-3/16	(55)	0.58	0.55	0.54	0.26	0.16	0.13	0.53	0.52	0.52	0.08	0.05	0.04	0.15	0.10	0.08	n/a	n/a	n/a
3	(76)	0.61	0.57	0.56	0.30	0.19	0.15	0.54	0.53	0.53	0.12	0.08	0.06	0.25	0.16	0.13	n/a	n/a	n/a
4	(102)	0.65	0.59	0.57	0.35	0.22	0.17	0.56	0.54	0.54	0.19	0.12	0.10	0.35	0.22	0.17	n/a	n/a	n/a
5	(127)	0.68	0.62	0.59	0.41	0.25	0.20	0.57	0.55	0.54	0.27	0.17	0.14	0.41	0.25	0.20	n/a	n/a	n/a
5-11/16	(145)	0.71	0.63	0.61	0.45	0.28	0.22	0.58	0.56	0.55	0.33	0.21	0.17	0.45	0.28	0.22	0.56	n/a	n/a
6	(152)	0.72	0.64	0.61	0.47	0.29	0.23	0.58	0.56	0.55	0.35	0.22	0.18	0.47	0.29	0.23	0.58	n/a	n/a
7	(178)	0.76	0.66	0.63	0.54	0.34	0.27	0.60	0.57	0.56	0.44	0.28	0.23	0.54	0.34	0.27	0.62	n/a	n/a
8	(203)	0.79	0.69	0.65	0.62	0.38	0.30	0.61	0.58	0.57	0.54	0.35	0.28	0.62	0.38	0.30	0.67	n/a	n/a
8-1/4	(210)	0.80	0.69	0.65	0.64	0.40	0.31	0.61	0.58	0.57	0.57	0.36	0.29	0.64	0.40	0.31	0.68	0.58	n/a
9	(229)	0.83	0.71	0.67	0.70	0.43	0.34	0.62	0.59	0.58	0.65	0.41	0.33	0.70	0.43	0.34	0.71	0.61	n/a
10-1/16	(256)	0.87	0.74	0.69	0.78	0.48	0.38	0.64	0.60	0.59	0.76	0.49	0.39	0.78	0.48	0.38	0.75	0.64	0.60
11	(279)	0.90	0.76	0.71	0.85	0.53	0.42	0.65	0.61	0.60	0.87	0.56	0.44	0.85	0.53	0.42	0.78	0.67	0.62
12	(305)	0.94	0.78	0.72	0.93	0.58	0.45	0.67	0.62	0.61	0.99	0.63	0.51	0.93	0.58	0.45	0.81	0.70	0.65
14	(356)	1.00	0.83	0.76	1.00	0.67	0.53	0.69	0.64	0.62	1.00	0.80	0.64	1.00	0.67	0.53	0.88	0.76	0.70
16	(406)		0.88	0.80		0.77	0.61	0.72	0.66	0.64		0.98	0.78		0.77	0.61	0.94	0.81	0.75
18	(457)		0.92	0.84		0.87	0.68	0.75	0.68	0.66		1.00	0.93		0.87	0.68	1.00	0.86	0.80
24	(610)		1.00	0.95		1.00	0.91	0.83	0.75	0.71			1.00		1.00	0.91		0.99	0.92
30	(762)			1.00			1.00	0.91	0.81	0.76						1.00		1.00	1.00
36	(914)							1.00	0.87	0.82									
> 48	(1219)								0.99	0.92									

Table 62 - Load adjustment factors for 10M rebar in cracked concrete[1,2,3]

10M cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ‖ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-8/9 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)	4-1/2 (115)	7-1/16 (180)	8-7/8 (226)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.49	0.44	0.42	n/a	n/a	n/a	0.05	0.03	0.03	0.10	0.07	0.05	n/a	n/a	n/a
2-3/16	(55)	0.58	0.55	0.54	0.52	0.46	0.43	0.53	0.52	0.52	0.07	0.04	0.04	0.14	0.09	0.07	n/a	n/a	n/a
3	(76)	0.61	0.57	0.56	0.60	0.50	0.47	0.54	0.53	0.53	0.11	0.07	0.06	0.23	0.15	0.12	n/a	n/a	n/a
4	(102)	0.65	0.59	0.57	0.70	0.56	0.51	0.55	0.54	0.53	0.18	0.11	0.09	0.35	0.23	0.18	n/a	n/a	n/a
5	(127)	0.68	0.62	0.59	0.80	0.62	0.56	0.57	0.55	0.54	0.25	0.16	0.13	0.49	0.32	0.25	n/a	n/a	n/a
5-11/16	(145)	0.71	0.63	0.61	0.88	0.66	0.59	0.57	0.56	0.55	0.30	0.19	0.15	0.60	0.39	0.31	0.55	n/a	n/a
6	(152)	0.72	0.64	0.61	0.91	0.68	0.61	0.58	0.56	0.55	0.32	0.21	0.17	0.65	0.41	0.33	0.56	n/a	n/a
7	(178)	0.76	0.66	0.63	1.00	0.74	0.65	0.59	0.57	0.56	0.41	0.26	0.21	0.82	0.52	0.42	0.61	n/a	n/a
8	(203)	0.79	0.69	0.65		0.81	0.70	0.60	0.58	0.57	0.50	0.32	0.25	1.00	0.64	0.51	0.65	n/a	n/a
8-1/4	(210)	0.80	0.69	0.65		0.83	0.72	0.61	0.58	0.57	0.53	0.34	0.27		0.67	0.53	0.66	0.57	n/a
9	(229)	0.83	0.71	0.67		0.88	0.76	0.62	0.59	0.58	0.60	0.38	0.30		0.76	0.61	0.69	0.59	n/a
10-1/16	(256)	0.87	0.74	0.69		0.96	0.81	0.63	0.60	0.58	0.71	0.45	0.36		0.90	0.72	0.73	0.63	0.58
11	(279)	0.90	0.76	0.71		1.00	0.86	0.64	0.61	0.59	0.81	0.51	0.41		1.00	0.82	0.76	0.65	0.61
12	(305)	0.94	0.78	0.72			0.92	0.66	0.62	0.60	0.92	0.59	0.47			0.92	0.79	0.68	0.63
14	(356)	1.00	0.83	0.76			1.00	0.68	0.64	0.62	1.00	0.74	0.59			1.00	0.86	0.74	0.68
16	(406)		0.88	0.80				0.71	0.66	0.63		0.90	0.72				0.92	0.79	0.73
18	(457)		0.92	0.84				0.74	0.68	0.65		1.00	0.86				0.97	0.84	0.78
24	(610)		1.00	0.95				0.81	0.73	0.70			1.00				1.00	0.97	0.90
30	(762)			1.00				0.89	0.79	0.75								1.00	1.00
36	(914)							0.97	0.85	0.80									
> 48	(1219)							1.00	0.97	0.90									

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from CSA A23.3-14 Annex D.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 63 - Load adjustment factors for 15M rebar in uncracked concrete[1,2,3]

15M uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.24	0.14	0.11	n/a	n/a	n/a	0.04	0.02	0.02	0.08	0.04	0.03	n/a	n/a	n/a
3-1/8	(80)	0.59	0.55	0.54	0.29	0.17	0.13	0.54	0.52	0.52	0.10	0.05	0.04	0.20	0.11	0.08	n/a	n/a	n/a
4	(102)	0.61	0.57	0.55	0.33	0.19	0.14	0.55	0.53	0.53	0.14	0.08	0.06	0.29	0.15	0.12	n/a	n/a	n/a
5	(127)	0.64	0.58	0.57	0.37	0.21	0.16	0.56	0.54	0.53	0.20	0.11	0.08	0.37	0.21	0.16	n/a	n/a	n/a
6	(152)	0.67	0.60	0.58	0.41	0.23	0.18	0.57	0.54	0.54	0.27	0.14	0.11	0.41	0.23	0.18	n/a	n/a	n/a
7	(178)	0.70	0.62	0.59	0.46	0.26	0.20	0.58	0.55	0.54	0.33	0.18	0.14	0.46	0.26	0.20	n/a	n/a	n/a
7-1/4	(184)	0.71	0.62	0.60	0.47	0.26	0.20	0.58	0.55	0.55	0.35	0.18	0.14	0.47	0.26	0.20	0.58	n/a	n/a
8	(203)	0.73	0.64	0.61	0.50	0.28	0.22	0.59	0.56	0.55	0.41	0.21	0.17	0.50	0.28	0.22	0.61	n/a	n/a
9	(229)	0.76	0.65	0.62	0.56	0.31	0.24	0.60	0.57	0.56	0.49	0.26	0.20	0.56	0.31	0.24	0.64	n/a	n/a
10	(254)	0.78	0.67	0.63	0.62	0.35	0.27	0.61	0.57	0.56	0.57	0.30	0.23	0.62	0.35	0.27	0.68	n/a	n/a
11-3/8	(289)	0.82	0.69	0.65	0.71	0.40	0.31	0.63	0.58	0.57	0.69	0.36	0.28	0.71	0.40	0.31	0.72	0.58	n/a
12	(305)	0.84	0.70	0.66	0.74	0.42	0.32	0.64	0.59	0.58	0.75	0.39	0.31	0.74	0.42	0.32	0.74	0.60	n/a
14-1/8	(359)	0.90	0.74	0.69	0.88	0.49	0.38	0.66	0.61	0.59	0.96	0.50	0.39	0.88	0.49	0.38	0.81	0.65	0.60
16	(406)	0.96	0.77	0.71	0.99	0.56	0.43	0.68	0.62	0.60	1.00	0.61	0.47	0.99	0.56	0.43	0.86	0.69	0.64
18	(457)	1.00	0.80	0.74	1.00	0.63	0.48	0.71	0.63	0.61		0.72	0.56	1.00	0.63	0.48	0.91	0.73	0.67
20	(508)		0.84	0.76		0.70	0.54	0.73	0.65	0.63		0.85	0.66		0.70	0.54	0.96	0.77	0.71
22	(559)		0.87	0.79		0.77	0.59	0.75	0.66	0.64		0.98	0.76		0.77	0.59	1.00	0.81	0.75
24	(610)		0.91	0.82		0.83	0.65	0.78	0.68	0.65		1.00	0.87		0.83	0.65		0.85	0.78
30	(762)		1.00	0.90		1.00	0.81	0.84	0.72	0.69			1.00		1.00	0.81		0.95	0.87
36	(914)			0.98			0.97	0.91	0.77	0.73						0.97		1.00	0.95
> 48	(1219)			1.00			1.00	1.00	0.86	0.80						1.00			1.00

Table 64 - Load adjustment factors for 15M rebar in cracked concrete[1,2,3]

15M cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)	5-11/16 (145)	9-13/16 (250)	12-5/8 (320)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.46	0.41	0.40	n/a	n/a	n/a	0.04	0.02	0.02	0.09	0.04	0.03	n/a	n/a	n/a
3-1/8	(80)	0.59	0.55	0.54	0.55	0.46	0.44	0.54	0.52	0.52	0.10	0.05	0.04	0.21	0.09	0.07	n/a	n/a	n/a
4	(102)	0.61	0.57	0.55	0.61	0.50	0.46	0.55	0.53	0.52	0.15	0.07	0.05	0.29	0.13	0.10	n/a	n/a	n/a
5	(127)	0.64	0.58	0.57	0.68	0.54	0.49	0.56	0.53	0.53	0.21	0.09	0.07	0.41	0.19	0.15	n/a	n/a	n/a
6	(152)	0.67	0.60	0.58	0.76	0.58	0.52	0.57	0.54	0.53	0.27	0.12	0.10	0.54	0.25	0.19	n/a	n/a	n/a
7	(178)	0.70	0.62	0.59	0.84	0.62	0.56	0.58	0.55	0.54	0.34	0.15	0.12	0.68	0.31	0.24	n/a	n/a	n/a
7-1/4	(184)	0.71	0.62	0.60	0.86	0.63	0.56	0.58	0.55	0.54	0.36	0.16	0.13	0.72	0.33	0.25	0.58	n/a	n/a
8	(203)	0.73	0.64	0.61	0.93	0.66	0.59	0.59	0.55	0.55	0.42	0.19	0.15	0.83	0.38	0.30	0.61	n/a	n/a
9	(229)	0.76	0.65	0.62	1.00	0.71	0.62	0.60	0.56	0.55	0.50	0.23	0.18	0.99	0.45	0.35	0.65	n/a	n/a
10	(254)	0.78	0.67	0.63		0.76	0.66	0.62	0.57	0.56	0.58	0.26	0.21	1.00	0.53	0.41	0.68	n/a	n/a
11-3/8	(289)	0.82	0.69	0.65		0.82	0.71	0.63	0.58	0.57	0.71	0.32	0.25		0.64	0.50	0.73	0.56	n/a
12	(305)	0.84	0.70	0.66		0.86	0.73	0.64	0.58	0.57	0.77	0.35	0.27		0.69	0.54	0.75	0.57	n/a
14-1/8	(359)	0.90	0.74	0.69		0.97	0.81	0.66	0.60	0.58	0.98	0.44	0.35		0.89	0.69	0.81	0.62	0.57
16	(406)	0.96	0.77	0.71		1.00	0.88	0.69	0.61	0.59	1.00	0.53	0.42		1.00	0.84	0.86	0.66	0.61
18	(457)	1.00	0.80	0.74			0.96	0.71	0.62	0.60		0.64	0.50			0.96	0.91	0.70	0.65
20	(508)		0.84	0.76			1.00	0.73	0.64	0.62		0.75	0.58			1.00	0.96	0.74	0.68
22	(559)		0.87	0.79				0.76	0.65	0.63		0.86	0.67				1.00	0.78	0.72
24	(610)		0.91	0.82				0.78	0.66	0.64		0.98	0.77					0.81	0.75
30	(762)		1.00	0.90				0.85	0.71	0.67		1.00	1.00					0.91	0.84
36	(914)			0.98				0.92	0.75	0.71								0.99	0.92
> 48	(1219)			1.00				1.00	0.83	0.78								1.00	1.00

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from CSA A23.3-14 Annex D.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 65 - Load adjustment factors for 20M rebar in uncracked concrete[1,2,3]

20M uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.21	0.11	0.10	n/a	n/a	n/a	0.03	0.01	0.01	0.06	0.03	0.02	n/a	n/a	n/a
3-7/8	(98)	0.58	0.55	0.54	0.26	0.14	0.13	0.53	0.52	0.52	0.09	0.04	0.04	0.18	0.09	0.08	n/a	n/a	n/a
4	(102)	0.58	0.55	0.54	0.27	0.15	0.13	0.53	0.52	0.52	0.10	0.05	0.04	0.19	0.09	0.09	n/a	n/a	n/a
5	(127)	0.61	0.56	0.55	0.30	0.16	0.15	0.54	0.53	0.53	0.13	0.07	0.06	0.27	0.13	0.12	n/a	n/a	n/a
6	(152)	0.63	0.57	0.57	0.33	0.18	0.16	0.55	0.53	0.53	0.17	0.09	0.08	0.33	0.17	0.16	n/a	n/a	n/a
7	(178)	0.65	0.58	0.58	0.36	0.19	0.18	0.56	0.54	0.54	0.22	0.11	0.10	0.36	0.19	0.18	n/a	n/a	n/a
8	(203)	0.67	0.60	0.59	0.39	0.21	0.19	0.57	0.54	0.54	0.27	0.13	0.12	0.39	0.21	0.19	n/a	n/a	n/a
9	(229)	0.69	0.61	0.60	0.42	0.23	0.21	0.58	0.55	0.55	0.32	0.16	0.15	0.42	0.23	0.21	n/a	n/a	n/a
10	(254)	0.71	0.62	0.61	0.46	0.25	0.23	0.59	0.55	0.55	0.38	0.19	0.17	0.46	0.25	0.23	0.59	n/a	n/a
11	(279)	0.73	0.63	0.62	0.50	0.27	0.25	0.60	0.56	0.56	0.43	0.22	0.20	0.50	0.27	0.25	0.62	n/a	n/a
12	(305)	0.75	0.64	0.63	0.54	0.30	0.27	0.60	0.57	0.56	0.49	0.25	0.22	0.54	0.30	0.27	0.65	n/a	n/a
14	(356)	0.80	0.67	0.65	0.63	0.34	0.31	0.62	0.58	0.57	0.62	0.31	0.28	0.63	0.34	0.31	0.70	n/a	n/a
16	(406)	0.84	0.69	0.67	0.72	0.39	0.36	0.64	0.59	0.58	0.76	0.38	0.34	0.72	0.39	0.36	0.74	0.59	n/a
18	(457)	0.88	0.71	0.70	0.81	0.44	0.40	0.66	0.60	0.59	0.91	0.45	0.41	0.81	0.44	0.40	0.79	0.63	0.61
20	(508)	0.92	0.74	0.72	0.90	0.49	0.45	0.67	0.61	0.60	1.00	0.53	0.48	0.90	0.49	0.45	0.83	0.66	0.64
22	(559)	0.97	0.76	0.74	0.99	0.54	0.49	0.69	0.62	0.61		0.61	0.56	0.99	0.54	0.49	0.87	0.69	0.67
24	(610)	1.00	0.79	0.76	1.00	0.59	0.54	0.71	0.63	0.62		0.70	0.63	1.00	0.59	0.54	0.91	0.72	0.70
26	(660)		0.81	0.78		0.64	0.58	0.73	0.64	0.63		0.79	0.72		0.64	0.58	0.95	0.75	0.73
28	(711)		0.83	0.80		0.69	0.62	0.74	0.65	0.64		0.88	0.80		0.69	0.62	0.99	0.78	0.76
30	(762)		0.86	0.83		0.74	0.67	0.76	0.66	0.65		0.97	0.89		0.74	0.67	1.00	0.81	0.78
36	(914)		0.93	0.89		0.89	0.80	0.81	0.70	0.68		1.00	1.00		0.89	0.80		0.89	0.86
> 48	(1219)		1.00	1.00		1.00	1.00	0.92	0.76	0.75					1.00	1.00		1.00	0.99

Table 66 - Load adjustment factors for 20M rebar in cracked concrete[1,2,3]

20M cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ǁ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)	7-7/8 (200)	14 (355)	15-3/8 (390)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm): 1-3/4	(44)	n/a	n/a	n/a	0.43	0.39	0.39	n/a	n/a	n/a	0.03	0.01	0.01	0.06	0.02	0.02	n/a	n/a	n/a
3-7/8	(98)	0.58	0.55	0.54	0.53	0.45	0.44	0.53	0.52	0.52	0.09	0.04	0.04	0.18	0.08	0.07	n/a	n/a	n/a
4	(102)	0.58	0.55	0.54	0.54	0.45	0.44	0.54	0.52	0.52	0.10	0.04	0.04	0.19	0.08	0.07	n/a	n/a	n/a
5	(127)	0.61	0.56	0.55	0.59	0.48	0.47	0.54	0.52	0.52	0.14	0.06	0.05	0.27	0.11	0.10	n/a	n/a	n/a
6	(152)	0.63	0.57	0.57	0.64	0.51	0.49	0.55	0.53	0.53	0.18	0.08	0.07	0.36	0.15	0.14	n/a	n/a	n/a
7	(178)	0.65	0.58	0.58	0.70	0.53	0.52	0.56	0.53	0.53	0.22	0.09	0.09	0.45	0.19	0.17	n/a	n/a	n/a
8	(203)	0.67	0.60	0.59	0.76	0.56	0.54	0.57	0.54	0.54	0.27	0.12	0.10	0.55	0.23	0.21	n/a	n/a	n/a
9	(229)	0.69	0.61	0.60	0.82	0.59	0.57	0.58	0.54	0.54	0.33	0.14	0.12	0.65	0.28	0.25	n/a	n/a	n/a
10	(254)	0.71	0.62	0.61	0.88	0.62	0.60	0.59	0.55	0.55	0.38	0.16	0.15	0.77	0.32	0.29	0.59	n/a	n/a
11	(279)	0.73	0.63	0.62	0.95	0.65	0.62	0.60	0.55	0.55	0.44	0.19	0.17	0.88	0.37	0.34	0.62	n/a	n/a
12	(305)	0.75	0.64	0.63	1.00	0.69	0.65	0.61	0.56	0.56	0.50	0.21	0.19	1.00	0.43	0.38	0.65	n/a	n/a
14	(356)	0.80	0.67	0.65		0.75	0.71	0.62	0.57	0.56	0.64	0.27	0.24		0.54	0.48	0.70	n/a	n/a
16	(406)	0.84	0.69	0.67		0.82	0.77	0.64	0.58	0.57	0.77	0.33	0.30		0.66	0.59	0.75	0.56	n/a
18	(457)	0.88	0.71	0.70		0.89	0.83	0.66	0.59	0.58	0.93	0.39	0.35		0.78	0.71	0.80	0.60	0.58
20	(508)	0.92	0.74	0.72		0.96	0.90	0.68	0.60	0.59	1.00	0.46	0.41		0.92	0.83	0.84	0.63	0.61
22	(559)	0.97	0.76	0.74		1.00	0.96	0.69	0.61	0.60		0.53	0.48		1.00	0.95	0.88	0.66	0.64
24	(610)	1.00	0.79	0.76			1.00	0.71	0.62	0.61		0.60	0.54			1.00	0.92	0.69	0.67
26	(660)		0.81	0.78				0.73	0.63	0.62		0.68	0.61				0.96	0.72	0.69
28	(711)		0.83	0.80				0.75	0.64	0.63		0.76	0.68				0.99	0.74	0.72
30	(762)		0.86	0.83				0.76	0.65	0.64		0.84	0.76				1.00	0.77	0.74
36	(914)		0.93	0.89				0.82	0.68	0.67		1.00	1.00					0.84	0.82
> 48	(1219)		1.00	1.00				0.92	0.74	0.72								0.98	0.94

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from CSA A23.3-14 Annex D.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 67 - Load adjustment factors for 25M rebar in uncracked concrete[1,2,3]

25M uncracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.24	0.12	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.02	n/a	n/a	n/a
5	(127)	0.59	0.55	0.54	0.32	0.16	0.13	0.54	0.52	0.52	0.11	0.05	0.04	0.22	0.09	0.07	n/a	n/a	n/a
6	(152)	0.61	0.56	0.55	0.34	0.18	0.14	0.55	0.53	0.52	0.14	0.06	0.05	0.28	0.12	0.10	n/a	n/a	n/a
7	(178)	0.63	0.57	0.56	0.37	0.19	0.15	0.55	0.53	0.53	0.18	0.08	0.06	0.36	0.15	0.12	n/a	n/a	n/a
8	(203)	0.65	0.58	0.57	0.40	0.21	0.16	0.56	0.53	0.53	0.22	0.09	0.07	0.40	0.19	0.15	n/a	n/a	n/a
9	(229)	0.67	0.59	0.58	0.43	0.22	0.18	0.57	0.54	0.53	0.26	0.11	0.09	0.43	0.22	0.18	n/a	n/a	n/a
10	(254)	0.68	0.60	0.58	0.46	0.24	0.19	0.58	0.54	0.54	0.30	0.13	0.10	0.46	0.24	0.19	n/a	n/a	n/a
11-9/16	(294)	0.71	0.62	0.60	0.51	0.26	0.21	0.59	0.55	0.54	0.38	0.16	0.13	0.51	0.26	0.21	0.59	n/a	n/a
12	(305)	0.72	0.63	0.60	0.52	0.27	0.21	0.59	0.55	0.54	0.40	0.17	0.14	0.52	0.27	0.21	0.60	n/a	n/a
14	(356)	0.76	0.65	0.62	0.59	0.31	0.24	0.61	0.56	0.55	0.50	0.22	0.17	0.59	0.31	0.24	0.65	n/a	n/a
16	(406)	0.79	0.67	0.63	0.68	0.35	0.28	0.62	0.57	0.56	0.62	0.26	0.21	0.68	0.35	0.28	0.69	n/a	n/a
18	(457)	0.83	0.69	0.65	0.76	0.39	0.31	0.64	0.58	0.57	0.74	0.31	0.25	0.76	0.39	0.31	0.74	n/a	n/a
18-7/16	(469)	0.84	0.69	0.66	0.78	0.40	0.32	0.64	0.58	0.57	0.76	0.33	0.26	0.78	0.40	0.32	0.75	0.56	n/a
20	(508)	0.87	0.71	0.67	0.85	0.44	0.35	0.65	0.59	0.57	0.86	0.37	0.30	0.85	0.44	0.35	0.78	0.59	n/a
22-3/8	(568)	0.91	0.73	0.69	0.95	0.49	0.39	0.67	0.60	0.58	1.00	0.44	0.35	0.95	0.49	0.39	0.82	0.62	0.58
24	(610)	0.94	0.75	0.70	1.00	0.52	0.42	0.68	0.60	0.59		0.48	0.39	1.00	0.52	0.42	0.85	0.64	0.60
26	(660)	0.98	0.77	0.72		0.57	0.45	0.70	0.61	0.60		0.55	0.44		0.57	0.45	0.89	0.67	0.62
28	(711)	1.00	0.79	0.74		0.61	0.49	0.71	0.62	0.60		0.61	0.49		0.61	0.49	0.92	0.69	0.64
30	(762)		0.81	0.75		0.66	0.52	0.73	0.63	0.61		0.68	0.54		0.66	0.52	0.95	0.72	0.67
36	(914)		0.88	0.80		0.79	0.63	0.77	0.65	0.63		0.89	0.71		0.79	0.63	1.00	0.79	0.73
> 48	(1219)		1.00	0.90		1.00	0.84	0.86	0.71	0.68		1.00	1.00		1.00	0.84		0.91	0.84

Table 68 - Load adjustment factors for 25M rebar in cracked concrete[1,2,3]

25M cracked concrete		Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear ⊥ Toward edge f_{RV}			Edge distance in shear ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in.	(mm)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)	9-1/16 (230)	15-15/16 (405)	19-13/16 (504)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																			
1-3/4	(44)	n/a	n/a	n/a	0.42	0.39	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.05	0.02	0.01	n/a	n/a	n/a
5	(127)	0.59	0.55	0.54	0.55	0.46	0.44	0.54	0.52	0.52	0.11	0.05	0.03	0.22	0.09	0.07	n/a	n/a	n/a
6	(152)	0.61	0.56	0.55	0.60	0.48	0.46	0.55	0.53	0.52	0.14	0.06	0.04	0.29	0.12	0.09	n/a	n/a	n/a
7	(178)	0.63	0.57	0.56	0.65	0.51	0.48	0.55	0.53	0.52	0.18	0.08	0.06	0.36	0.16	0.11	n/a	n/a	n/a
8	(203)	0.65	0.58	0.57	0.70	0.53	0.50	0.56	0.53	0.53	0.22	0.10	0.07	0.44	0.19	0.14	n/a	n/a	n/a
9	(229)	0.67	0.59	0.58	0.75	0.56	0.51	0.57	0.54	0.53	0.27	0.11	0.08	0.53	0.23	0.16	n/a	n/a	n/a
10	(254)	0.68	0.60	0.58	0.80	0.59	0.53	0.58	0.54	0.53	0.31	0.13	0.10	0.62	0.27	0.19	n/a	n/a	n/a
11-9/16	(294)	0.71	0.62	0.60	0.89	0.63	0.57	0.59	0.55	0.54	0.39	0.17	0.12	0.77	0.33	0.24	0.60	n/a	n/a
12	(305)	0.72	0.63	0.60	0.91	0.64	0.58	0.59	0.55	0.54	0.41	0.17	0.13	0.82	0.35	0.25	0.61	n/a	n/a
14	(356)	0.76	0.65	0.62	1.00	0.69	0.62	0.61	0.56	0.55	0.51	0.22	0.16	1.00	0.44	0.32	0.65	n/a	n/a
16	(406)	0.79	0.67	0.63		0.75	0.66	0.62	0.57	0.56	0.63	0.27	0.19		0.54	0.39	0.70	n/a	n/a
18	(457)	0.83	0.69	0.65		0.81	0.71	0.64	0.58	0.56	0.75	0.32	0.23		0.64	0.46	0.74	n/a	n/a
18-7/16	(469)	0.84	0.69	0.66		0.83	0.72	0.64	0.58	0.56	0.78	0.33	0.24		0.67	0.48	0.75	0.57	n/a
20	(508)	0.87	0.71	0.67		0.87	0.75	0.65	0.59	0.57	0.88	0.38	0.27		0.75	0.54	0.78	0.59	n/a
22-3/8	(568)	0.91	0.73	0.69		0.95	0.81	0.67	0.60	0.58	1.00	0.44	0.32		0.89	0.64	0.83	0.62	0.56
24	(610)	0.94	0.75	0.70		1.00	0.85	0.68	0.60	0.58		0.49	0.36		0.99	0.71	0.86	0.65	0.58
26	(660)	0.98	0.77	0.72			0.90	0.70	0.61	0.59		0.56	0.40		1.00	0.80	0.89	0.67	0.60
28	(711)	1.00	0.79	0.74			0.95	0.71	0.62	0.60		0.62	0.45			0.90	0.93	0.70	0.63
30	(762)		0.81	0.75			1.00	0.73	0.63	0.60		0.69	0.50			1.00	0.96	0.72	0.65
36	(914)		0.88	0.80				0.78	0.66	0.63		0.91	0.65				1.00	0.79	0.71
> 48	(1219)		1.00	0.90				0.87	0.71	0.67		1.00	1.00					0.91	0.82

1 Linear interpolation not permitted.
2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.
3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from CSA A23.3-14 Annex D.
4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 69 - Load adjustment factors for 30M rebar in uncracked concrete[1,2,3]

30M uncracked concrete	Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in. (mm)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																		
1-3/4 (44)	n/a	n/a	n/a	0.25	0.13	0.10	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-7/8 (150)	0.59	0.55	0.54	0.34	0.17	0.13	0.54	0.52	0.52	0.12	0.05	0.03	0.23	0.10	0.07	n/a	n/a	n/a
6 (152)	0.59	0.56	0.54	0.34	0.18	0.13	0.54	0.52	0.52	0.12	0.05	0.04	0.24	0.10	0.07	n/a	n/a	n/a
7 (178)	0.61	0.57	0.55	0.37	0.19	0.14	0.55	0.53	0.52	0.15	0.06	0.04	0.30	0.13	0.09	n/a	n/a	n/a
8 (203)	0.63	0.57	0.56	0.39	0.20	0.15	0.55	0.53	0.52	0.18	0.08	0.05	0.36	0.16	0.11	n/a	n/a	n/a
9 (229)	0.64	0.58	0.56	0.42	0.21	0.16	0.56	0.53	0.53	0.22	0.09	0.07	0.42	0.19	0.13	n/a	n/a	n/a
10 (254)	0.66	0.59	0.57	0.45	0.23	0.17	0.57	0.54	0.53	0.25	0.11	0.08	0.45	0.22	0.15	n/a	n/a	n/a
11 (279)	0.67	0.60	0.58	0.47	0.24	0.18	0.57	0.54	0.53	0.29	0.13	0.09	0.47	0.24	0.18	n/a	n/a	n/a
12 (305)	0.69	0.61	0.58	0.50	0.25	0.19	0.58	0.55	0.54	0.33	0.14	0.10	0.50	0.25	0.19	n/a	n/a	n/a
13-1/4 (337)	0.71	0.62	0.59	0.54	0.27	0.21	0.59	0.55	0.54	0.39	0.17	0.12	0.54	0.27	0.21	0.60	n/a	n/a
14 (356)	0.72	0.63	0.60	0.56	0.28	0.21	0.59	0.55	0.54	0.42	0.18	0.13	0.56	0.28	0.21	0.61	n/a	n/a
16 (406)	0.75	0.65	0.61	0.63	0.32	0.24	0.61	0.56	0.55	0.51	0.22	0.15	0.63	0.32	0.24	0.65	n/a	n/a
18 (457)	0.78	0.67	0.63	0.71	0.35	0.27	0.62	0.57	0.55	0.61	0.26	0.18	0.71	0.35	0.27	0.69	n/a	n/a
20 (508)	0.81	0.69	0.64	0.79	0.39	0.30	0.63	0.58	0.56	0.72	0.31	0.22	0.79	0.39	0.30	0.73	n/a	n/a
20-7/8 (531)	0.83	0.69	0.65	0.82	0.41	0.31	0.64	0.58	0.56	0.77	0.33	0.23	0.82	0.41	0.31	0.75	n/a	n/a
22 (559)	0.85	0.70	0.66	0.87	0.43	0.33	0.65	0.58	0.57	0.83	0.36	0.25	0.87	0.43	0.33	0.77	0.58	n/a
24 (610)	0.88	0.72	0.67	0.94	0.47	0.36	0.66	0.59	0.57	0.94	0.41	0.28	0.94	0.47	0.36	0.80	0.61	n/a
26-9/16 (675)	0.92	0.75	0.69	1.00	0.52	0.39	0.68	0.60	0.58	1.00	0.47	0.33	1.00	0.52	0.39	0.84	0.64	0.56
28 (711)	0.94	0.76	0.70		0.55	0.42	0.69	0.61	0.58		0.51	0.36		0.55	0.42	0.86	0.65	0.58
30 (762)	0.97	0.78	0.71		0.59	0.44	0.70	0.61	0.59		0.57	0.40		0.59	0.44	0.89	0.68	0.60
36 (914)	1.00	0.83	0.75		0.71	0.53	0.74	0.64	0.61		0.75	0.52		0.71	0.53	0.98	0.74	0.66
> 48 (1219)		0.95	0.84		0.95	0.71	0.82	0.68	0.64		1.00	0.80		0.95	0.71	1.00	0.86	0.76

Table 70 - Load adjustment factors for 30M rebar in cracked concrete[1,2,3]

30M cracked concrete	Spacing factor in tension f_{AN}			Edge distance factor in tension f_{RN}			Spacing factor in shear[4] f_{AV}			Edge distance in shear: ⊥ Toward edge f_{RV}			Edge distance in shear: ∥ To and away from edge f_{RV}			Concrete thickness factor in shear[5] f_{HV}		
Embedment h_{ef} in. (mm)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)	10-1/4 (260)	17-15/16 (455)	23-9/16 (598)
Spacing (s) / edge distance (c_a) / concrete thickness (h), - in. (mm)																		
1-3/4 (44)	n/a	n/a	n/a	0.41	0.38	0.38	n/a	n/a	n/a	0.02	0.01	0.01	0.04	0.02	0.01	n/a	n/a	n/a
5-7/8 (150)	0.59	0.55	0.54	0.56	0.47	0.44	0.54	0.52	0.52	0.12	0.05	0.03	0.23	0.10	0.07	n/a	n/a	n/a
6 (152)	0.59	0.56	0.54	0.56	0.47	0.44	0.54	0.52	0.52	0.12	0.05	0.03	0.24	0.10	0.07	n/a	n/a	n/a
7 (178)	0.61	0.57	0.55	0.60	0.49	0.46	0.55	0.53	0.52	0.15	0.07	0.04	0.30	0.13	0.09	n/a	n/a	n/a
8 (203)	0.63	0.57	0.56	0.64	0.51	0.47	0.55	0.53	0.52	0.19	0.08	0.05	0.37	0.16	0.11	n/a	n/a	n/a
9 (229)	0.64	0.58	0.56	0.68	0.53	0.49	0.56	0.53	0.53	0.22	0.10	0.06	0.44	0.19	0.13	n/a	n/a	n/a
10 (254)	0.66	0.59	0.57	0.72	0.56	0.50	0.57	0.54	0.53	0.26	0.11	0.07	0.52	0.22	0.15	n/a	n/a	n/a
11 (279)	0.67	0.60	0.58	0.77	0.58	0.52	0.57	0.54	0.53	0.30	0.13	0.09	0.60	0.26	0.17	n/a	n/a	n/a
12 (305)	0.69	0.61	0.58	0.81	0.60	0.54	0.58	0.55	0.54	0.34	0.15	0.10	0.68	0.29	0.19	n/a	n/a	n/a
13-1/4 (337)	0.71	0.62	0.59	0.87	0.63	0.56	0.59	0.55	0.54	0.40	0.17	0.11	0.79	0.34	0.23	0.60	n/a	n/a
14 (356)	0.72	0.63	0.60	0.91	0.65	0.57	0.59	0.55	0.54	0.43	0.19	0.12	0.86	0.37	0.25	0.62	n/a	n/a
16 (406)	0.75	0.65	0.61	1.00	0.70	0.61	0.61	0.56	0.55	0.52	0.23	0.15	1.00	0.45	0.30	0.66	n/a	n/a
18 (457)	0.78	0.67	0.63		0.75	0.64	0.62	0.57	0.55	0.62	0.27	0.18		0.54	0.36	0.70	n/a	n/a
20 (508)	0.81	0.69	0.64		0.81	0.68	0.64	0.58	0.56	0.73	0.32	0.21		0.63	0.42	0.74	n/a	n/a
20-7/8 (531)	0.83	0.69	0.65		0.83	0.70	0.64	0.58	0.56	0.78	0.34	0.22		0.68	0.45	0.75	n/a	n/a
22 (559)	0.85	0.70	0.66		0.86	0.72	0.65	0.59	0.56	0.84	0.36	0.24		0.73	0.48	0.77	0.58	n/a
24 (610)	0.88	0.72	0.67		0.92	0.76	0.66	0.59	0.57	0.96	0.42	0.28		0.83	0.55	0.81	0.61	n/a
26-9/16 (675)	0.92	0.75	0.69		0.99	0.81	0.68	0.60	0.58	1.00	0.48	0.32		0.97	0.64	0.85	0.64	0.56
28 (711)	0.94	0.76	0.70		1.00	0.84	0.69	0.61	0.58		0.52	0.35		1.00	0.69	0.87	0.66	0.57
30 (762)	0.97	0.78	0.71			0.88	0.70	0.62	0.59		0.58	0.39			0.77	0.90	0.68	0.59
36 (914)	1.00	0.83	0.75			1.00	0.74	0.64	0.61		0.76	0.51			1.00	0.99	0.75	0.65
> 48 (1219)		0.95	0.84				0.82	0.69	0.64		1.00	0.78				1.00	0.86	0.75

1 Linear interpolation not permitted.

2 Shaded area with reduced edge distance is permitted provided the rebar has no installation torque.

3 When combining multiple load adjustment factors (e.g. for a four-anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from CSA A23.3-14 Annex D.

4 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

5 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 71 - Hilti HIT-RE 500 V3 design information with Hilti HAS/HIT-V threaded rods in hammer drilled holes in accordance with CSA A23.3-14 Annex D[1,8]

Design parameter	Symbol	Units	Nominal rod diameter (in.)							Ref A23.3-14
			3/8	1/2	5/8	3/4	7/8	1	1-1/4	
Nominal anchor diameter	d_a	mm	9.5	12.7	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]	$h_{ef,min}$	mm	60	70	79	89	89	102	127	
Effective maximum embedment[2]	$h_{ef,max}$	mm	191	254	318	381	445	508	635	
Min. concrete thickness[2]	h_{min}	mm	h_{ef} + 30	$h_{ef} + 2d_0$						
Critical edge distance	c_{ac}	-	see ESR-3814, section 4.1.10							
Minimum edge distance	c_{min}[3]	mm	48	64	79	95	111	127	159	
Minimum anchor spacing	s_{min}	mm	48	64	79	95	111	127	159	
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$[4]	-	10							D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$[4]	-	7							D.6.2.2
Concrete material resistance factor	ϕ_c	-	0.65							8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	-	1.00							D.5.3(c)
Dry and water saturated concrete										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	1,280 (8.8)	1,270 (8.8)	1,260 (8.7)	1,250 (8.6)	1,240 (8.6)	1,240 (8.6)	1,180 (8.1)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	2,380 (16.4)	2,300 (15.9)	2,210 (15.2)	2,130 (14.7)	2,040 (14.1)	1,960 (13.5)	1,790 (12.3)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	880 (6.1)	870 (6.0)	870 (6.0)	860 (5.9)	860 (5.9)	850 (5.9)	810 (5.6)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,640 (11.3)	1,590 (11.0)	1,530 (10.6)	1,470 (10.1)	1,410 (9.7)	1,350 (9.3)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete	-	-	1	1	1	1	1	1	1	
Resistance modification factor	R_{dry}	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Water-filled hole										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	940 (6.5)	940 (6.5)	940 (6.5)	940 (6.5)	940 (6.5)	950 (6.6)	920 (6.3)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,760 (12.1)	1,700 (11.7)	1,660 (11.4)	1,600 (11.0)	1,550 (10.7)	1,500 (10.3)	1,400 (9.7)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	650 (4.5)	640 (4.4)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,210 (8.3)	1,170 (8.1)	1,140 (7.9)	1,110 (7.7)	1,070 (7.4)	1,040 (7.2)	970 (6.7)	D.6.5.2
Anchor category, water-filled hole	-	-	3	3	3	3	3	3	3	
Resistance modification factor	R_{wf}	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Submerged concrete										
Temp. range A[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	820 (5.7)	830 (5.7)	830 (5.7)	840 (5.8)	850 (5.9)	860 (5.9)	860 (5.9)	D.6.5.2
Temp. range A[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,530 (10.6)	1,500 (10.3)	1,470 (10.1)	1,430 (9.9)	1,400 (9.7)	1,370 (9.4)	1,300 (9.0)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	570 (3.9)	570 (3.9)	580 (4.0)	580 (4.0)	590 (4.1)	590 (4.1)	590 (4.1)	D.6.5.2
Temp. range B[6]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,060 (7.3)	1,030 (7.1)	1,010 (7.0)	990 (6.8)	960 (6.6)	940 (6.5)	900 (6.2)	D.6.5.2
Anchor category, underwater	-	-	3	3	3	3	3	3	3	
Resistance modification factor	R_{uw}		0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Reduction for seismic tension	$\alpha_{N,seis}$	-	0.92	0.93	0.95	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, tables 8 and 9, and converted for use with CSA A23.3-14 Annex D.

2 See figure 4 of section 3.2.4.3.4.

3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided T_{inst} is reduced. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

7 Bond stress values corresponding to concrete compressive stress f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete.

8 For structures assigned to Seismic Design Categories C, D, E, or F, bond strength values must be multiplied by $\alpha_{N,seis}$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 72 - Hilti HIT-RE 500 V3 design information with Hilti HAS and HIT-V threaded rods in diamond core drilled holes in accordance with CSA A23.3-14 Annex D[1]

Design parameter	Symbol	Units	Nominal rod diameter (in.)							Ref
			3/8	1/2	5/8	3/4	7/8	1	1-1/4	A23.3-14
Nominal anchor diameter	d_a	mm	9.5	12.7	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]	h_{ef}	mm	60	70	79	89	89	102	127	
Effective maximum embedment[2]	h_{ef}	mm	191	254	318	381	445	508	635	
Minimum concrete thickness[2]	h_{min}	mm	h_{ef} + 30		h_{ef} + $2d_o$					
Critical edge distance	c_{ac}	-	see ESR-3814, section 4.1.10							
Minimum edge distance	c_{min} [3]	mm	48	64	79	95	111	127	159	
Minimum anchor spacing	s_{min}	mm	48	64	79	95	111	127	159	
Coeff. for factored concrete breakout resistance, uncracked concrete	$k_{c,uncr}$ [4]	-	10							D.6.2.2
Coeff. for factored concrete breakout resistance, cracked concrete	$k_{c,cr}$ [4]	-	7							D.6.2.2
Concrete material resistance factor	ϕ_c	-	0.65							8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	-	1.00							D.5.3(c)
Dry and water saturated concrete										
Temp. range A[6] — Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi	1,740	1,705	1,555	1,440	1,355	1,280	1,170	D.6.5.2
		(MPa)	(12.0)	(11.8)	(10.7)	(9.9)	(9.3)	(8.8)	(8.1)	
Temp. range B[6] — Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi	600	590	535	495	470	440	405	D.6.5.2
		psi	(4.1)	(4.1)	(3.7)	(3.4)	(3.2)	(3.0)	(2.8)	
Anchor category, dry concrete	-	-	2	2	3	3	3	3	3	
Resistance modification factor	R_{dry}	-	0.85	0.85	0.75	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, tables 8 and 10, and converted for use with CSA A23.3-14 Annex D.

2 See figure 4 of section 3.2.4.3.4.

3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided T_{inst} is reduced. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

7 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 73 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N: f'_c = 20 MPa (2,900 psi) lb (kN)	Tension N: f'_c = 25 MPa (3,625 psi) lb (kN)	Tension N: f'_c = 30 MPa (4,350 psi) lb (kN)	Tension N: f'_c = 40 MPa (5,800 psi) lb (kN)	Shear V: f'_c = 20 MPa (2,900 psi) lb (kN)	Shear V: f'_c = 25 MPa (3,625 psi) lb (kN)	Shear V: f'_c = 30 MPa (4,350 psi) lb (kN)	Shear V: f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	2-3/8 (60)	3,060 (13.6)	3,425 (15.2)	3,750 (16.7)	4,330 (19.3)	3,060 (13.6)	3,425 (15.2)	3,750 (16.7)	4,330 (19.3)
	3-3/8 (86)	5,185 (23.1)	5,800 (25.8)	6,355 (28.3)	7,335 (32.6)	10,375 (46.1)	11,600 (51.6)	12,705 (56.5)	14,670 (65.3)
	4-1/2 (114)	7,985 (35.5)	8,930 (39.7)	9,430 (41.9)	10,130 (45.1)	15,970 (71.0)	17,855 (79.4)	18,855 (83.9)	20,260 (90.1)
	7-1/2 (191)	14,200 (63.2)	15,010 (66.8)	15,715 (69.9)	16,885 (75.1)	28,395 (126.3)	30,025 (133.6)	31,425 (139.8)	33,770 (150.2)
1/2	2-3/4 (70)	3,815 (17.0)	4,265 (19.0)	4,670 (20.8)	5,395 (24.0)	7,630 (33.9)	8,530 (37.9)	9,345 (41.6)	10,790 (48.0)
	4-1/2 (114)	7,985 (35.5)	8,930 (39.7)	9,780 (43.5)	11,295 (50.2)	15,970 (71.0)	17,855 (79.4)	19,560 (87.0)	22,585 (100.5)
	6 (152)	12,295 (54.7)	13,745 (61.1)	15,060 (67.0)	17,385 (77.3)	24,590 (109.4)	27,490 (122.3)	30,115 (134.0)	34,775 (154.7)
	10 (254)	24,390 (108.5)	25,790 (114.7)	26,995 (120.1)	29,005 (129.0)	48,785 (217.0)	51,585 (229.5)	53,990 (240.2)	58,015 (258.1)
5/8[10]	3-1/8 (79)	4,620 (20.6)	5,165 (23.0)	5,660 (25.2)	6,535 (29.1)	9,245 (41.1)	10,335 (46.0)	11,320 (50.4)	13,070 (58.1)
	5-5/8 (143)	11,160 (49.6)	12,480 (55.5)	13,670 (60.8)	15,785 (70.2)	22,320 (99.3)	24,955 (111.0)	27,335 (121.6)	31,565 (140.4)
	7-1/2 (191)	17,185 (76.4)	19,210 (85.5)	21,045 (93.6)	24,300 (108.1)	34,365 (152.9)	38,420 (170.9)	42,090 (187.2)	48,600 (216.2)
	12-1/2 (318)	36,620 (162.9)	38,725 (172.2)	40,530 (180.3)	43,550 (193.7)	73,245 (325.8)	77,445 (344.5)	81,055 (360.6)	87,100 (387.4)
3/4[10]	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	6-3/4 (171)	14,670 (65.3)	16,400 (73.0)	17,970 (79.9)	20,745 (92.3)	29,340 (130.5)	32,805 (145.9)	35,935 (159.8)	41,495 (184.6)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	15 (381)	48,600 (216.2)	53,740 (239.1)	56,250 (250.2)	60,445 (268.9)	97,200 (432.4)	107,485 (478.1)	112,495 (500.4)	120,885 (537.7)
7/8[10]	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	7-7/8 (200)	18,485 (82.2)	20,670 (91.9)	22,640 (100.7)	26,145 (116.3)	36,975 (164.5)	41,340 (183.9)	45,285 (201.4)	52,290 (232.6)
	10-1/2 (267)	28,465 (126.6)	31,820 (141.6)	34,860 (155.1)	40,255 (179.1)	56,925 (253.2)	63,645 (283.1)	69,720 (310.1)	80,505 (358.1)
	17-1/2 (445)	61,240 (272.4)	68,470 (304.6)	73,325 (326.2)	78,795 (350.5)	122,485 (544.8)	136,940 (609.1)	146,650 (652.3)	157,585 (701.0)
1[10]	4 (102)	6,690 (29.8)	7,480 (33.3)	8,195 (36.5)	9,465 (42.1)	13,385 (59.5)	14,965 (66.6)	16,395 (72.9)	18,930 (84.2)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	12 (305)	34,775 (154.7)	38,880 (172.9)	42,590 (189.5)	49,180 (218.8)	69,550 (309.4)	77,760 (345.9)	85,180 (378.9)	98,360 (437.5)
	20 (508)	74,825 (332.8)	83,655 (372.1)	91,640 (407.6)	98,875 (439.8)	149,650 (665.7)	167,310 (744.2)	183,280 (815.3)	197,755 (879.7)
1-1/4[10]	5 (127)	9,355 (41.6)	10,455 (46.5)	11,455 (51.0)	13,225 (58.8)	18,705 (83.2)	20,915 (93.0)	22,910 (101.9)	26,455 (117.7)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	38,660 (172.0)	44,640 (198.6)	63,135 (280.8)	70,585 (314.0)	77,320 (343.9)	89,285 (397.1)
	15 (381)	48,600 (216.2)	54,335 (241.7)	59,520 (264.8)	68,730 (305.7)	97,200 (432.4)	108,670 (483.4)	119,045 (529.5)	137,460 (611.4)
	25 (635)	104,570 (465.1)	116,910 (520.0)	128,070 (569.7)	141,095 (627.6)	209,140 (930.3)	233,825 (1040.1)	256,140 (1139.4)	282,190 (1255.2)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply above values by 0.55. Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1-1/4". See Table 76.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

3.2.4

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 74 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete/bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	2-3/8 (60)	2,145 (9.5)	2,395 (10.7)	2,530 (11.3)	2,645 (11.8)	2,145 (9.5)	2,395 (10.7)	2,530 (11.3)	2,645 (11.8)
	3-3/8 (86)	3,385 (15.1)	3,500 (15.6)	3,595 (16.0)	3,755 (16.7)	6,770 (30.1)	7,000 (31.1)	7,195 (32.0)	7,510 (33.4)
	4-1/2 (114)	4,515 (20.1)	4,665 (20.8)	4,795 (21.3)	5,005 (22.3)	9,025 (40.1)	9,335 (41.5)	9,590 (42.7)	10,015 (44.5)
	7-1/2 (191)	7,520 (33.5)	7,780 (34.6)	7,995 (35.6)	8,345 (37.1)	15,045 (66.9)	15,555 (69.2)	15,985 (71.1)	16,690 (74.2)
1/2	2-3/4 (70)	2,670 (11.9)	2,985 (13.3)	3,270 (14.5)	3,775 (16.8)	5,340 (23.8)	5,970 (26.6)	6,540 (29.1)	7,555 (33.6)
	4-1/2 (114)	5,590 (24.9)	6,175 (27.5)	6,345 (28.2)	6,625 (29.5)	11,180 (49.7)	12,345 (54.9)	12,690 (56.4)	13,250 (58.9)
	6 (152)	7,960 (35.4)	8,230 (36.6)	8,460 (37.6)	8,830 (39.3)	15,920 (70.8)	16,460 (73.2)	16,920 (75.3)	17,665 (78.6)
	10 (254)	13,265 (59.0)	13,720 (61.0)	14,100 (62.7)	14,720 (65.5)	26,535 (118.0)	27,435 (122.0)	28,200 (125.4)	29,440 (131.0)
5/8[10]	3-1/8 (79)	3,235 (14.4)	3,615 (16.1)	3,960 (17.6)	4,575 (20.4)	6,470 (28.8)	7,235 (32.2)	7,925 (35.2)	9,150 (40.7)
	5-5/8 (143)	7,810 (34.8)	8,735 (38.9)	9,570 (42.6)	10,270 (45.7)	15,625 (69.5)	17,470 (77.7)	19,135 (85.1)	20,540 (91.4)
	7-1/2 (191)	12,030 (53.5)	12,760 (56.8)	13,115 (58.3)	13,690 (60.9)	24,055 (107.0)	25,520 (113.5)	26,230 (116.7)	27,385 (121.8)
	12-1/2 (318)	20,565 (91.5)	21,265 (94.6)	21,855 (97.2)	22,820 (101.5)	41,135 (183.0)	42,535 (189.2)	43,715 (194.4)	45,640 (203.0)
3/4[10]	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	6-3/4 (171)	10,270 (45.7)	11,480 (51.1)	12,575 (55.9)	14,525 (64.6)	20,540 (91.4)	22,965 (102.1)	25,155 (111.9)	29,045 (129.2)
	9 (229)	15,810 (70.3)	17,675 (78.6)	18,735 (83.3)	19,560 (87.0)	31,620 (140.7)	35,355 (157.3)	37,470 (166.7)	39,120 (174.0)
	15 (381)	29,380 (130.7)	30,380 (135.1)	31,225 (138.9)	32,600 (145.0)	58,760 (261.4)	60,760 (270.3)	62,445 (277.8)	65,200 (290.0)
7/8[10]	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	7-7/8 (200)	12,940 (57.6)	14,470 (64.4)	15,850 (70.5)	18,300 (81.4)	25,880 (115.1)	28,935 (128.7)	31,700 (141.0)	36,605 (162.8)
	10-1/2 (267)	19,925 (88.6)	22,275 (99.1)	24,400 (108.5)	26,410 (117.5)	39,850 (177.3)	44,550 (198.2)	48,805 (217.1)	52,820 (235.0)
	17-1/2 (445)	39,670 (176.5)	41,020 (182.5)	42,160 (187.5)	44,020 (195.8)	79,340 (352.9)	82,040 (364.9)	84,315 (375.1)	88,035 (391.6)
1[10]	4 (102)	4,685 (20.8)	5,240 (23.3)	5,740 (25.5)	6,625 (29.5)	9,370 (41.7)	10,475 (46.6)	11,475 (51.0)	13,250 (58.9)
	9 (229)	15,810 (70.3)	17,675 (78.6)	19,365 (86.1)	22,360 (99.5)	31,620 (140.7)	35,355 (157.3)	38,730 (172.3)	44,720 (198.9)
	12 (305)	24,340 (108.3)	27,215 (121.1)	29,815 (132.6)	34,425 (153.1)	48,685 (216.6)	54,430 (242.1)	59,625 (265.2)	68,850 (306.3)
	20 (508)	51,815 (230.5)	53,580 (238.3)	55,065 (244.9)	57,490 (255.7)	103,630 (461.0)	107,155 (476.7)	110,130 (489.9)	114,985 (511.5)
1-1/4[10]	5 (127)	6,545 (29.1)	7,320 (32.6)	8,020 (35.7)	9,260 (41.2)	13,095 (58.2)	14,640 (65.1)	16,035 (71.3)	18,520 (82.4)
	11-1/4 (286)	22,095 (98.3)	24,705 (109.9)	27,060 (120.4)	31,250 (139.0)	44,195 (196.6)	49,410 (219.8)	54,125 (240.8)	62,500 (278.0)
	15 (381)	34,020 (151.3)	38,035 (169.2)	41,665 (185.3)	48,110 (214.0)	68,040 (302.7)	76,070 (338.4)	83,330 (370.7)	96,220 (428.0)
	25 (635)	73,200 (325.6)	79,665 (354.4)	81,875 (364.2)	85,485 (380.3)	146,395 (651.2)	159,330 (708.7)	163,750 (728.4)	170,970 (760.5)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30-41 as necessary to the above values. Compare to the steel values in table 29 to the above values. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176 °F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry or water saturated concrete conditions.
For water-filled drilled holes multiply design strength by 0.51.
For submerged (under water) applications multiply design strength by 0.44.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 5/8", 3/4", 7/8", 1", and 1-1/4". See Table 77.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} indicated below. See section 3.1.8.7 for additional information on seismic applications.
3/8-in. diameter - α_{seis} = 0.69
1/2-in. diameter - α_{seis} = 0.70
5/8-in. diameter - α_{seis} = 0.71
3/4-in. diameter and larger - α_{seis} = 0.75

Table 75 - Hilti HIT-RE 500-V3 design information with HAS/HIT-V threaded rods in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3-14 Annex D[1,8]

Design parameter		Symbol	Units	Nominal rod diameter (in.)					Ref
				5/8	3/4	7/8	1	1-1/4	A23.3-14
Nominal anchor diameter		d_a	mm	15.9	19.1	22.2	25.4	31.8	
Effective minimum embedment[2]		h_{ef}	mm	79	89	89	102	127	
Effective maximum embedment[2]		h_{ef}	mm	318	286	445	508	635	
Minimum concrete thickness[2]		h_{min}	mm	$h_{ef} + 2d_o$					
Critical edge distance		c_{ac}	-	see ESR-2322, section 4.1.10					
Minimum edge distance		c_{min}[3]	mm	79	95	111	127	159	
Minimum anchor spacing		s_{min}	mm	79	95	111	127	159	
Coeff. for factored concrete breakout resistance, uncracked concrete		$k_{c,uncr}$[4]	-	10					D.6.2.2
Coeff. for factored concrete breakout resistance, cracked concrete		$k_{c,cr}$[4]	-	7					D.6.2.2
Concrete material resistance factor		ϕ_c	-	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	-	1.00					D.5.3(c)
Dry and water saturated concrete									
Temp. range A[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	880 (6.1)	875 (6.0)	870 (6.0)	870 (6.0)	825 (5.7)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	2,210 (15.2)	2,130 (14.7)	2,040 (14.1)	1,960 (13.5)	1,790 (12.3)	D.6.5.2
Temp. range B[6]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	610 (4.2)	605 (4.2)	605 (4.2)	600 (4.1)	570 (3.9)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,530 (10.6)	1,470 (10.1)	1,410 (9.7)	1,350 (9.3)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete		-	-	1	1	1	1	1	
Resistance modification factor		R_{dry}	-	1.00	1.00	1.00	1.00	1.00	
Reduction for seismic tension		$\alpha_{N,seis}$	-	0.95	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, table 11 and 12, and converted for use with CSA A23.3-14 Annex D.

2 See figure 8 of section 3.2.4.3.4.

3 Minimum edge distance may be reduced to 45mm ≤ c_{ai} < 5d provided Tinst is reduced. See ESR-3814 section 4.1.9.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

7 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 8,000 psi.

8 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 76 - Hilti HIT-RE 500 V3 Core Drilled and roughened with TE-YRT Roughening Tool adhesive factored resistance with concrete / bond failure for threaded rod in uncracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
5/8	3-1/8 (79)	4,620 (20.6)	5,165 (23.0)	5,660 (25.2)	6,535 (29.1)	9,245 (41.1)	10,335 (46.0)	11,320 (50.4)	13,070 (58.1)
	5-5/8 (143)	11,160 (49.6)	12,480 (55.5)	13,670 (60.8)	15,785 (70.2)	22,320 (99.3)	24,955 (111.0)	27,335 (121.6)	31,565 (140.4)
	7-1/2 (191)	17,185 (76.4)	19,210 (85.5)	21,045 (93.6)	21,160 (94.1)	34,365 (152.9)	38,420 (170.9)	42,090 (187.2)	42,320 (188.2)
	12-1/2 (318)	35,265 (156.9)	35,265 (156.9)	35,265 (156.9)	35,265 (156.9)	70,535 (313.7)	70,535 (313.7)	70,535 (313.7)	70,535 (313.7)
3/4	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	6-3/4 (171)	14,670 (65.3)	16,400 (73.0)	17,970 (79.9)	20,745 (92.3)	29,340 (130.5)	32,805 (145.9)	35,935 (159.8)	41,495 (184.6)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	29,365 (130.6)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	58,735 (261.3)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	36,710 (163.3)	36,710 (163.3)	63,135 (280.8)	70,585 (314.0)	73,420 (326.6)	73,420 (326.6)
7/8	3-1/2 (89)	5,480 (24.4)	6,125 (27.2)	6,710 (29.8)	7,745 (34.5)	10,955 (48.7)	12,250 (54.5)	13,420 (59.7)	15,495 (68.9)
	7-7/8 (200)	18,485 (82.2)	20,670 (91.9)	22,640 (100.7)	26,145 (116.3)	36,975 (164.5)	41,340 (183.9)	45,285 (201.4)	52,290 (232.6)
	10-1/2 (267)	28,465 (126.6)	31,820 (141.6)	34,860 (155.1)	38,285 (170.3)	56,925 (253.2)	63,645 (283.1)	69,720 (310.1)	76,565 (340.6)
	17-1/2 (445)	61,240 (272.4)	63,805 (283.8)	63,805 (283.8)	63,805 (283.8)	122,485 (544.8)	127,610 (567.6)	127,610 (567.6)	127,610 (567.6)
1	4 (102)	6,690 (29.8)	7,480 (33.3)	8,195 (36.5)	9,465 (42.1)	13,385 (59.5)	14,965 (66.6)	16,395 (72.9)	18,930 (84.2)
	9 (229)	22,585 (100.5)	25,255 (112.3)	27,665 (123.1)	31,945 (142.1)	45,175 (200.9)	50,505 (224.7)	55,325 (246.1)	63,885 (284.2)
	12 (305)	34,775 (154.7)	38,880 (172.9)	42,590 (189.5)	48,040 (213.7)	69,550 (309.4)	77,760 (345.9)	85,180 (378.9)	96,085 (427.4)
	20 (508)	74,825 (332.8)	80,070 (356.2)	80,070 (356.2)	80,070 (356.2)	149,650 (665.7)	160,140 (712.3)	160,140 (712.3)	160,140 (712.3)
1-1/4	5 (127)	9,355 (41.6)	10,455 (46.5)	11,455 (51.0)	13,225 (58.8)	18,705 (83.2)	20,915 (93.0)	22,910 (101.9)	26,455 (117.7)
	11-1/4 (286)	31,565 (140.4)	35,290 (157.0)	38,660 (172.0)	44,640 (198.6)	63,135 (280.8)	70,585 (314.0)	77,320 (343.9)	89,285 (397.1)
	15 (381)	48,600 (216.2)	54,335 (241.7)	59,520 (264.8)	68,555 (304.9)	97,200 (432.4)	108,670 (483.4)	119,045 (529.5)	137,110 (609.9)
	25 (635)	104,570 (465.1)	114,255 (508.2)	114,255 (508.2)	114,255 (508.2)	209,140 (930.3)	228,515 (1016.5)	228,515 (1016.5)	228,515 (1016.5)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 77 - Hilti HIT-RE 500 V3 Core Drilled and roughened with TE-YRT Roughening Tool adhesive factored resistance with concrete / bond failure for threaded rod in cracked concrete[1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension N				Shear V			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
5/8	3-1/8 (79)	3,235 (14.4)	3,510 (15.6)	3,510 (15.6)	3,510 (15.6)	6,470 (28.8)	7,020 (31.2)	7,020 (31.2)	7,020 (31.2)
	5-5/8 (143)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	6,320 (28.1)	12,640 (56.2)	12,640 (56.2)	12,640 (56.2)	12,640 (56.2)
	7-1/2 (191)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	8,425 (37.5)	16,850 (75.0)	16,850 (75.0)	16,850 (75.0)	16,850 (75.0)
	12-1/2 (318)	14,045 (62.5)	14,045 (62.5)	14,045 (62.5)	14,045 (62.5)	28,085 (124.9)	28,085 (124.9)	28,085 (124.9)	28,085 (124.9)
3/4	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,690 (20.9)	4,690 (20.9)	7,670 (34.1)	8,575 (38.1)	9,385 (41.7)	9,385 (41.7)
	6-3/4 (171)	9,050 (40.2)	9,050 (40.2)	9,050 (40.2)	9,050 (40.2)	18,095 (80.5)	18,095 (80.5)	18,095 (80.5)	18,095 (80.5)
	9 (229)	12,065 (53.7)	12,065 (53.7)	12,065 (53.7)	12,065 (53.7)	24,130 (107.3)	24,130 (107.3)	24,130 (107.3)	24,130 (107.3)
	11-1/4 (286)	15,080 (67.1)	15,080 (67.1)	15,080 (67.1)	15,080 (67.1)	30,160 (134.2)	30,160 (134.2)	30,160 (134.2)	30,160 (134.2)
7/8	3-1/2 (89)	3,835 (17.1)	4,285 (19.1)	4,695 (20.9)	5,425 (24.1)	7,670 (34.1)	8,575 (38.1)	9,390 (41.8)	10,845 (48.2)
	7-7/8 (200)	12,245 (54.5)	12,245 (54.5)	12,245 (54.5)	12,245 (54.5)	24,490 (108.9)	24,490 (108.9)	24,490 (108.9)	24,490 (108.9)
	10-1/2 (267)	16,325 (72.6)	16,325 (72.6)	16,325 (72.6)	16,325 (72.6)	32,655 (145.2)	32,655 (145.2)	32,655 (145.2)	32,655 (145.2)
	17-1/2 (445)	27,210 (121.0)	27,210 (121.0)	27,210 (121.0)	27,210 (121.0)	54,420 (242.1)	54,420 (242.1)	54,420 (242.1)	54,420 (242.1)
1	4 (102)	4,685 (20.8)	5,240 (23.3)	5,740 (25.5)	6,625 (29.5)	9,370 (41.7)	10,475 (46.6)	11,475 (51.0)	13,250 (58.9)
	9 (229)	15,810 (70.3)	15,995 (71.1)	15,995 (71.1)	15,995 (71.1)	31,620 (140.7)	31,985 (142.3)	31,985 (142.3)	31,985 (142.3)
	12 (305)	21,325 (94.9)	21,325 (94.9)	21,325 (94.9)	21,325 (94.9)	42,650 (189.7)	42,650 (189.7)	42,650 (189.7)	42,650 (189.7)
	20 (508)	35,540 (158.1)	35,540 (158.1)	35,540 (158.1)	35,540 (158.1)	71,080 (316.2)	71,080 (316.2)	71,080 (316.2)	71,080 (316.2)
1-1/4	5 (127)	6,545 (29.1)	7,320 (32.6)	8,020 (35.7)	9,260 (41.2)	13,095 (58.2)	14,640 (65.1)	16,035 (71.3)	18,520 (82.4)
	11-1/4 (286)	22,095 (98.3)	23,695 (105.4)	23,695 (105.4)	23,695 (105.4)	44,195 (196.6)	47,395 (210.8)	47,395 (210.8)	47,395 (210.8)
	15 (381)	31,595 (140.5)	31,595 (140.5)	31,595 (140.5)	31,595 (140.5)	63,190 (281.1)	63,190 (281.1)	63,190 (281.1)	63,190 (281.1)
	25 (635)	52,660 (234.2)	52,660 (234.2)	52,660 (234.2)	52,660 (234.2)	105,320 (468.5)	105,320 (468.5)	105,320 (468.5)	105,320 (468.5)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 30 - 41 as necessary to the above values. Compare to the steel values in table 29. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λa as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} indicated below. See section 3.1.8.7 for additional information on seismic applications.
5/8-in. diameter a_{seis}=0.71
3/4-in. diameter and larger - α_{seis} = 0.75

3.2.4

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 78 - Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in hammer drilled holes in accordance with CSA A23.3-14 Annex D[1,7]

Design parameter	Symbol	Units	Nominal bolt/cap screw diameter (in.) 3/8	1/2	5/8	3/4	Ref A23.3-14
HIS insert outside diameter	D	mm	16.5	20.5	25.4	27.6	
Effective embedment[2]	h_{ef}	mm	110	125	170	205	
Min. concrete thickness[2]	h_{min}	mm	150	170	230	270	
Critical edge distance	c_{ac}	-	see ESR-3814, section 4.1.10				
Minimum edge distance	c_{min}	mm	83	102	127	140	
Minimum anchor spacing	s_{min}	mm	83	102	127	140	
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$[3]	-	10				D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$[3]	-	7				D.6.2.2
Concrete material resistance factor	Φ_c	-	0.65				8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	-	1.00				D.5.3(c)
Dry and water saturated concrete							
Temp. range A[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	1,070 (7.4)	D.6.5.2
Temp. range A[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	740 (5.1)	740 (5.1)	740 (5.1)	740 (5.1)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete	-	-	1	1	1	1	
Resistance modification factor	R_{dry}	-	1.00	1.00	1.00	1.00	
Water-filled hole							
Temp. range A[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	800 (5.5)	810 (5.6)	820 (5.7)	820 (5.7)	D.6.5.2
Temp. range A[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,340 (9.2)	1,350 (9.3)	1,370 (9.4)	1,380 (9.5)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	550 (3.8)	560 (3.9)	570 (3.9)	570 (3.9)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	920 (6.3)	930 (6.4)	950 (6.6)	950 (6.6)	D.6.5.2
Anchor category, water-filled hole	-	-	3	3	3	3	
Resistance modification factor	R_{wf}	-	0.75	0.75	0.75	0.75	
Underwater applications							
Temp. range A[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	710 (4.9)	720 (5.0)	750 (5.2)	750 (5.2)	D.6.5.2
Temp. range A[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,190 (8.2)	1,210 (8.3)	1,250 (8.6)	1,260 (8.7)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	490 (3.4)	500 (3.4)	510 (3.5)	520 (3.6)	D.6.5.2
Temp. range B[5]: Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	820 (5.7)	840 (5.8)	860 (5.9)	870 (6.0)	D.6.5.2
Anchor category, underwater	-	-	3	3	3	3	
Resistance modification factor	R_{uw}		0.75	0.75	0.75	0.75	
Reduction for seismic tension	$\alpha_{N,seis}$	-	1.00	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, tables 16 and 17, and converted for use with CSA A23.3-14 Annex D.

2 See figure 3 of this section.

3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

4 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

6 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$]. for uncracked concrete and $(f'c/2{,}500)^{0.15}$ [for SI: $(f'c/17.2)^{0.15}$] for cracked concrete

7 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 79 - Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in diamond core drilled holes in accordance with CSA A23.3-14 Annex D[1]

Design parameter	Symbol	Units	Nominal bolt/cap screw diameter (in.)				Ref A23.3-14
			3/8	1/2	5/8	3/4	
HIS insert outside diameter	D	mm	16.5	20.5	25.4	27.6	
Effective embedment[2]	h_{ef}	mm	110	125	170	205	
Min. concrete thickness[2]	h_{min}	mm	150	170	230	270	
Critical edge distance	c_{ac}	-	see ESR-3814, section 4.1.10				
Minimum edge distance	c_{min}	mm	83	102	127	140	
Minimum anchor spacing	s_{min}	mm	83	102	127	140	
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$[3]	-	10				D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$[3]	-	7				D.6.2.2
Concrete material resistance factor	ϕ_c	-	0.65				8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R_{conc}	-	1.00				D.5.3(c)
Dry concrete							
Temp. range A[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi (MPa)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	D.6.5.2
Temp. range B[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi (MPa)	830 (5.7)	830 (5.7)	830 (5.7)	830 (5.7)	D.6.5.2
Anchor category, dry concrete	-	-	3	3	3	3	
Resistance modification factor	R_{dry}	-	0.75	0.75	0.75	0.75	
Water saturated hole							
Temp. range A[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi (MPa)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	1,200 (8.3)	D.6.5.2
Temp. range B[5] – Characteristic bond stress in uncracked concrete[6,7]	τ_{cr}	psi (MPa)	830 (5.7)	830 (5.7)	830 (5.7)	830 (5.7)	D.6.5.2
Anchor category, water-saturated conc.	-	-	3	3	3	3	
Resistance modification factor	R_{ws}	-	0.75	0.75	0.75	0.75	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, tables 16 and 17, and converted for use with CSA A23.3-14 Annex D.

2 See figure 8 of section 3.2.4.3.6.

3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

4 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

6 Bond stress values corresponding to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond stress may be increased by a factor of $(f'_c/2{,}500)^{0.25}$ [for SI: $(f'_c/17.2)^{0.25}$] for uncracked concrete.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 80 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8-16 UNC	4-3/8 (110)	7,540 (33.5)	8,430 (37.5)	9,235 (41.1)	10,660 (47.4)	15,080 (67.1)	16,860 (75.0)	18,470 (82.1)	21,325 (94.9)
1/2-13 UNC[10]	5 (125)	9,135 (40.6)	10,210 (45.4)	11,185 (49.8)	12,915 (57.5)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)
5/8-11 UNC[10]	6-3/4 (170)	14,485 (64.4)	16,195 (72.0)	17,740 (78.9)	20,485 (91.1)	28,970 (128.9)	32,390 (144.1)	35,480 (157.8)	40,970 (182.2)
3/4-10 UNC[10]	8-1/8 (205)	19,180 (85.3)	21,445 (95.4)	23,490 (104.5)	27,125 (120.7)	38,360 (170.6)	42,890 (190.8)	46,985 (209.0)	54,255 (241.3)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 - 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
6 Tabular values are for dry concrete or water-saturated concrete conditions. For water-filled drilled holes multiply design strength by 0.52. For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. For diamond core drilling, except as indicated in note 10, multiply uncracked concrete tabular values by 0.57. Diamond core drilling is not permitted for the water-filled or under-water (submerged) applications.
10 Diamond core drilling with Hilti TE-YRT roughening tool is permitted for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Table 83.
11 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete.

Table 81 - Hilti HIT-RE 500 V3 adhesive factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9,11]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8-16 UNC	4-3/8 (110)	5,280 (23.5)	5,900 (26.2)	6,465 (28.8)	6,985 (31.1)	10,555 (47.0)	11,800 (52.5)	12,925 (57.5)	13,965 (62.1)
1/2-13 UNC[10]	5 (125)	6,395 (28.4)	7,150 (31.8)	7,830 (34.8)	9,040 (40.2)	12,785 (56.9)	14,295 (63.6)	15,660 (69.7)	18,080 (80.4)
5/8-11 UNC[10]	6-3/4 (170)	10,140 (45.1)	11,335 (50.4)	12,420 (55.2)	14,340 (63.8)	20,280 (90.2)	22,675 (100.9)	24,835 (110.5)	28,680 (127.6)
3/4-10 UNC[10]	8-1/8 (205)	13,425 (59.7)	15,010 (66.8)	16,445 (73.1)	18,990 (84.5)	26,855 (119.5)	30,025 (133.5)	32,890 (146.3)	37,975 (168.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50-51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130 (55°C), max. long term temperature = 110°F (43°C). For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69. Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. For water-filled drilled holes multiply design strength by 0.52. For submerged (under water) applications multiply design strength by 0.46.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows: For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for holes drilled in concrete with carbide tipped hammer drill bit. Diamond core drilling is not permitted in cracked concrete except as indicated in note 10.
10 Diamond core drilling is permitted in cracked concrete with use of the Hilti TE-YRT roughening tool for 1/2-13 UNC, 5/8-11 UNC, and 3/4-10 UNC anchors in dry and water-saturated concrete. See Table 84.
11 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.8.7 for additional information on seismic applications.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 82 - Hilti HIT-RE 500 V3 design information with Hilti HIS-N and HIS-RN internally threaded inserts in core drilled holes roughened with the TE-YRT Roughening Tool in accordance with CSA A23.3-14 Annex D[1]

Design parameter		Symbol	Units	Nominal bolt/cap screw diameter (in.)			Ref A23.3-14
				1/2	5/8	3/4	
HIS insert outside diameter		D	mm	20.5	25.4	27.6	
Effective embedment[2]		h_{ef}	mm	125	170	205	
Min. concrete thickness[2]		h_{min}	mm	170	230	270	
Critical edge distance		c_{ac}	-	See ESR-2322, section 4.1.10			
Minimum edge distance		c_{min}	mm	102	127	140	
Minimum anchor spacing		s_{min}	mm	102	127	140	
Coeff. for factored conc. breakout resistance, uncracked concrete		$k_{c,uncr}$[3]	-	10			D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete		$k_{c,cr}$[3]	-	7			D.6.2.2
Concrete material resistance factor		ϕ_c	-	0.65			8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]		R_{conc}	-	1.00			D.5.3(c)
Dry and water saturated concrete							
Temp. range A[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	750 (5.2)	750 (5.2)	750 (5.2)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,790 (12.3)	1,790 (12.3)	1,790 (12.3)	D.6.5.2
Temp. range B[5]	Characteristic bond stress in cracked concrete[6,7]	τ_{cr}	psi (MPa)	515 (3.6)	515 (3.6)	515 (3.6)	D.6.5.2
	Characteristic bond stress in uncracked concrete[6,7]	τ_{uncr}	psi (MPa)	1,240 (8.6)	1,240 (8.6)	1,240 (8.6)	D.6.5.2
Anchor category, dry concrete		-	-	1	1	1	
Resistance modification factor		R_{dry}	-	1.00	1.00	1.00	
Reduction for seismic tension		$\alpha_{N,seis}$	-	1.00	1.00	1.00	

1 Design information in this table is taken from ICC-ES ESR-3814, dated January, 2016, table 29, and converted for use with CSA A23.3-14 Annex D.

2 See figure 8 of section 3.2.4.3.6.

3 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

4 For use with the load combinations of CSA A23.3-14 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

5 Temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
Temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

6 Bond stress values correspond to concrete compressive strength in the range 2,500 psi ≤ f'_c ≤ 8,000 psi.

7 For structures assigned to Seismic Design Categories C, D, E, or F, bond stress values must be multiplied by $\alpha_{N,seis}$.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 83 - Hilti HIT-RE 500-V3 adhesive core drilled and roughened with TE-YRT Roughening Tool factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in uncracked concrete[1,2,3,4,5,6,7,8]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/2-13 UNC	5 (125)	9,135 (40.6)	10,210 (45.4)	11,185 (49.8)	12,915 (57.5)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)
5/8-11 UNC	6-3/4 (170)	14,485 (64.4)	16,195 (72.0)	17,740 (78.9)	20,485 (91.1)	28,970 (128.9)	32,390 (144.1)	35,480 (157.8)	40,970 (182.2)
3/4-10 UNC	8-1/8 (205)	19,180 (85.3)	21,445 (95.4)	23,490 (104.5)	27,125 (120.7)	38,360 (170.6)	42,890 (190.8)	46,985 (209.0)	54,255 (241.3)

Table 84 - Hilti HIT-RE 500 V3 adhesive core drilled and roughened with TE-YRT Roughening Tool factored resistance with concrete / bond failure for Hilti HIS-N and HIS-RN internally threaded inserts in cracked concrete[1,2,3,4,5,6,7,8,9]

Thread size	Effective embedment in. (mm)	Tension N_r				Shear V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
1/2-13 UNC	5 (125)	6,105 (27.2)	6,105 (27.2)	6,105 (27.2)	6,105 (27.2)	12,215 (54.3)	12,215 (54.3)	12,215 (54.3)	12,215 (54.3)
5/8-11 UNC	6-3/4 (170)	10,140 (45.1)	10,255 (45.6)	10,255 (45.6)	10,255 (45.6)	20,280 (90.2)	20,505 (91.2)	20,505 (91.2)	20,505 (91.2)
3/4-10 UNC	8-1/8 (205)	13,425 (59.7)	13,475 (59.9)	13,475 (59.9)	13,475 (59.9)	26,855 (119.5)	26,955 (119.9)	26,955 (119.9)	26,955 (119.9)

1 See Section 3.1.8 for explanation on development of load values.
2 See Section 3.1.8.6 to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 50 - 51 as necessary to the above values. Compare to the steel values in table 49. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above values by 0.69.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete or water-saturated concrete conditions. Water-filled and submerged (under water) applications are not permitted for this hole preparation method.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8.
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength (factored resistance) by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.8.7 for additional information on seismic applications.

Table 85 - Steel factored resistance for steel bolt/cap screw for Hilti HIS-N and HIS-RN internally threaded inserts[1,2,3]

Thread size	ASTM A193 B7			ASTM A193 Grade B8M Stainless Steel		
	Tensile[4] N_{sar} lb (kN)	Shear[5] V_{sar} lb (kN)	Seismic Shear[6] $V_{sar,eq}$ lb (kN)	Tensile[4] N_{sar} lb (kN)	Shear[5] V_{sar} lb (kN)	Seismic Shear[6] $V_{sar,eq}$ lb (kN)
3/8-16 UNC	5,765 (25.6)	3,215 (14.3)	2,250 (10.0)	5,070 (22.6)	2,825 (12.6)	1,975 (8.8)
1/2-13 UNC	9,635 (42.9)	5,880 (26.2)	4,115 (18.3)	9,290 (41.3)	5,175 (23.0)	3,620 (16.1)
5/8-11 UNC	16,020 (71.3)	9,365 (41.7)	6,555 (29.2)	14,790 (65.8)	8,240 (36.7)	5,770 (25.7)
3/4-10 UNC	16,280 (72.4)	13,860 (61.7)	9,700 (43.1)	21,895 (97.4)	12,195 (54.2)	8,535 (38.0)

1 See Section 3.1.8.6 to convert design strength value to ASD value.
2 Hilti HIS-N and HIS-RN inserts with steel bolts are considered brittle steel elements.
3 Table values are the lesser of steel failure in the HIS-N insert or inserted steel bolt.
4 Tensile = $A_{se,N}\ \phi_s\ f_{uta}$ R as noted in CSA A23.3-14 Annex D
5 Shear = $A_{se,V}\ \phi_s$ 0.60 f_{uta} R as noted in CSA A23.3-14 Annex D. For 3/8-in diameter insert, shear = $A_{se,V}\ \phi_s$ 0.50 f_{uta} R.
6 Seismic Shear = $\alpha_{V,seis}\ V_{sar}$: Reduction factor for seismic shear only. See section 3.1.8.7 for additional information on seismic applications.

3.2.4.3.8 Development and splicing of post-installed reinforcement

Calculations for post-installed rebar for typical development lengths may be done according to ACI 318-14 Chapter 25 (formerly ACI 318-11 Chapter 12) and CSA A23.3-14 Chapter 12 for adhesive anchors tested and approved in accordance with AC 308. This section contains tables for the data provided in ICC Evaluation Services ESR-3814. Refer to section 3.1.14 and the Hilti North America Post-Installed Reinforcing Bar Guide for the design method.

Table 86 - Calculated tension development and Class B Splice lengths for Grade 60 bars in walls, slabs, columns, and footings per ACI 318-14 Chapter 25 for Hilti HIT-RE 500 V3

Rebar size	$\frac{c_b + K_{tr}}{d_b}$	min. edge dist. in.[1]	min. spacing in.[2]	f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi	
				ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.	ℓ_d in.	Class B splice in.
#3	2.5	2-1/4	2	12	14	12	13	12	12	12	12
#4		2-3/4	2-1/2	14	19	13	17	12	15	12	12
#5		3	3-1/4	18	23	16	21	14	18	12	15
#6		3-3/4	3-3/4	22	28	20	26	17	22	14	18
#7		4-1/2	4-1/2	32	41	29	37	25	32	20	26
#8		5	5	36	47	33	43	28	37	23	30
#9		5-1/4	5-3/4	41	53	37	48	32	42	26	34
#10		5-3/4	6-1/2	46	59	42	54	36	47	30	38

1 Edge distances are determined using the minimum cover specified by ESR-3814 with an additional 6% of the development length per suggestions for drilling without an aid per Hilti Post-Installed Reinforcing Bar Guide Section 3.3. Smaller edge distances may be possible, for which development and splice lengths may need to be recalculated. For further information on required cover see ACI 318-14, Sec. 20.6.1.3.1; see Sec. 2.2 for determination of cb.

2 Spacing values represent those producing c_b =5 d_b rounded up to the nearest 1/4 in. Smaller spacing values may be possible, for which development and splice lengths may need to be recalculated. For further information on required spacing see ACI 318-14 Sec. 25.2; see Sec. 2.2 for determination of c_b.

3 ψ_t = 1.0 See ACI 318-14, Sec. 25.4.2.4.

4 ψ_e = 1.0 for non-epoxy coated bars. See ACI 318-14, Sec. 25.4.2.4.

5 ψ_s = 0.8 for #6 bars and smaller bars, 1.0 for #7 and larger bars. See ACI 318-14, Sec. 25.4.2.4.

6 Values are for normal weight concrete. For sand-lightweight concrete, multiply development and splice lengths by 1.18, for all-lightweight concrete multiply development and splice lengths by 1.33. See ACI 318-14 Sec. 19.2.4.

7 Development and splice length values are for static design. Seismic design development and splice lengths can be found in ACI 318-14 18.8.5 for special moment frames and ACI 318-14 18.10.2.3 for special structural walls. For further information about reinforcement in seismic design, see ACI 318-14 Ch. 18.

8 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples.

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 87 - Suggested embedment, edge distance, and spacing (see figure below) to develop 125% of f_y in Grade 60 bars based on ACI 318-14 Chapter 17 - SDC A and B only[1,2,3,4,5,6,7]

Rebar size	f'_c = 2,500 psi				f'_c = 3,000 psi				f'_c = 4,000 psi				f'_c = 6,000 psi			
	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Cond. II	Min. spacing s_{min} in.	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Cond. II	Min. spacing s_{min} in.	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Cond. II	Min. spacing s_{min} in.	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Cond. II	Min. spacing s_{min} in.
#3	7	17	8	15	6	16	7	14	6	16	7	13	5	15	6	11
#4	9	23	11	22	9	23	11	21	8	22	10	19	7	20	9	17
#5	**11**	29	15	29	**11**	28	14	28	10	27	13	25	9	25	11	22
#6	**13**	35	19	37	**13**	34	18	35	12	32	16	32	11	30	14	28
#7	**16**	41	23	45	**15**	40	22	43	**14**	38	20	39	13	36	17	34
#8	**18**	48	27	54	**17**	46	26	51	**16**	44	24	47	**15**	42	21	41
#9	**21**	56	32	63	**20**	54	30	60	**18**	50	27	54	**17**	47	24	48
#10	**25**	65	37	74	**24**	63	35	70	**22**	58	32	64	**19**	54	28	56

1 For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.

2 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.3 to develop 125% of nominal bar yield. Bond stresses apply for sustained and non-sustained load conditions. Additional reductions per ACI 318-14, 17.3.1.2 are not included, however, and as such these embedments are not intended for sustained tension load applications. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the unbolded and bolded tabulated hef values by 0.80 and 0.86, respectively. Reduction factors for non-sustained loading and no bar overstrength may be combined.

3 c_a and s are the minimum edge distance and bar spacing (from bar centerline) associated with the tabulated embedments. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

5 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

6 Values are for normal weight concrete. For lightweight concrete contact Hilti.

7 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

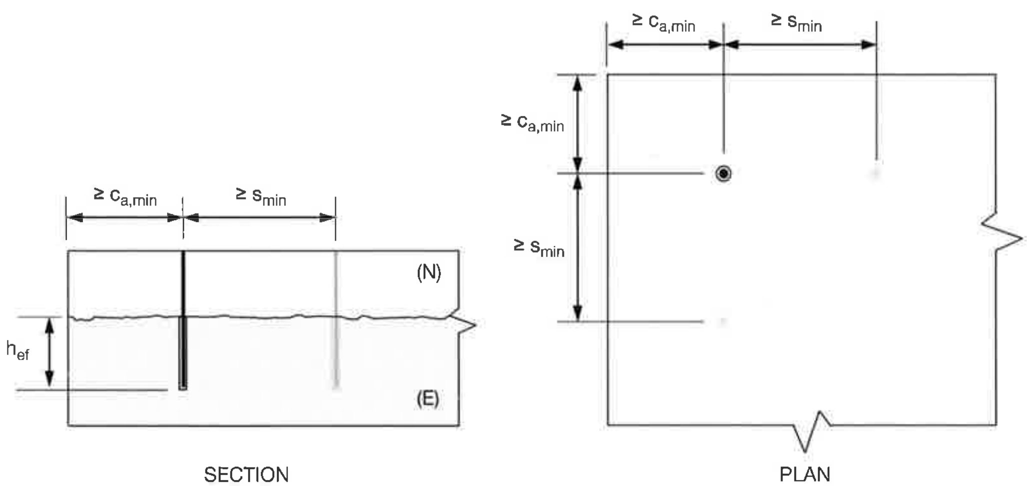


Illustration of Table 84 dimensions

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 88 - Suggested embedment and edge distance (see figure below) based on ACI 318-14 Chapter 17 to develop 125% of f_y in Grade 60 wall/column starter bars in a linear array with bar spacing = 24 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in.	
			Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II		Cond. I	Cond. II
#3		7	17	8	6	16	7	6	16	7	5	15	6
#4		9	23	11	9	23	11	8	22	10	7	20	9
#5	24	13	34	19	11	30	17	10	27	13	9	25	11
#6		21	57	32	19	51	28	15	43	23	11	32	17
#7		-	-	-	-	-	-	24	66	35	18	52	27

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 24 in. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

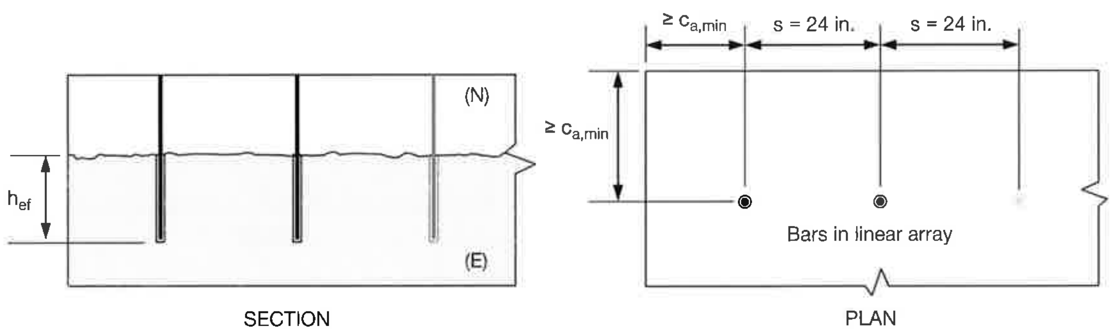


Illustration of Table 85 dimensions

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 89 - Suggested embedment and edge distance (see figure below) based on ACI 318-14 Chapter 17 to develop 125% of fy in Grade 60 wall/column starter bars in a linear array with bar spacing = 18 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II
#3	18	7	17	8	6	16	7	6	16	7	5	15	6
#4		10	26	14	9	23	13	8	22	10	7	20	9
#5		-	-	-	-	-	-	13	36	19	10	28	14

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 18 in. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

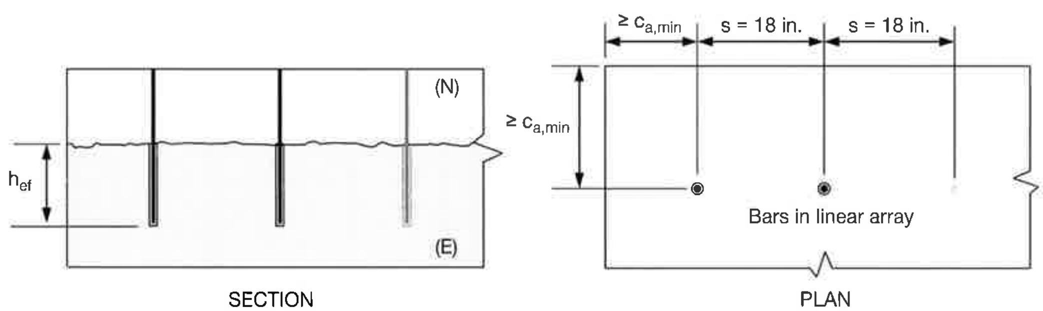


Illustration of Table 86 dimensions

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 90 - Suggested embedment and edge distance (see figure below) based on ACI 318-14 Chapter 17 to develop 125% of f_y in Grade 60 wall/column starter bars in a linear array with bar spacing = 12 inches - SDC A and B only[1,2,3,4,5,6]

Rebar size	Linear spacing s in.	f'_c = 2,500 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Effective embed. h_{ef} in.	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II
#3	12	7	17	10	6	16	9	6	16	7	5	15	6
#4		-	-	-	-	-	-	11	31	16	8	24	12

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 12 in. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

3 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for detailed explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

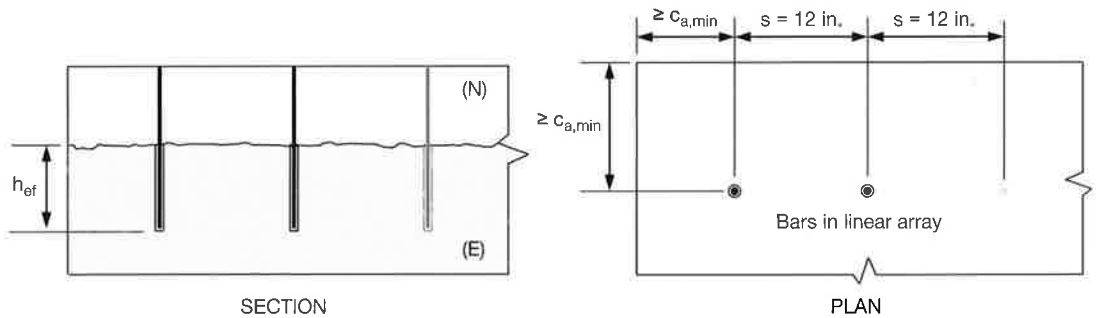


Illustration of Table 87 dimensions

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 91 - Calculated tension development and Class B Splice lengths for Canadian 400 MPa bars in walls, slabs, columns, and footings per CSA 23.3-14 for Hilti HIT-RE 500 V3 - non-seismic design only[3,4,5,6,7,8]

Rebar size	$d_{cs} + K_{tr}$	min. edge dist. mm[1]	min. spacing mm[2]	f'_c = 20 MPa		f'_c = 25 MPa		f'_c = 30 MPa		f'_c = 40 MPa	
				ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm	ℓ_d mm	Class B splice mm
10M	2.5 d_b	60	50	300	380	300	340	300	310	300	300
15M		70	75	410	540	370	480	340	440	300	380
20M		80	100	510	660	450	490	410	540	360	460
25M		120	125	820	1,060	730	950	670	870	580	750
30M		130	150	960	1,250	860	1,120	790	1,020	680	890

1 Edge distances are determined using the minimum cover specified by ESR-3184 with an additional 6% of the development length per suggestions for drilling without an aid per Hilti Post-Installed Reinforcing Bar Guide Section 3.3. Smaller edge distances may be possible, for which development and splice lengths may need to be recalculated. For further information on required cover see CSA A23.1-14 Table 17; see Sec. 3.2 for determination of d_{cs}.

2 Spacing values represent those producing $d_{cs} = 5d_b$. Smaller spacing values may be possible, for which development and splice lengths may need to be recalculated. For further information on required spacing see CSA A23.1 Sec. 6.6.5.2; see Sec. 3.2 for determination of d_{cs}.

3 k_1 and k_2 as defined by CSA A23.3-14 12.2.4 (a) and (b), are taken as 1.0 for post-installed reinforcing bars. For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.

4 k_4 = 0.8 for 20M bars and smaller bars, 1.0 for 25M and larger bars. See CSA A23.3-14 12.2.4 (d).

5 K_{tr} is assumed to equal zero.

6 Values are for normal weight concrete. For lightweight concrete, multiply development and splice lengths by 1.3.

7 Development and splice length values are for static design. For tension development and splice lengths of bars in joints, see CSA A23.3-14 21.3.3.5. For further information about reinforcement in seismic design, see CSA A23.3-14 Ch. 21.

8 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples.

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 92 - Suggested embedment, edge distance, and spacing (see figure below) to develop 125% of f_y in Canadian 400 MPa bars based on CSA 23.3-14 Annex D - non-seismic design only[1,2,3,4,5,6,7]

Rebar size	f'_c = 20 MPa				f'_c = 25 MPa				f'_c = 30 MPa				f'_c = 40 MPa			
	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Min. spacing s_{min} mm	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ in. Cond. I	Minimum edge dist $c_{a,min}$ in. Cond. II	Min. spacing s_{min} mm
10M	180	480	220	440	170	470	200	400	160	450	190	380	150	430	180	350
15M	260	690	350	690	240	670	320	640	230	650	300	600	220	620	280	550
20M	**310**	850	450	900	**300**	820	420	840	**280**	800	400	790	270	760	360	720
25M	**420**	1,140	630	1,260	**400**	1,080	590	1,170	**380**	1,050	560	1,110	**350**	1,000	500	1,000
30M	**530**	1,420	790	1,580	**490**	1,340	740	1,470	**460**	1,280	690	1,380	**420**	1,200	630	1,260

1 For additional information see May-June 2013 issue of the ACI Structural Journal, "Recommended Procedures for Development and Splicing of Post-Installed Bonded Reinforcing Bars in Concrete Structures" by Charney, Pal and Silva.

2 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.3 to develop 125% of nominal bar yield. Bond stresses apply for sustained and non-sustained load conditions. Additional reductions per ACI 318-14, 17.3.1.2 are not included, however, and as such these embedments are not intended for sustained tension load applications. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the unbolded and bolded tabulated hef values by 0.80 and 0.86, respectively. Reduction factors for non-sustained loading and no bar overstrength may be combined.

3 c_a and s are the minimum edge distance and bar spacing (from bar centerline) associated with the tabulated embedments. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Applicable for hammer-drilled holes. For rock-drilled and core-drilled holes, contact Hilti.

5 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814 Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

6 Values are for normal weight concrete. For lightweight concrete contact Hilti.

7 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

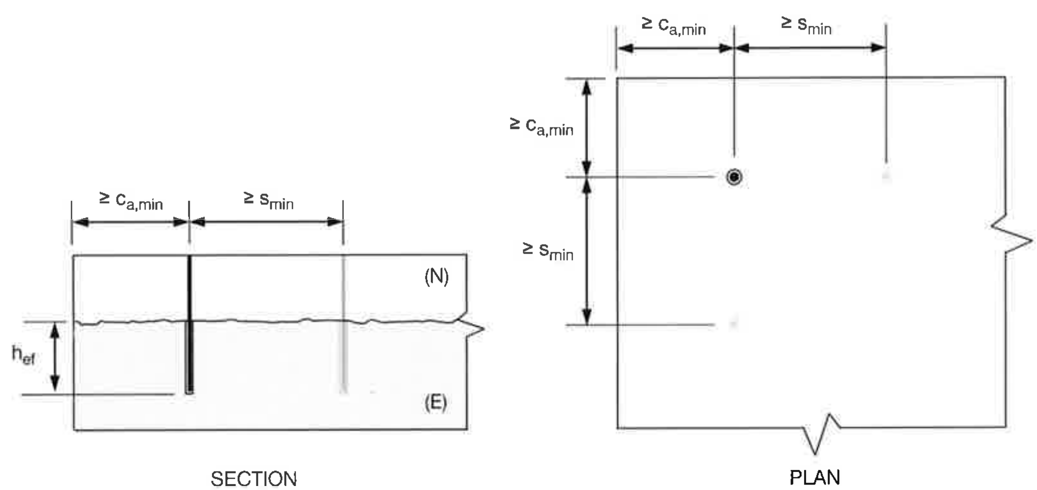


Illustration of Table 89 dimensions

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 93 - Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 600 mm - non-seismic only[1,2,3,4,5,6]

Rebar size	Linear spacing s mm	f'_c = 20 MPa			f'_c = 25 MPa			f'_c = 30 MPa			f'_c = 40 MPa		
		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II
10M	600	180	480	220	170	470	200	160	450	190	150	430	180
15M		280	760	420	240	670	350	230	650	300	220	620	280
20M		-	-	-	430	1,220	650	380	1,080	570	310	890	460

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 600 mm. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

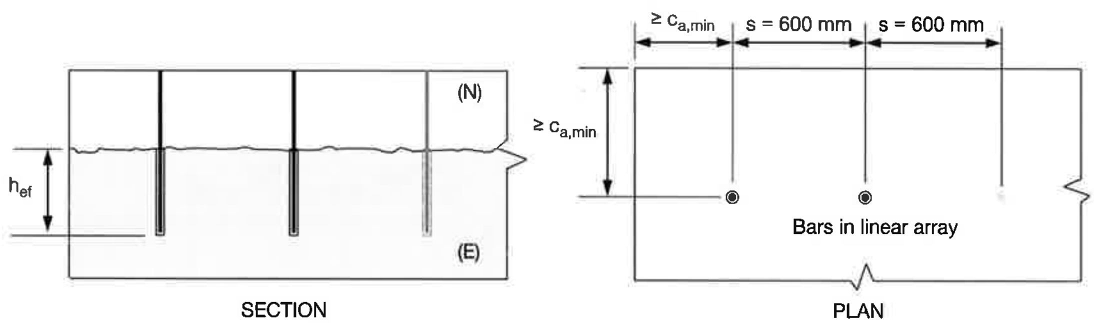


Illustration of Table 90 dimensions

HIT-RE 500 V3 Epoxy Adhesive Anchoring System 3.2.4

Table 94 - Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 450 mm - non-seismic only[1,2,3,4,5,6]

Rebar size	Linear spacing s mm	f'_c = 20 MPa Effective embed. h_{ef} mm	f'_c = 20 MPa Minimum edge dist $c_{a,min}$ mm Cond. I	f'_c = 20 MPa Cond. II	f'_c = 25 MPa Effective embed. h_{ef} mm	f'_c = 25 MPa Minimum edge dist $c_{a,min}$ mm Cond. I	f'_c = 25 MPa Cond. II	f'_c = 30 MPa Effective embed. h_{ef} mm	f'_c = 30 MPa Minimum edge dist $c_{a,min}$ mm Cond. I	f'_c = 30 MPa Cond. II	f'_c = 40 MPa Effective embed. h_{ef} mm	f'_c = 40 MPa Minimum edge dist $c_{a,min}$ mm Cond. I	f'_c = 40 MPa Cond. II
10M	450	180	480	220	170	470	200	160	450	190	150	430	180
15M		400	1,090	590	340	950	510	300	840	440	240	690	360

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 450 mm. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

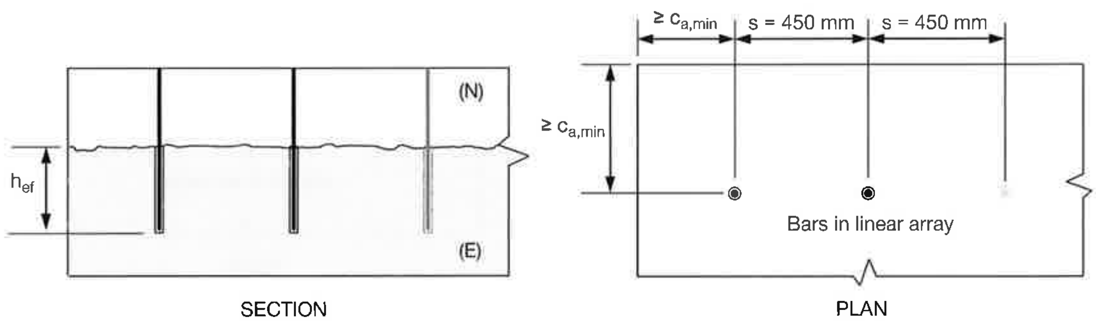


Illustration of Table 91 dimensions

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

Table 95 - Suggested embedment and edge distance (see figure below) based on CSA 23.3 Annex D to develop 125% of f_y in Canadian 400 MPa wall/column starter bars in a linear array with bar spacing = 300 mm - non-seismic only[1,2,3,4,5,6]

Rebar size	Linear spacing s mm	f'_c = 20 MPa			f'_c = 25 MPa			f'_c = 30 MPa			f'_c = 40 MPa		
		Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II	Effective embed. h_{ef} mm	Minimum edge dist $c_{a,min}$ mm Cond. I	Cond. II
10M	300	240	650	350	200	560	300	180	500	260	160	450	210

1 h_{ef} is the calculated bar embedment based on uncracked bond and concrete breakout strengths using equations in section 3.1.14.4 to develop 125% of nominal bar yield. Shaded embedment values exceed 20 bar diameters. For non-tabulated rebar sizes, design per development length provisions is recommended. The particular assumptions used for the application of anchor theory to bar development (e.g., bar yield and bond strength values) are a matter of engineering judgment and will in part depend on the specific circumstances of the design. For embedments corresponding to nominal yield (i.e., no overstrength) multiply the tabulated hef values by 0.86.

2 c_a is the minimum edge distance (from bar centerline) associated with the tabulated embedments and s = 300 mm. Refer to sec. 3.1.14.3 for applicability of edge distance "Condition I" and "Condition II."

4 Values determined with bond stresses, k-factors and strength reduction factors taken from ESR-3814, Tables 12 and 13 assuming dry, uncracked concrete conditions where concrete temperatures will not exceed a maximum short-term temperature of 130°F (55°C) and long-term temperature of 110°F (43°C). Bond stresses are for static (non-seismic) loading conditions.

5 Values are for normal weight concrete. For lightweight concrete contact Hilti.

6 Refer to the Hilti North America Post-Installed Reinforcing Bar Guide for further explanation, background information, and design examples. See Hilti Instructions for Use (IFU) for specific installation requirements.

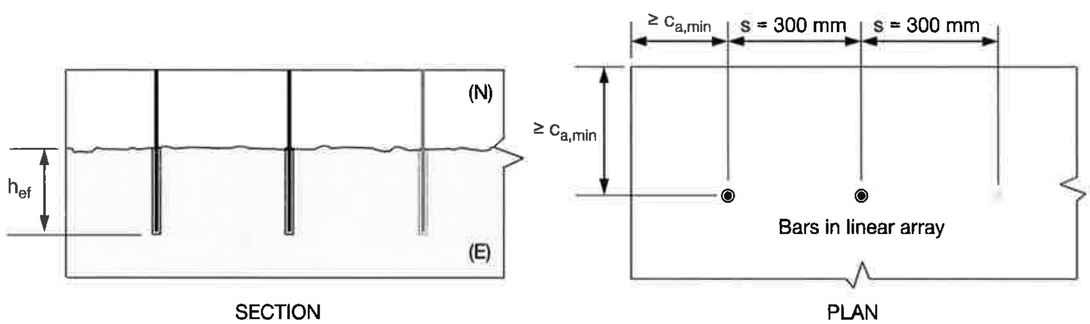


Illustration of Table 92 dimensions

3.2.4.4 Installation instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

Figure 9 - Hilti HIT-RE 500 V3 adhesive cure and working time (approx.)

[°F]	[°C]	t_{work}	$t_{cure, ini}$	$t_{cure, full}$
23	-5	2 h	48 h	168 h
32	0	2 h	24 h	36 h
40	4	2 h	16 h	24 h
50	10	1.5 h	12 h	16 h
60	16	1 h	8 h	16 h
72	22	25 min	4 h	6.5 h
85	29	15 min	2.5 h	5 h
95	35	12 min	2 h	4.5 h
105	41	10 min	2 h	4 h

≥ +5 °C / 41 °F

= 2x t_{cure}

Table 96 - Resistance of cured Hilti HIT-RE 500 V3 to chemicals

Chemicals tested	Content (%)	Resistance
toluene	47.5	+
iso-octane	30.4	
heptane	17.1	
methanol	3	
butanol	2	
toluene	60	+
xylene	30	
methylnaphthalene	10	
diesel	100	+
petrol	100	+
methanol	100	-
dichloromethane	100	-
mono-chlorobenzene	100	●
ethylacetat	50	+
methylisobutylketone	50	
salicylic acid-methylester	50	+
mcetophenon	50	
acetic acid	50	-
propionic acid	50	
sulfuric acid	100	-
nitric acid	100	-
hyrdocholoric acid	36	-
potassium hydroxide	100	-
sodium hydroxide 20%	100	-
triethanolamine	50	-
butylamine	50	
benzyl alcohol	100	-
ethanol	100	
ethyl acetate	100	
methyl ethly ketone (MEK)	100	
trichlorethylene	100	
lutensit TC KLC 50	3	+
marlophen NP 9,5	2	
water	95	
tetrahydrofurane	100	-
demineralized water	100	+
salt water	saturated	+
salt spray testing	-	+
SO_2	-	+
environment/weather	-	+
oil for formwork (forming oil)	100	+
concrete plasticizer	-	+
concrete drilling mud	-	+
concrete potash solution	-	+
saturated suspension of bore-hole cuttings	-	+

+ Resistant
● Partially resistant
- Not resistant

3.2.4 HIT-RE 500 V3 Epoxy Adhesive Anchoring System

3.2.4.5 Ordering information

HIT-RE 500 V3

Description	Package contents	Qty
HIT-RE 500 V3 (11.1 fl oz/330 ml)	Includes (1) foil pack with (1) mixer and 3/8 filler tube per pack	1
HIT-RE 500 V3 Master Carton (11.1 fl oz/330 ml)	Includes (1) master carton containing (25) foil packs with (1) mixer and 3/8 filler tube per pack	25
HIT-RE 500 V3 Combo (11.1 fl oz/330 ml)	Includes (1) master carton containing (25) foil packs with (1) mixer and 3/8 filler tube per pack and (1) HDM 500 Manual Dispenser	25
HIT-RE 500 V3 Master Carton (16.9 fl oz/500 ml)	Includes (1) master carton containing (20) foil packs with (1) mixer and 3/8 filler tube per pack	20
HIT-RE 500 V3 Combo (16.9 fl oz/500 ml)	Includes (2) master cartons containing (20) foil packs each with (1) mixer and 3/8 filler tube per pack and (1) HDM 500 Manual Dispenser	40
HIT-RE 500 V3 (47.3 fl oz/1400 ml)	Includes (4) foil packs with (1) mixer and 3/8 filler tube per pack	4
HIT-RE 500 V3 Pallet (47.3 fl oz/1400 ml)	Includes (64) foil packs with (1) mixer and 3/8 filler tube per pack and (1) P800 Pneumatic Dispenser	64
HIT-RE 500 V3 TE-CD Starter Package	Includes foil packs, dispensers, vacuum, hammer drill and various drill bit sizes. Contact Hilti for exact package contents.	40
HIT-RE 500 V3 TE-YD Starter Package	Includes foil packs, dispensers, vacuum, hammer drill and various drill bit sizes. Contact Hilti for exact package contents.	40
HIT-RE-M Static Mixer For use with HIT-RE 500 V3 cartridges		1

TE-YRT Roughening Tool

Order description	Description	Length
TE-YRT 7/8" x 15"	Roughening tool for use with 3/4" diameter threaded rod in core drilled holes	15"
TE-YRT 1-1/8" x 20	Roughening tool for use with 1" diameter threaded rod in core drilled holes	20"
TE-YRT 1-3/8" x 25"	Roughening tool for use with 1-1/4" diameter threaded rod in core drilled holes	25"
RTG 7/8"	Roughening tool gauge for TE-YRT 7/8"	
RTG 1-1/8"	Roughening tool gauge for TE-YRT 1-1/8"	
RTG 1-3/8"	Roughening tool gauge for TE-YRT 1-3/8"	

TE-CD Hollow Drill Bits

Order description	Working length
Hollow Drill Bit TE-CD 1/2" x 13"	8"
Hollow Drill Bit TE-CD 9/16" x 14"	9-1/2"
Hollow Drill Bit TE-CD 5/8" x 14"	9-1/2"
Hollow Drill Bit TE-CD 3/4" x 14"	9-1/2"

TE-YD Hollow Drill Bits

Order description	Working length
Hollow drill bit TE-YD 5/8" x 24"	15-3/4"
Hollow drill bit TE-YD 3/4" x 24"	15-3/4"
Hollow drill bit TE-YD 7/8" x 24"	15-3/4"
Hollow drill bit TE-YD 1" x 24"	15-3/4"
Hollow drill bit TE-YD 1-1/8" x 24"	15-3/4"
Hollow drill bit TE-YD 5/8" x 35"	26"
Hollow drill bit TE-YD 3/4" x 35"	26"
Hollow drill bit TE-YD 7/8" x 35"	26"
Hollow drill bit TE-YD 1" x 35"	26"
Hollow drill bit TE-YD 1-1/8" x 47"	39"

DIFFUSER INSTALLATION PROCEDURES

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Pipe Coupling

INSTALLATION MANUAL

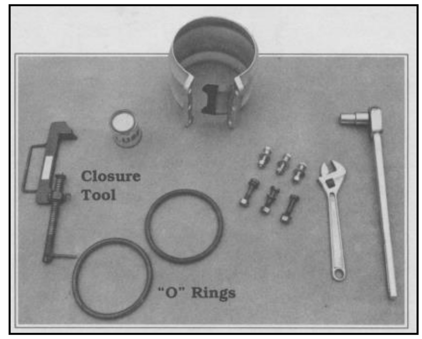
6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

Pipe Coupling Installation Procedures

1. Check to be sure all items required are on hand:

   Items provided with coupling:
      A. Coupling
      B. (2) Rubber "O" Rings
      C. (3) Carbon Steel Bolts with Washers & Nuts
      D. (3) Stainless Steel Bolts with Washers & Nuts (See Note under Step 6.)
      E. Lubricant
   Required Tools:
      A. "C" Clamp
      B. Long Handle Ratchet Wrench
      C. Adjustable Wrench
   Optional Tools:
      D. Manual Closure Tool*
      E. Hydraulic Closure Tool.

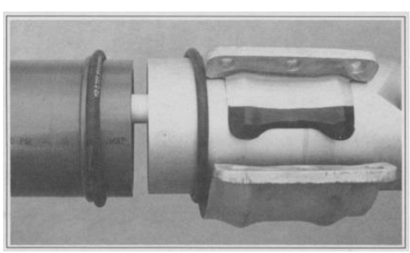
      *Available from distributor

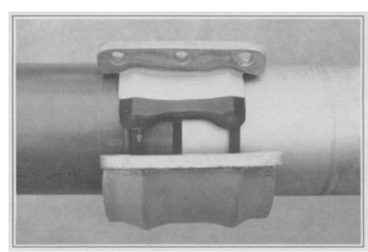


2. Lubricate I.D. of coupling, especially in the grooved areas. Be sure to lubricate the area of the coupling that closes over the Sealing Plate and the rubber sealing surface.

3. Slide the coupling onto one of the pipe ends and position the gasket rings on the pipe ends as shown.

   Pull the pipe ends together and adjust to get the desired space between the pipe ends.



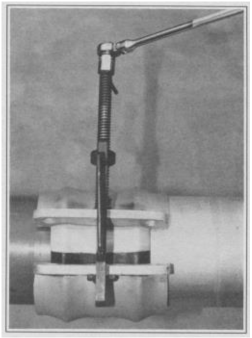


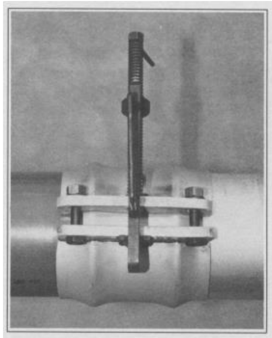
NOTICE

Type FxE, as shown, has end ring affixed to one pipe end. Type ExE has no end rings. Installation is the same for both types.

4. Check the spacing of the gasket rings to be sure they are spaced to fit under the grooves of the coupling. Position the coupling over the pipe joint.

5. Place the "C" clamp or Closure Tool over the center bolt holes in the Closure Plates and begin closing the coupling. A nut is welded to the back of the tool so a wrench may be used to ease the closing.





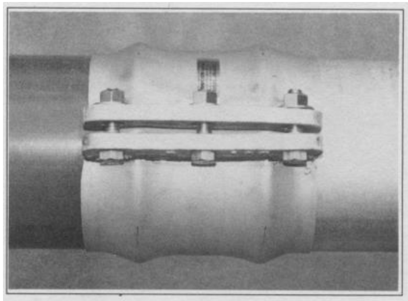
6. When the Closure Plates are close enough for the bolts to fit, insert carbon steel bolts, washers and nuts in the two outside holes. Turn the nuts a few turns, remove the Closure Tool and insert a carbon steel bolt in the center hole.

NOTICE

For Stainless Steel Couplings only. Stainless Steel bolts have a tendency to "freeze" under stress. Carbon steel bolts are included and we suggest using carbon steel bolts to close the coupling. The carbon steel bolts are reusable.

7. Tighten bolts by gradually tightening each one using a long handle ratchet wrench. Be sure to work the nuts down evenly; do not draw each nut down tight one at a time.

   The coupling is designed so that the seal is complete when the coupling is snug all around the pipe. The Closure Plates do not have to touch each other.



8. Replace the carbon steel bolts with the stainless steel bolts, retighten them and the installation is complete.

AQUA-AEROBIC SYSTEMS, INC.

Manufactured Products

• Aqua-Jet®	Surface Mechanical Aerator
• Aqua-Jet II®	Contained Flow Aerator
• Aqua EnduraTube®	Fine-bubble Tube Diffuser
• Aqua EnduraDisc®	Fine-bubble Disc Diffuser
• Aqua CB-24®	Course-bubble Diffuser
• AquaABF®	Automatic Backwash Filter
• AquaCAM-D®	Combination Aerator/Mixer/Decanter
• AquaDisk®	Cloth-Media Filter
• AquaDiamond®	Cloth-Media Filter
• Aqua MixAir®	Aeration System
• AquaSBR®	Sequencing Batch Reactor
• AquaMB Process®	Multiple Barrier Membrane System
• AquaDDM®	Direct-drive Mixer
• Aqua MSBR®	Modified Sequencing Batch Reactor
• ThermoFlo®	Surface Spray Cooler
• AquaPASS®	Phased Activated Sludge System
• Aqua MiniDisk®	Cloth Media Filter
• AquaExcel®	Batch Reactor System
• IntelliPro®	Monitoring & Control System
• AquaEnsure®	Ballast Decanter
• Aqua-Aerobic® MBR	Membrane Bioreactor System

6306 N. Alpine Road • Loves Park, IL 61111 U.S.A • (815) 654-2501 • Fax (815) 654-2508
Website: www.aqua-aerobic.com

Blow-Off System
For Fine Bubble Diffused Aeration Systems

Purpose:

Air within aeration system piping is always under pressure from the liquid in the basin. As liquid level drops, as during a decant cycle, the pressure on the air decreases. The air inside the piping expands as the pressure drops and the excess volume must be allowed to vent. The blow-off system vents this excess volume at a controlled elevation above the sludge blanket to avoid disturbing the blanket.

Retrievable:

A 1/4" fitting is tapped into the air piping of one of the diffuser racks in the SBR basin. A flexible tube connects this fitting to a 1/4" rigid stainless steel pipe attached to the vertical track beam. This rigid pipe extends down below the design low water level of the SBR basin. When the water level begins to decrease in the basin during the decant phase, this tube will "blow-off" any remaining air pressure that is still in the lines, thus preventing the sludge blanket from being disturbed.

Fixed:

A 1/4" fitting is tapped into the basin air manifold piping just upstream of the diffuser drop pipe. A flexible tube connects this fitting to a rigid 1/4" stainless steel pipe that is attached to the drop pipe wall brackets. This rigid pipe extends down below the design low water level of the SBR basin. When the water level begins to decrease in the basin during the decant phase, this tube will "blow off" any remaining air pressure that is still in the lines, thus preventing the sludge blanket from being disturbed.

Refer to Fine Bubble Diffuser Blow-Off Installation drawing for component details.

BLOWER INSTALLATION PROCEDURES

POSITIVE DISPLACEMENT BLOWER
INSTALLATION PROCEDURE

⚠ CAUTION

Do not locate blowers or controls where they will be subject to ambient temperatures above 104° F (40° C) during operation, unless specifically equipped for higher temperatures.

NOTICE

Prior to installing any equipment, review all installation and assembly drawings and instructions in the Operation and Maintenance manual.

Prior to installing the blower packages, review the air manifold and piping arrangement between the blowers and the basins. Piping / valve arrangement should allow for intended operation of blowers as well as back-up of blower packages. All inlet piping must be cleaned internally before connection to the blower. Debris left in the piping will damage the blower.

Air manifold piping must be properly supported to prevent damage to the blower assembly. The blower assembly may **NOT** be used to support the air manifold piping.

Blowers may be installed outdoors under cover, or indoors. When installed indoors, be sure there is sufficient ventilation to allow unrestricted air flow to the blower.

Several feet of space should be left between blower packages and between blower packages and walls to allow for ease of servicing.

Consideration should be given to the noise generated by the blower packages. The walls of the room which the blowers are to be installed should be lined with a acoustic material.

The packages should be moved / transported using only the designated lifting points. Lifting the package otherwise could result in damage to the unit.

Locate and install anchors as shown on the installation drawing. After the anchors are properly installed, set the unit in place. Some blower packages are provided with vibration isolation pads. Refer to the anchor details on the installation drawing.

Assemble any accessories that have been shipped loose (i.e. isolation valve, expansion joint, etc.) to the package. Verify that the check valve is installed in the proper direction. The isolation valve must not be mounted directly adjacent to the check valve as they could interfere with each other's operation.

If the blower package has been supplied with a weighted pressure relief valve, do not install the weight plates. Leave the weight plates with the unit for installation at start-up. Check for proper fit and function of the relief valve body and cap.

An expansion joint must be provided between the package and the inlet (if applicable) and discharge manifold piping. This will prevent vibration created by the blower package from being transmitted through the piping.

Check the lubrication levels in the unit prior to starting. **Some units are shipped without oil**.

The drive belts should be properly aligned and tensioned prior to starting. The blower units are shipped with the drive belts installed, but not tightened. This is so that if the storage instructions are not followed, it will not damage the shaft seal.

With the power **"OFF"** and locked out, turn the drive by hand to make certain that it rotates freely. Then, with the guard cover removed, and all personnel clear of the drive components, the motor should be "bumped" to see that the blower is rotating in the proper direction. After this is complete, replace and secure all guards. Refer to the Operation and Maintenance manual for proper rotation.

All wiring and electrical adjustments or installations must be performed by a qualified electrician in accordance with the National Electric Code and local codes.

DOUBLE NUT
TIGHTENING PROCEDURE

1. Hand tighten full nut onto bolt.

2. Tighten the bolt or nut, with the torque wrench, within the given torque range for the size bolt being used per Bolt Torque Specification Sheet ES-1057.

3. Hand tighten jam nut down to full nut.

4. While holding the full nut in place, tighten the jam nut, with the torque wrench, within the given torque range for the size bolt being used per Bolt Torque Specification Sheet ES-1057.

Bolt Torque Specification Sheet

Thread Size	304 & 316 Stainless Steel		SAE J995 Grade 2		SAE J995 Grade 5		SAE J995 Grade 8	
	Dry	**Lubricated**	**Dry**	**Lubricated**	**Dry**	**Lubricated**	**Dry**	**Lubricated**
	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*	in-lbs *N-m*
1/4-20 UNC	79 *8.9*	67 *7.6*	72 *8.1*	61 *6.9*	120 *13.6*	102 *11.5*	168 *19.0*	143 *16.2*
1/4-28 UNF	99 *11.2*	84 *9.5*	90 *10.2*	77 *8.7*	150 *16.9*	128 *14.5*	211 *23.8*	179 *20.2*
5/16-18 UNC	138 *15.6*	117 *13.2*	144 *16.3*	157 *17.7*	228 *25.8*	316 *35.7*	348 *39.3*	296 *33.4*
5/16-24 UNF	147 *16.6*	125 *14.1*	153 *17.3*	173 *19.5*	243 *27.5*	346 *39.1*	371 *41.9*	315 *35.6*
3/8-16 UNC	247 *27.9*	210 *23.7*	240 *27.1*	204 *23.0*	396 *44.7*	337 *38.1*	564 *63.7*	479 *54.1*
3/8-24 UNF	271 *30.6*	230 *26.0*	263 *29.7*	224 *25.3*	434 *49.0*	369 *41.7*	619 *69.9*	526 *59.4*
7/16-14 UNC	393 *44.4*	334 *37.7*	384 *43.4*	326 *36.8*	648 *73.2*	551 *62.3*	936 *106*	796 *89.9*
7/16-20 UNF	418 *47.2*	355 *40.1*	408 *46.1*	347 *39.2*	689 *77.8*	586 *66.2*	996 *113*	847 *95.7*
	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*	ft-lbs *N-m*
1/2-13 UNC	45 *61*	38 *52*	47 *64*	40 *54*	78 *106*	66 *89*	119 *161*	101 *137*
1/2-20 UNF	47 *64*	40 *54*	49 *66*	42 *57*	81 *110*	69 *94*	124 *168*	105 *142*
5/8-11 UNC	96 *130*	82 *111*	96 *130*	82 *111*	154 *209*	131 *178*	230 *312*	196 *266*
5/8-18 UNF	108 *146*	92 *125*	108 *146*	92 *125*	173 *235*	147 *199*	259 *351*	220 *298*
3/4-10 UNC	131 *178*	111 *150*	155 *210*	132 *179*	257 *348*	218 *296*	380 *515*	323 *438*
3/4-16 UNF	129 *175*	110 *149*	153 *207*	130 *176*	253 *343*	215 *292*	374 *507*	318 *431*
7/8-9 UNC	202 *274*	172 *233*	206 *279*	175 *237*	382 *518*	325 *441*	600 *813*	510 *691*
7/8-14 UNF	201 *273*	171 *232*	205 *278*	174 *236*	380 *515*	323 *438*	597 *809*	507 *687*
1-8 UNC	299 *405*	254 *344*	310 *420*	264 *358*	587 *796*	499 *677*	700 *949*	595 *807*
1-12 UNF	270 *366*	230 *312*	275 *373*	234 *317*	510 *691*	434 *588*	802 *1087*	682 *925*

Notes:
1. Torque values listed are based on actual lab testing on dry or near dry fasteners wiped clean.
2. Lubricated values are 85% of dry values.
3. Torque specification applies only if fastening identical materials. Consult Engineering if materials differ or length of engagement is shorter than specified in note 4. Pre-load stress ***not*** to exceed 75% of the softest material's proof stress.
4. Bolt, screw, or stud fastened with regular height nuts. Nuts to be made of either same material or grade as fastener or stronger.

START-UP-PAPERS

Equipment Inspection, Mechanical Start-up, and Process Training Report

AquaNereda®

Project ID # ______________

Date:__________ By:___________________________ Equip. Ship Date:______________

Job Location:__________________________ Contractor:____________________________

Engineer:_____________________________ Owner:_______________________________

Equipment Inspection, Mechanical Start-up, and Process Training Report
AquaNereda®

A. Describe general condition of jobsite and equipment installation for proper handling, appearance and operation.

____
____
____
____
____

B. List any potential hazards observed that could impair operational success of equipment, such as ice damage in cold weather, low water levels, voltage or amperage problem, debris in water, exposure to vandalism, etc.

____
____
____
____
____
____
____
____
____

C. Name people present at inspection and start-up.

Name **Company**

____
____
____
____
____

Plant Operator ______________________________ **Phone #** ____________________

Mailing Address for the Plant: **E-Mail** ____________________

____
____
____
____

D. Explain the inspection and start-up work performed.

____
____
____
____
____
____
____

E. Did you discuss panel operation, alarms messages, aeration counters, cycle structure options?____
____
____
____

Did you watch the system go through a full cycle to verify operation of the equipment and controls?____
Were there any outstanding alarms?____________________________________

F. Was flow introduced to the basins? __Yes __No

Comments: ____
____
____
____

G. What are the plant's permit requirements? What was the plant designed for?

____
____
____

H. Did you and the operator make any operational changes?____________________
____
____
____

I. Did you discuss the process manual and calculation sheets?___________________
____
____
____

J. Did you discuss influent/effluent testing?______________________________________
____
____

K. Did you discuss target values for MLSS, F/M, DO?___________________________
____
____

L. Did you request the operator to send monthly operating data to Aqua-Aerobic Systems to assist in troubleshooting?____
____
____

M. How long were you at the jobsite? Did you take any pictures of the AquaNereda and AquaNereda equipment?____
____
____
____

N. How long were owner's representatives at the jobsite?________________________
____
____
____

O. Is this the final inspection and start-up? __Yes __No
If no, explain: ____
____
____

P. Did you verify O & M manuals were at the jobsite?
Explain: ____
____
____

Q. Did you explain the safe use of all Aqua equipment and explain the safety instructions contained in the O & M manuals?
Yes______(initial)

R. Did you perform operator training on all Aqua-Aerobic Systems' equipment?
Yes______(initial)

S. Did you explain the meaning and importance of the "warnings" contained in the O & M manuals?
Yes______(initial)

T. Did you advise the customer of factory contacts for mechanical problems/process questions: 1-800-940-5008
Yes______(initial)

NOTE: The above three items must be explained and initialed by the person performing start-up before start-up can be considered complete.

SPECIAL COMMENTS: ____
____
____
____
____

Start-up Technician (Please print clearly) ______________________________
Signature ____
Title ____
Date ____

***Owner's acknowledgment that the contents of the above inspection and report are correct and that the explanations and advice in I) and J) were given to the owner.**

Owner (Please print clearly) ______________________________________
Signature ____
Title ____
Date ____

Owner's comments: ____
____
____
____

Training Session Sign-In Sheet

Attendee's Name:	Firm Represented:
1. ______________________	______________________
2. ______________________	______________________
3. ______________________	______________________
4. ______________________	______________________
5. ______________________	______________________
6. ______________________	______________________
7. ______________________	______________________
8. ______________________	______________________
9. ______________________	______________________
10. ______________________	______________________
11. ______________________	______________________
12. ______________________	______________________
13. ______________________	______________________
14. ______________________	______________________
15. ______________________	______________________
16. ______________________	______________________
17. ______________________	______________________

Date Training was completed: ______________

Hours spent for classroom Training: __________

Hours spent for On-Site Training: __________

Instructor's Name: ______________________________

Field Checkout
AquaNereda®

This checklist encompasses all phases of site startup. Therefore, it must be scanned after each trip and emailed to the AASI Project Manager. The hard copy may be left on site for the next Service Technician if a secure location is available. Complete each section below for each reactor or system indicated in the sequence shown. If deviations from Engineering documentation are found they must be corrected or reported to the AASI Project Manager.

Mechanical Checkout, Dry
Reference the installation drawings to confirm design parameters such as equipment placement and dimensions. Tolerances will be listed on the installation drawings or in the appropriate manufacturer documentation included in this O&M manual.

Parameter	Note	☐
Influent		
Confirm influent site piping is unrestricted		
Confirm upstream screening matches design		
Influent Buffer (if applicable)		
Confirm pump, mixer, and piping placement		
Confirm feed pump rotation		
Influent Grid		
Confirm header and lateral pipe size and material		
Confirm header and lateral placement in basin		
Confirm lateral elevation		
Confirm lateral distribution holes are facing downwards		
Confirm vent pipes will function, no traps etc. for full length		
Re-tighten expansion joint clamps; inspect joint for centering over pipe		
Sludge Decanter		
Confirm header, lateral, and tail pipe size		
Confirm header, lateral, and tail placement in basin		
Confirm tails are oriented correctly		
Confirm decanter piping from tails to discharge is unrestricted		
Re-tighten expansion joint clamps; inspect joint for centering over pipe		
Sludge Buffer		
Confirm manifold placement in basin		
Confirm manifold suction holes are facing downwards		
Confirm pump and piping placement		
Confirm pump rotation		
Digester (if applicable)		
Confirm pump, mixer, and piping placement		

Effluent System		
Confirm main gutter dimensions and elevations		
Confirm lateral placement in basin		
Confirm lateral v-notch elevation		
Confirm effluent system is unrestricted		

Aeration		
Confirm aeration placement in basin		
Confirm aeration element elevation		
Confirm aeration piping arrangement		
Confirm air relief piping present		
Valves		
Check cycle time of each automatic valve		
Check line placement of each manual and automatic valve		

Mechanical/Electrical Checkout, Instrumentation
The following instruments are to be checked for each occurrence in the installation. Installation details will be found in the drawings, offsets and spans will be found in the control strategy found in this O&M manual. Buffer solutions and various tank levels may be required depending on sensors.

Parameter	**Note**	☐
General Instrumentation		
Check cables have a drip loop		
Check air blast functionality for instruments so equipped		
Float Switch		
Mounted securely and in designated location / elevation		
Confirm switch trips and compare to PLC / Nereda® controller		
Level Transducer		
Mounted securely and in designated location / elevation		
Record and update sensing element offset		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Flow Meter (Water / Air)		
Mounted securely and in designated location		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Pressure (Air)		
Mounted securely and in designated location		

Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Conductivity Probe		
Mounted securely and in designated location		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
pH Probe		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Total Suspended Solids (TSS)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
ORP/pH/Temp (Redox)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Dissolved Oxygen (DO)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Ammonia (NH_4-N)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Nitrate (NO_3-N)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		
Phosphate (PO_4-P)		
Mounted securely and in designated location / elevation		
Check min / max sensor output, compare to PLC / Nereda® controller		
Check field wiring with signal generator (unless digital instrument)		

Mechanical Checkout, Clean Water Submerged
The basin is to be filled with clean water or screened effluent prior to the following checks. Some of the checks may occur at elevations lower than completely full (i.e. checking items for level). Please review the checklist prior to filling.

Parameter	Note	☐
Influent		
Record pressure at minimum flow rate		
Record pressure at maximum flow rate		
Confirm pump creates maximum flow rate at high/low pre-eq level		
With water at top of laterals, confirm level placement of laterals		
Confirm influent venting system operational		
Check for leaks at expansion joints		
Water Level Correction		
Adjust throttling valve / actuator limit as required to achieve flow rate		
Sludge Decanter		
Record time to fill decanter with air		
Check for air/water leaks		
Record time to purge air from decanter		
Adjust throttling valve / actuator limit as required to achieve flow rate		
With water at bottom of tails, confirm level placement of laterals		
Check for leaks at expansion joints		
Sludge Buffer		
Record pump pressure at minimum flow rate		
Record pump pressure at maximum flow rate		
Confirm pump system can achieve maximum flow rate		
Effluent System		
Check gutters are water tight up to v-notch elevation		
Check system performs adequately (no backup) up to maximum flow		
With water at v-notch, confirm all effluent launder elevations equal		
Aeration		
Record minimum blower flow rate		
Record maximum blower flow rate		
Record maximum discharge pressure (full basin, max. air flow)		
Check for equal air distribution when submerged about 2’		
Confirm no leaks in grid when submerged 2’ (allow 15 minutes)		
Confirm shut off valve seals grid (blowers on to another basin)		
Check that no air bubbles enter influent grid		

General		
Confirm product signage is properly mounted		

Nereda Controller Site Acceptance Testing
Once the site is confirmed ready for SAT, the Nereda® controller will be checked out by the manufacturer. Confirm phases and set points with latest control strategy.

Parameter	**Note**	☐
Preparation for SAT Protocol		
All equipment has been connected and tested		
PLC updated with latest spans, offsets, defaults, and logic		
Nereda® controller installed and wired		
Internet connection and remote access verified		
PLC Phase Checks - Reactor		
Check emergency recipe with short phase times		
Check feed phase		
Check lower level phase (water level correction)		
Check aeration phase		
Check chemical addition phase		
Check settle phase		
Check decant phase		
PLC Phase Checks - Sludge Buffer		
Check water discharge phase		
Check sludge discharge phase		
Check settle phase		

Once the items above are complete, contact the AASI Project Manager to schedule the Nereda® controller site acceptance test. All parties (Maintenance, Operations, Lab Technicians, AASI, and Client) are asked to be present.

Parameter	**Note**	☐
Nereda® Controller SAT Protocol *(By Manufacturer)*		

Site Startup
When the SAT is successfully completed, the plant may be officially placed online after the following items have been completed.

Parameter	**Note**	☐
Site Preparation		
Pre-treatment and effluent handling ready to operate		
Sample bottles and lab equipment ready		
Reactor has been successfully seeded		
Operational staff onsite for training		

Parameter	**Note**	☐
Final Commissioning *(By Manufacturer's startup manager)*		
Signing of completion and startup declaration		

PROCESS AND CONTROL

6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

NAPANEE WWTP ON

Design# 171482
Option: Bid Design

AquaNereda®

Aerobic Granular Sludge Technology

May 02, 2024
Designed By: Thea Davis

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- 1/4 inch (6 mm) screening (perforated plate-style preferred) and grit removal (95% removal at 140 mesh) is required (by others) ahead of the AquaNereda system.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 2 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 7.7°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- To achieve the effluent monthly average total phosphorus limit, the biological process, chemical feed systems, and Cloth Media Filters need to be designed to facilitate optimum performance.

- A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for total phosphorus analysis.

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- Provisions for a flocculation tank with a minimum of 5-minute HRT at the maximum daily flow shall be furnished after chemical addition and prior to the filter.

- pH monitoring 6.5-8.5 of the biological reactor is required when adding metal salts.

- The cloth media filter will only remove TP that is associated with the TSS removed by the filter. Since only insoluble, particle-associated phosphorous is capable of being removed by filtration, phosphorous speciation shall be provided by the owner to substantiate the concentrations of soluble and insoluble phosphorous in the filter influent. If the proportions of soluble (unfilterable) and insoluble phosphorous are such that removal to achieve the desired effluent limit is not practical, the owner will provide for proper conditioning of the wastewater, upstream of the filter system, to allow for the required removal.

- The average, maximum and peak design flow and loading conditions, shown within the report, are based on maximum month average, maximum day and peak hour conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process:
- Post-EQ
- Tertiary filtration

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report.

- The filter influent should be free of algae and other solids that are not filterable through a nominal 5 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The cloth media filter has been designed to handle the maximum design flow while maintaining one unit out of service.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction.

- Equipment selection is based upon the use of materials of construction and electrical components suitable for a Class I, Division II electrically classified environment.

- The biological control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- If the cloth media filter will be offline for extended periods of time, protection from sunlight is required.

INFLUENT BUFFER DESIGN PARAMETERS

Avg. Daily Flow:	= 5.16 MGD	= 19,550 m3/day
Max. Daily Flow:	= 8.08 MGD	= 30,600 m3/day

No. of AGS Reactors: = 3

INFLUENT BUFFER VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

INFLUENT BUFFER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 29.2 ft	= (8.9 m)			
Width of Basin:	= 54.1 ft	= (16.5 m)			
Min. Water Depth:	= 3.3 ft	= (1.0 m)	**Min. Basin Vol. Basin:**	= 38,821 gallons	= (147.0 m³)
Max. Water Depth:	= 21.6 ft	= (6.6 m)	**Max. Basin Vol. Basin:**	= 255,442.0 gallons	= (967.0 m³)

INFLUENT BUFFER EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 8,343 GPM	= (1,895 m³/hr)
Avg. Power Required:	= 475 kWhr/day	

AquaNereda® - Aerobic Granular Sludge Reactor - Design Summary

Design#: 171482

Project: NAPANEE WWTP ON

Option: Bid Design

Designed by Thea Davis on Thursday, May 2, 2024

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 5.16 MGD	= 19,550 m^3/day
Max Design Flow	= 8.08 MGD	= 30,600 m^3/day
Peak Hyd. Flow	= 11.18 MGD	= 42,336 m^3/day (modifying cycles)

DESIGN PARAMETERS

	Influent	mg/l	Effluent (After Filtration) Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	162	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	214	TSSa	10	TSSa	10
Total Kjeldahl Nitrogen:	TKN	45	TKN	--	TKN	--
NH3-N	--	--	NH3-N	2	NH3-N	2
Phosphorus:	Total P	5	Total P	0.1	Total P	0.1

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	90 F	32.0 C	0 F	-18.0 C	381 ft
Influent Waste Temperatures:	68 F	20.0 C	46 F	7.7 C	116.0 m

AGS BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin	
No./Basin Geometry:	3 Rectangular Basin(s)		**Process Level (PWL):**	21.0 ft	(6.4 m)	0.93 MG	(3,533 m^3)
Freeboard (from PWL):	2.5 ft	(0.8 m)	**Discharge Level (DWL):**	22.0 ft	(6.7 m)		
Length of Basin:	106.5 ft	(32.5 m)	**Top of Wall (TOW):**	23.5 ft	(7.2 m)		
Width of Basin:	55.8 ft	(17.0 m)					

PROCESS DETAILS

Cycle Duration:	= 4.5 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.037 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.54 Days	
Solids Retention Time:	= 25.80 Days	
Est. Net Sludge Yield:	= 0.95 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 6608.0 lbs. WAS/Day	= (2997.4 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.00	
Actual Oxygen Required:	= 17636 lbs./Day	= (7999.6 kg/Day)
Max. Discharge Pressure:	= 10.67 PSIG	= (74 KPA)
Max. Air Flowrate/Basin:	= 2,173 SCFM	
Min. Air Flowrate/Basin:	= 543 SCFM	
Max. Simultaneous Air:	= 4,303 SCFM	
Min. Simultaneous Air:	= 1,869 SCFM	

RETURN FLOW ESTIMATES

Daily Estimated Return Flow:	= 0.59 MGD
Max. Instantaneous Return Flow:	= 566 GPM

POWER CONSUMPTION

Average Aeration Power Consumption:	= 1443 kWh/day (at 48% design load)

Project: *NAPANEE WWTP ON*

Option: *Bid Design*

Designed by Thea Davis on Thursday, May 2, 2024

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 2 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 15.4 ft	= (4.7 m)
Max. Basin Volume:	= 49,668 gallons	= (188.0 m^3)
Length of Basin:	= 26.3 ft	= (8.0 m)
Width of Basin:	= 16.4 ft	= (5.0 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 101 gpm	= (23 m^3/hr)
Max. Supernatant Flow Rate Required:	= 405 gpm	= (92 m^3/hr)
Average Power Consumption:	= 27 kWh/day (at 48% design load)	

POST-EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 5.16 MGD	= (19,550 m³/day)
Max. Daily Flow (MDF):	= 8.08 MGD	= (30,600 m³/day)
Decant Flow Rate from (Qd):	= 8,343 gpm	= (1,895 m³/hr)
Decant Duration (Td):	= 60 min	

POST-EQUALIZATION VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua-Aerobic. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

POST- EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 25.6 ft	= (7.8 m)			
Width of Basin:	= 91.9 ft	= (28.0 m)			
Min. Water Depth:	= 3.3 ft	= (1.0 m)	**Min. Basin Vol. Basin:**	= 57,726 gal	= (219 m³)
Max. Water Depth:	= 10.9 ft	= (3.3 m)	**Max. Basin Vol. Basin:**	= 191,997 gal	= (727 m³)

POST- EQUALIZATION EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 5,970.3 gpm	= (1,356.0 m³/hr)

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	AquaNereda		
Avg. Design Flow	= 3.04 MGD	= 2109.71 gpm	= 11500.00 m³/day
Max Design Flow	= 11.18 MGD	= 7766.66 gpm	= 42336.00 m³/day

AquaDisk FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 3
Number Of Disks Per Unit	= 12
Total Number Of Disks Recommended	= 36
Total Filter Area Provided	= 1936.8 ft² = (179.93 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-54 x 12E-PC
Filter Media Cloth Type	= OptiFiber PES-14®

AquaDisk FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a hopper-bottom and solids removal manifold system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 2109.7 / 1936.8 ft²
= 1.09 gpm/ft² (2.66 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 7766.7 / 1936.8 ft²
= 4.01 gpm/ft² (9.80 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 1399.1 lbs/day / 1936.8 ft²
= 0.72 lbs. TSS /day/ft² (3.52 kg. TSS/day/m²)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 6 gpm / ft² = (14.7 m/hr)

AquaNereda® Aerobic Granular Sludge Technology

Napanee WWTP ON
ID # 704419A

Revision Date	By	Comments
2024-05-22	TD	Submittal Issue
2024-12-06	BQ	Re-submittal Update

Table of Contents

1.0 INTRODUCTION

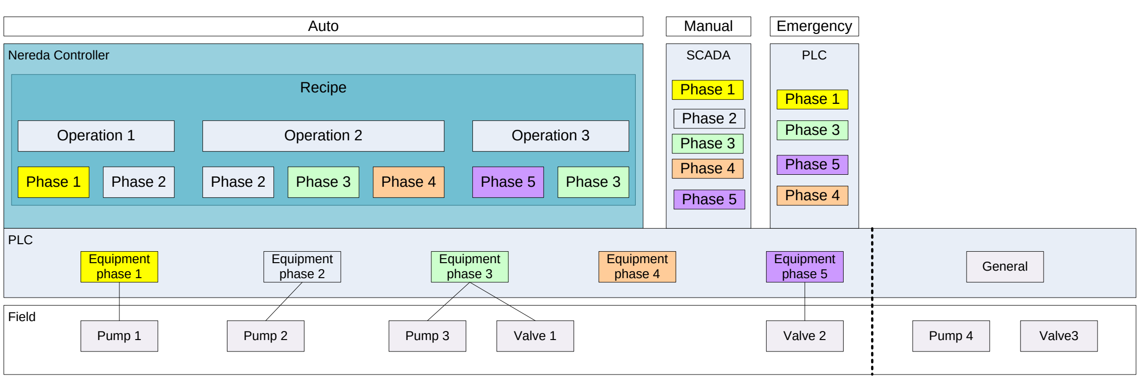
The AquaNereda® process and all associated equipment is controlled via a PLC-based control program. The PLC provides control signals to all equipment that is integral to the AquaNereda® process, and operator access to these controls is available via the touch screen HMI located on the control panel enclosure.

In addition, there is the PC-based Nereda® Controller, which takes in signals from the process instrumentation and uses that feedback to adjust operating parameters and send control instructions to the PLC. The Nereda® Controller provides process automation and optimization for the AquaNereda® process, which is primarily managed through configurable Recipes which provide the logic for each phase in the AquaNereda® treatment cycle. The Nereda® Controller has screens for confirming treatment and equipment status, checking performance trends from the online instruments, and for accessing the various process settings and setpoints. These screens are accessed via a webpage that can opened either locally at the Nereda® Controller workstation PC, or from any PC on the local network. When the controls are set to their default Automatic mode, all instructions for controlling the process equipment will originate from the Nereda® Controller and will be executed by the PLC. There is also an Interim Mode, which allows the process to run in a simplified, time-based cycle structure directly from the PLC without input from the Nereda® Controller. All relevant process settings and setpoints for Interim Mode can be accessed from the control panel's HMI screens.

The AquaNereda® Aerobic Granular Sludge Technology is a batch process, with control of the batches based on the concept of Recipes. The building blocks for recipes are called "Operations", and the building blocks for Operations are called "Phases".

Each phase in a recipe corresponds to an "equipment phase" in the process automation. The equipment (pumps, valves, blowers, etc.) is controlled from within the equipment phase. Typically, equipment that is controlled from within one or more equipment phases cannot also be controlled by automation outside the equipment phases.

The phase control parameters (e.g., setpoints) are sent to the equipment phase via the phase in the recipe. The same equipment phase can be used at different places, and in multiple places, in the recipe.



Under normal operating conditions, the recipes are executed by the Nereda® Controller, and the equipment phases are executed by the Programmable Logic Controller (PLC).

If communication is lost between the Nereda® Controller and the PLC, then an Interim Recipe is activated in the PLC. The Interim Recipe in the PLC calls the equipment phases as programmed in the interim recipe.

2.0 PLC/HMI EQUIPMENT

2.1 DESCRIPTION

The facility has one main control panel. The PLC is located in this control panel. The PLC interfaces with the real world devices using the following I/O (Input/Output) module types:

Discrete input module: 120VAC (24VDC)
Discrete output module: 120VAC (24VDC)
Analog input module: 4-20mA (24VDC)
Analog output module: 4-20mA (24VDC)

The control system is equipped with a touch screen Human Machine Interface (HMI) which communicates directly with the PLC. The HMI is the operator interface which displays the system status and alarm information. The HMI unit also provides the operator with the ability to change system setpoints and other parameters.

In addition, there is a desktop computer provided that acts as the Nereda® Controller. The Nereda® controller is equipped with software to provide real time displays including data trending and alarm/event logging, and it has software installed to communicate directly with the PLC.
In case of a power loss, the system will resume operation at the feed phase once the power is restored and a minimum time has passed. This operation will begin with the reactor furthest from the feed phase.

2.2 MAIN COMPONENTS

PLC	Allen-Bradley	CompactLogix L38ERM
HMI	Allen-Bradley	PanelView Plus 7 15”
Nereda® Controller	Dell or equal	Desktop Computer

3.0 MANUAL OVERRIDE

Moving the respective Hand-Off-Auto selector switch (for motors) or Open-Close-Auto selector switch (for valves) from the “Auto” position can operate the respective components independent of PLC command.

⚠ WARNING
Manually controlling the equipment bypasses all safety interlocks. **Caution must be used when operating equipment manually.**

4.0 NEREDA CONTROLLER

4.1 NEREDA® PROCESS CONTROL MODE

The On and Off switching of the Nereda® Controller is activated by the PLC. The Nereda® process control modes are listed below.

- AUTO mode: The Nereda® Controller is in charge of Starting and Stopping the equipment phases. It issues the phase START and STOP commands. The actual phase time (being the elapsed time while a phase is in the RUN state) is calculated by the Nereda Controller.
- INTERIM mode: The PLC is in charge of Starting and Stopping the equipment phases. It issues the phase START and STOP commands according to the Interim recipe. The phase time is calculated by the PLC. The phase time must be reset and started when the phase enters the RUN state and must be stopped when the phase leaves the RUN state.
- OFF mode: All phases are given the STOP command.
- MANUAL mode: The START and STOP commands are given by the operator. There effectively are no phase times. This is primarily for testing purposes and is not viable for controlling the process.

When the Nereda® Controller is switched among these modes, all phases should first receive the STOP command. Further, each reactor has a status (on-aborted-off), which is determined by the Nereda® Controller and is presented in the PLC. For each reactor the following control must be realized:

Interim recipe active: 'On-Off'. Based on this setting, the interim recipe will be started for a reactor.

RESET: with a RESET command, all equipment phases (in the PLC) of the reactor receive a RESET command. The RESET command is also received by the Nereda® Controller (if the process control mode is in AUTO), which resets the reactor if the reactor status is 'ABORTED'.

The RESET command stays active as long as the status from the Nereda® Controller (if the process control mode is in AUTO) for this reactor is ABORTED.

4.2 EQUIPMENT PHASES

All equipment that is controlled by the recipe in the Nereda® Controller is actuated by means of the equipment phases. Depending on the AquaNereda® configuration, several phases are possible, for example "Feed", "Aerate" and "Sludge Discharge".

Each module in the Nereda® Controller has a PLC counterpart, called equipment phases. The Nereda® Controller determines which equipment phase to start and stop. Also additional parameters can be passed from the Controller Nereda to the PLC such as a desired flow rate or a desired capacity (for example for aeration). In the PLC, subsequently, the corresponding equipment phase is executed. The equipment phase can be influenced by external signals during the Starting, Run, and Stopping states. These signals are 'phase parameters' (e.g. flow setpoint) which are defined in the control description.

All equipment phases are executed according to a fixed state diagram, which is illustrated in this section of the document.

A state in this diagram can be static or dynamic:

- Dynamic (pink): In a dynamic state, actions take place (start pump, open valve etc.). When the actions are finished the next state in the diagram must become active.
- Static (green): This state remains active until a command is received or a specific condition becomes active. In a static state controls can be active (e.g. flow control of a pump).

For state transitions, the following signals are used:

- External commands to move to the next state.
- One operating condition to determine if the equipment phase can be in starting/RUN/stopping/READY state.

START, STOP and RESET are commands. The command RESET is always given by the operator via the PLC. Commands START and STOP are given based on the AquaNereda® process control mode; as described in the previous subsection.

The logic in the dynamic states (starting, stopping, aborting) and static states (RUN) must be performed by the PLC. They are different for each equipment phase.

The starting state is READY. A START command must be executed when the operating conditions for the current phase are met. When the operating conditions are not met, the state must become INTERLOCKED. The START command can only be given when in state 'READY', if not, the 'START' command must be reset.

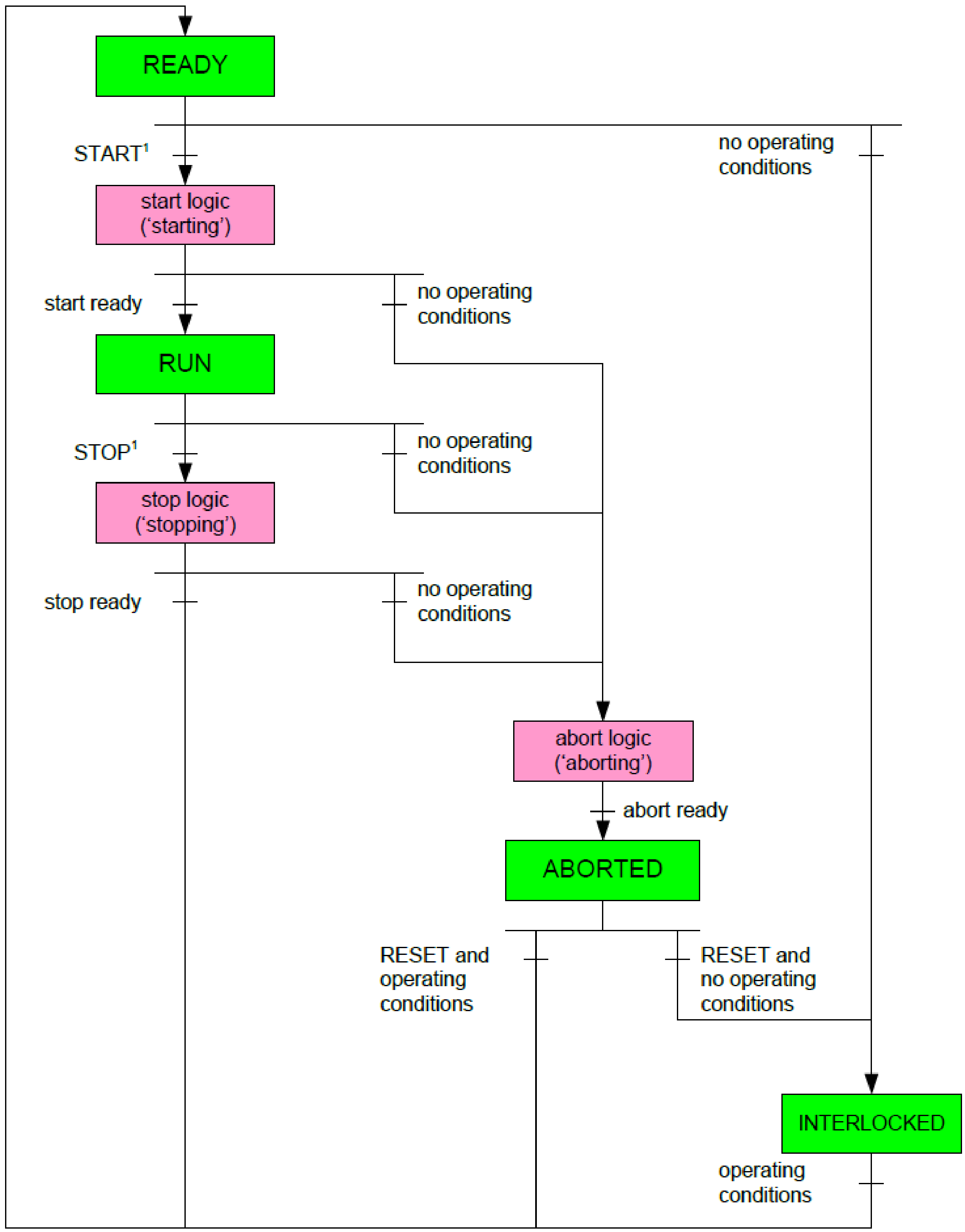
After processing the START command the start logic must be executed. The status of the equipment phase now is 'starting'. When the start logic has finished successfully the RUN state must become active.

When a STOP command is given in RUN state, the stop logic must be started. The phase status now becomes 'stopping'. When the stopping logic has finished successfully the READY state must become active. The STOP command can only be given when in state 'RUN', if not, the 'STOP' command must be reset.

When the equipment phase is in RUN, 'starting' or 'stopping' and the operating conditions are not met, the 'aborting' state must become active and the abort logic must be executed. This aborting logic is almost identical to the stopping logic with the difference that in the abort logic there is no check on feedback.

When the abort logic has finished, the active state must be ABORTED. After a RESET command the active state becomes READY (when all operating conditions are met) or INTERLOCKED.

Other state transitions than those indicated in the state diagram (e.g., from state RUN directly to state ABORTED) are not allowed.



4.3 COMMUNICATION AND MONITORING

Communication between the Nereda® Controller and the PLC must be monitored by means of a watchdog signal as follows (first signal initiated by the PLC):

- The process automation activates a Boolean signal on the ‘watchdog-send’ address.
- The Nereda® Controller reads this signal and copies it to the ‘watchdog-receive’ address in the PLC.
- The PLC copies the inverted signal from ‘watchdog-receive’ to ‘watchdog-send’ address, after which the loop is repeated.

The watchdog signal in the PLC is monitored as follows:

- When the ‘watchdog-send’ and ‘watchdog-receive’ signals differ the PLC must start the watchdog timer. This watchdog timer must be reset when the signals are equal again.
- When the watchdog timer exceeds a predefined time the PLC must conclude that there is a communication failure.

For communication failure:

- An alarm must be generated.
- If the AquaNereda® process control is in “Auto” mode, it must be automatically switched to “Interim” mode. The interim recipe is started for each reactor for which the interim recipe is set to ‘On’.

4.4 INTERIM RECIPE

The Nereda® Controller is important for optimal process conditions. For a stable AquaNereda® process, simpler control can also be used for a limited period of time. In case of Nereda® Controller failure (hardware failure), the PLC takes over the control, in order to keep the process going in the reactor. Therefore, an interim recipe is programmed in the PLC.

An interim recipe of a reactor is started when Nereda® Controller in the PLC is switched to “Interim” mode and for this reactor the interim recipe is set to ‘On’.

The interim recipe consists of a series of equipment phases, which are carried out sequentially on phase time basis. The exact interim recipe depends on the installation and is described later in this document. The settings of the interim recipe are defined and stored in the PLC.

5.0 HUMAN-MACHINE INTERFACE (HMI)

The HMI screens are organized by different levels. There are screens which provide the operator with system status and alarm information. There are also screens which allow the operator to modify system setpoints and parameters. All screens include touch cells to navigate to additional screens.

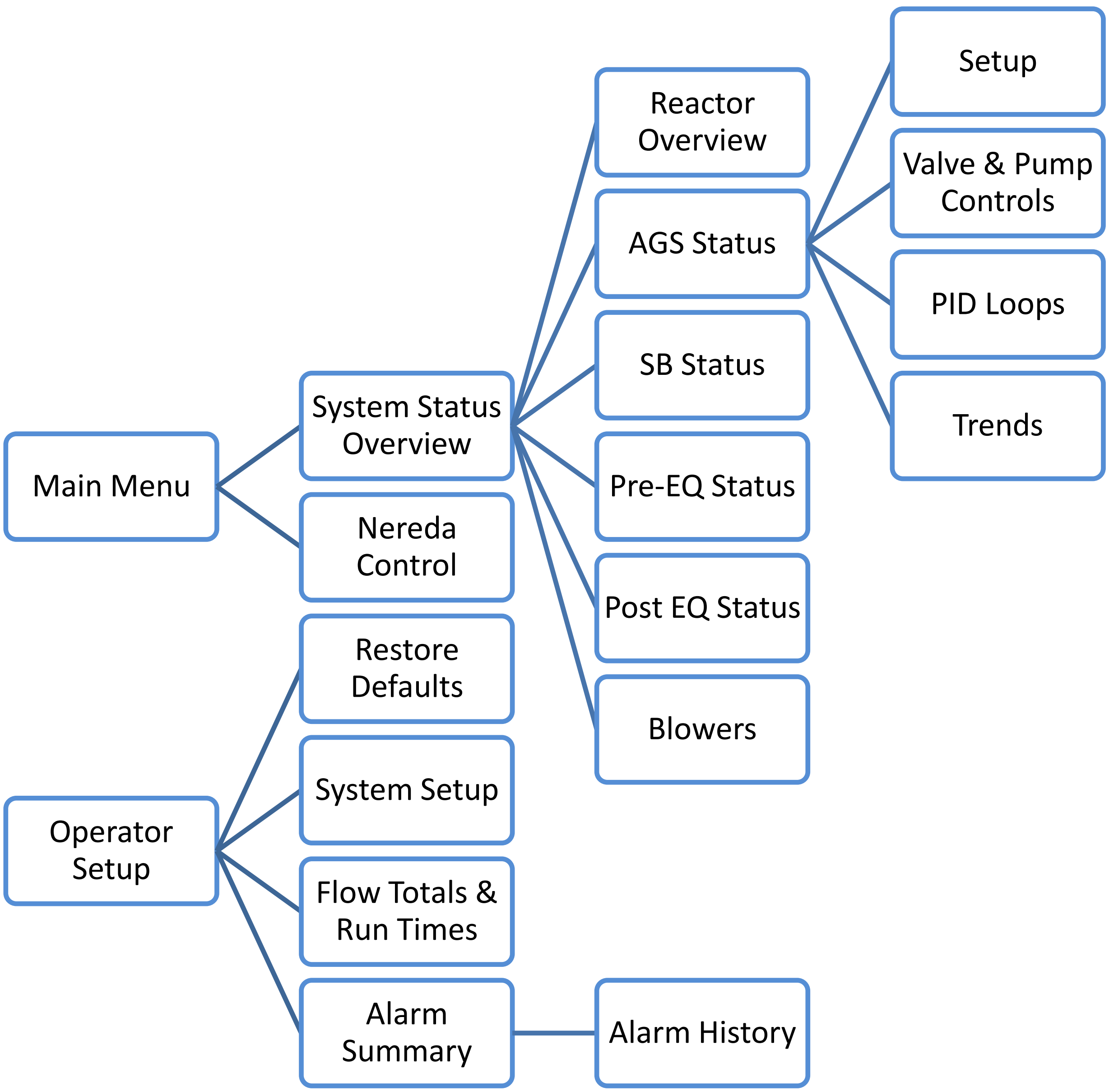
5.1 HMI SCREEN LIST

Screen Name	Screen Description
Main Menu	This screen contains the name and project number. There is access to security login/logout.
System Status Overview	Overview of the components within AASI's control.
System Status Reactors	Overview of the AGS reactors with basic information such as analog values.
System Status AGS	This screen contains all components within an AGS reactor. Valves, instrumentation, phase information, etc.
System Status SB	This screen contains all components within a Sludge Buffer basin. Valves, motors, instrumentation, phase information, etc.
System Status Pre-EQ	This screen contains all components within the Pre-Equalization basin.
System Status Post-EQ	This screen contains all components within the Post-Equalization basin.
System Status Blowers	This screen contains all components within the Blower Header.
AGS Control	This screen is used to switch Nereda modes such as Auto or Interim. It also contains the reset for aborted phases, phase info, and start/stop for manual phase initiation.
SB Control	This screen is used to switch Nereda modes such as Auto or Interim. It also contains the reset for aborted phases, phase info, and start/stop for manual phase initiation.
Flow Totals (2)	These screens display the flow totals for each flow meter. Daily totals are displayed for the current day and up to the last 7 days.
Motor Run Times	This screen contains a pair of hour meters for each three-phase motor in the system. One meter can be reset by the operator, while the other meter is not resettable.
Interim Recipe Status	This screen contains the current interim recipe status of the selected AGS. The display will show 5 phases with the current active phase being the middle (when applicable). This screen will only display the status when the Nereda controller is in Interim mode. The phase time, elapsed time, and other parameters when applicable will also be displayed for the active phase
Alarm Summary/History	These screens display the current active alarms and recent history of alarms for the system. Active alarms must be reset after the alarm condition has been corrected.
PID Loop	Each PID loop screen contains the status of one ID loop. Included is access to the loop tuning parameters. There is a PID loop for SB discharge flow, AGS D.O., AGS Redox, and AGS Main Aeration.
Restore Defaults	This screen is used to restore default setpoints and configurations to the system.
Operator Setup	This screen allows the user to set the real time clock in the PLC.
System Setup	These screens contain setup information and configurations for the system. This includes which valves and instruments exist, as well as the analog scaling

	parameters are for all instrumentation, some sequencing parameters such as start/stop levels for the Water Level Correction cycle, blower operation parameters, etc.
Interim Phases Allowed	This screen contains setup information for available Nereda phases, influent buffer, number of basins in system, etc.
Interim Operations	This screen contains setup information for the three Nereda operations. This is where the interim recipe configuration begins.
Interim Recipe Screens	There are several screens used for the Interim Recipe configurations. They perform various functions. One may be all phases together, another used for individual phase parameters, some popups for configuration, etc.
Misc Screens	There are several navigation screens, global component operation screens, and helper screens that may be encountered when navigating through the system. The most commonly used screens have been explained previously or are self-explanatory.
Chemical Feed Summary	This screen displays detailed information about a specific chemical feed system. Each type of chemical feed will have its own summary.
Chemical Feed Setup	These screens provide access to a specific chemical feed system. Each type of chemical feed will have its own setup.

* Some of these screens are secured. See the Appendix for setpoints and the required access level.

5.2 HMI SCREEN TREE



5.3 HMI SECURITY LEVELS

The HMI has security levels built in to protect the system operation, setpoint parameters, and the system configuration. There are four security accounts, or user levels: “Guest” (or Default), “Operator”, “Supervisor”, and “Engineer”. The “Guest” account has view access only. The “Operator” account provides protection to parameters that may need to be adjusted as part of normal operation. The “Supervisor” account includes operator functionality plus additional setpoint access. The “Engineer” account has full access to the system.

The system default values are identified in the Appendix. This appendix also identifies the security level required to modify a specific parameter.

The current security login (account name) is displayed on the Main Menu screen. There is also a button on that screen to access the login/logout functions. To login as a different account on the HMI, perform the following:

1. Press the “Login” button to bring up the Login window.
2. Press the “User” button to bring up the software keyboard. Type the desired account name, then press the enter button.
3. Press the “Password” button to bring up the software keyboard. Type the password, then press the enter button.
4. Press the enter button on the Login window.

5.4 HMI CONTROL AND DATA ENTRY

The operator has the ability to modify system setpoints and other parameters via the HMI. The operator selects the desired parameter to modify by pressing the respective point on the HMI touch screen. A numeric keypad will appear which allows the operator to enter a new value. This new value is tied to the parameter that was selected. After entering the new value via the numeric keypad, the operator then presses the Enter key to store the new value.

Software buttons and discrete (digital) parameters do not use the numeric keypad. These are activated directly by the operator pressing the respective location on the touch screen.

5.5 HMI ALARM SUMMARY

When a new alarm is detected, the HMI may automatically change to the alarm summary screen. The alarm summary will indicate the description of the alarm condition, and the time and date at which the alarm occurred. There will also be a button for the user to acknowledge the current alarm shown.

On the HMI, the alarm message will be prefixed with an alarm number. This is a reference number assigned by Aqua-Aerobic Systems and is not related to an equipment tag number.

6.0 ALARM HANDLING

6.1 ALARM RESET

When a new (unacknowledged) alarm is present, an alarm banner will appear on the HMI and the alarm reset light on the front of the control panel will flash on/off. If alarms are active and acknowledged, the alarm banner will not be displayed, but the alarm will be listed on the Alarm Summary and the alarm reset light will be on steady.

To reset an alarm, it must be acknowledged, and the conditions causing the alarm must be checked and cleared. An alarm may be reset by pressing either the alarm reset pushbutton on the HMI or the alarm reset pushbutton on the front of the control panel. If there are no active alarms present, the Alarm Summary screen on the HMI will be empty and the alarm reset light will be off.

6.2 ALARM MESSAGES

The alarm messages for this system are indicated on the following pages.

Alarm #500 PLC Battery Low
Alarm #501 PLC Input Power Fail
Alarm #502 PLC Output Power Fail
Alarm #503 PLC Power was Lost
Alarm #504 PLC-Plant Communication Lost
Alarm #505 PLC-Nereda Controller Communication Lost
Alarm #506 PLC-SCADA Communication Lost
Alarm #507 PLC On UPS Power
Alarm #508 UPS Battery Low
Alarm #509 Comm Loss on Critical Component
Alarm #510 Blower #1 Fault, Check Blower for Data
Alarm #511 Blower #1 Failed to Run
Alarm #512 Blower #1 Failed to Stop
Alarm #513 Blower #1 Warning, Check Blower for Data
Alarm #514 Blower #1 High Temperature
Alarm #515 Blower #2 Fault, Check Blower for Data
Alarm #516 Blower #2 Failed to Run
Alarm #517 Blower #2 Failed to Stop
Alarm #518 Blower #2 Warning, Check Blower for Data
Alarm #519 Blower #2 High Temperature
Alarm #520 Blower #3 Fault, Check Blower for Data
Alarm #521 Blower #3 Failed to Run
Alarm #522 Blower #3 Failed to Stop
Alarm #523 Blower #3 Warning, Check Blower for Data
Alarm #524 Blower #3 High Temperature
Alarm #525 Blower #4 Fault, Check Blower for Data
Alarm #526 Blower #4 Failed to Run
Alarm #527 Blower #4 Failed to Stop
Alarm #528 Blower #4 Warning, Check Blower for Data
Alarm #529 Blower #4 High Temperature
Alarm #535 Comm Loss with Aerzen Optimizer
Alarm #541 Comm Loss with Blower 1 and Optimizer
Alarm #542 Comm Loss with Blower 2 and Optimizer
Alarm #543 Comm Loss with Blower 3 and Optimizer
Alarm #544 Comm Loss with Blower 4 and Optimizer
Alarm #545 Comm Loss with Blower 1 VFD Ethernet Module
Alarm #546 Comm Loss with Blower 2 VFD Ethernet Module
Alarm #547 Comm Loss with Blower 3 VFD Ethernet Module
Alarm #548 Comm Loss with Blower 4 VFD Ethernet Module
Alarm #549 Comm Loss with IB Pump 1 Ethernet Module
Alarm #550 Comm Loss with IB Pump 2 Ethernet Module
Alarm #553 Comm Loss with IB Pump 3 Ethernet Module
Alarm #554 Comm Loss with IB Pump 4 Ethernet Module
Alarm #551 Comm Loss with SB 1 Pump Ethernet Module
Alarm #552 Comm Loss with SB 2 Pump Ethernet Module
Alarm #555 Comm Loss with MBS Card in Chassis

Alarm #100 AGS #1 Level High Alarm #101 AGS #1 Level Low Alarm #102 AGS #1 Level Out of Range Alarm #103 AGS #1 Air Flow High Alarm #104 AGS #1 Air Flow Low Alarm #105 AGS #1 Air Flow Out of Range Alarm #106 AGS #1 Ammonia High Alarm #107 AGS #1 Ammonia Sensor Error Alarm #110 AGS #1 Effluent TSS High Alarm #111 AGS #1 Effluent TSS Sensor Error Alarm #112 AGS #1 D.O. High Alarm #113 AGS #1 D.O. Low Alarm #114 AGS #1 D.O. Sensor Error Alarm #115 AGS #1 Reactor pH High Alarm #116 AGS #1 Reactor pH Low Alarm #117 AGS #1 Reactor pH Sensor Error Alarm #118 AGS #1 Temperature Sensor Error Alarm #119 AGS #1 Redox High Alarm #120 AGS #1 Redox Low Alarm #121 AGS #1 Redox Sensor Error Alarm #123 AGS #1 Influent Flow Out of Range Alarm #124 AGS #1 Phosphorus High Alarm #125 AGS #1 Phosphorus Sensor Error Alarm #126 AGS #1 Air Flow Deviation PID Limit Alarm #129 AGS #1 Phase Failed to Start Alarm #130 AGS #1 Comm Loss on Critical Component Alarm #131 AGS #1 A Phase has Aborted Alarm #132 AGS #1 Phase Failed to Stop Alarm #133 AGS #1 Feed Valve Failed to Open Alarm #134 AGS #1 Feed Valve Failed to Close Alarm #135 AGS #1 Air Fill Valve Failed to Open Alarm #136 AGS #1 Air Fill Valve Failed to Close Alarm #137 AGS #1 Air Vent Valve Failed to Open Alarm #138 AGS #1 Air Vent Valve Failed to Close Alarm #139 AGS #1 Sludge Discharge Valve Failed to Open Alarm #140 AGS #1 Sludge Discharge Valve Failed to Close Alarm #141 AGS #1 Lower Level Valve Failed to Open Alarm #142 AGS #1 Lower Level Valve Failed to Close Alarm #143 AGS #1 Air Valve Beyond Deviation Limit	Alarm #147 AGS #1 Reactor Aborted by ANC, Press AGS Reset Aborted Phases Alarm #148 AGS #1 Aerate Not Ready, Reactor now Offline Alarm #149 AGS #1 Feed Not Ready, Reactor now Offline Alarm #150 AGS #1 Extended Feed Occurring, Next Feed not Ready Alarm #151 AGS #1 Feed Aborted Alarm #153 AGS #1 Air Valve Failed to Close Alarm #154 AGS #1 Water Detected in Sludge Decant Alarm #173 AGS #1 Coagulant Level High Alarm #174 AGS #1 Coagulant Level Low Alarm #175 AGS #1 Coagulant Level Out of Range Alarm #176 AGS #1 Coagulant Pump VFD Fault Alarm #177 AGS #1 Coagulant Pump Failed to Start Alarm #178 AGS #1 Coagulant Pump Failed to Stop Alarm #179 AGS #1 Coagulant Valve Failed to Open Alarm #180 AGS #1 Coagulant Valve Failed to Close

Alarm #200 AGS #2 Level High Alarm #201 AGS #2 Level Low Alarm #202 AGS #2 Level Out of Range Alarm #203 AGS #2 Air Flow High Alarm #204 AGS #2 Air Flow Low Alarm #205 AGS #2 Air Flow Out of Range Alarm #206 AGS #2 Ammonia High Alarm #207 AGS #2 Ammonia Sensor Error Alarm #210 AGS #2 Effluent TSS High Alarm #211 AGS #2 Effluent TSS Sensor Error Alarm #212 AGS #2 D.O. High Alarm #213 AGS #2 D.O. Low Alarm #214 AGS #2 D.O. Sensor Error Alarm #215 AGS #2 Reactor pH High Alarm #216 AGS #2 Reactor pH Low Alarm #217 AGS #2 Reactor pH Sensor Error Alarm #218 AGS #2 Temperature Sensor Error Alarm #219 AGS #2 Redox High Alarm #220 AGS #2 Redox Low Alarm #221 AGS #2 Redox Sensor Error Alarm #223 AGS #2 Influent Flow Out of Range Alarm #224 AGS #2 Phosphorus High Alarm #225 AGS #2 Phosphorus Sensor Error Alarm #226 AGS #2 Air Flow Deviation PID Limit Alarm #229 AGS #2 Phase Failed to Start Alarm #230 AGS #2 Comm Loss on Critical Component Alarm #231 AGS #2 A Phase has Aborted Alarm #232 AGS #2 Phase Failed to Stop Alarm #233 AGS #2 Feed Valve Failed to Open Alarm #234 AGS #2 Feed Valve Failed to Close Alarm #235 AGS #2 Air Fill Valve Failed to Open Alarm #236 AGS #2 Air Fill Valve Failed to Close Alarm #237 AGS #2 Air Vent Valve Failed to Open Alarm #238 AGS #2 Air Vent Valve Failed to Close Alarm #239 AGS #2 Sludge Discharge Valve Failed to Open Alarm #240 AGS #2 Sludge Discharge Valve Failed to Close Alarm #241 AGS #2 Lower Level Valve Failed to Open Alarm #242 AGS #2 Lower Level Valve Failed to Close Alarm #243 AGS #2 Air Valve Beyond Deviation Limit	Alarm #247 AGS #2 Reactor Aborted by ANC, Press AGS Reset Aborted Phases Alarm #248 AGS #2 Aerate Not Ready, Reactor now Offline Alarm #249 AGS #2 Feed Not Ready, Reactor now Offline Alarm #250 AGS #2 Extended Feed Occurring, Next Feed not Ready Alarm #251 AGS #2 Feed Aborted Alarm #253 AGS #2 Air Valve Failed to Close Alarm #254 AGS #2 Water Detected in Sludge Decant Alarm #273 AGS #2 Coagulant Level High Alarm #274 AGS #2 Coagulant Level Low Alarm #275 AGS #2 Coagulant Level Out of Range Alarm #276 AGS #2 Coagulant Pump VFD Fault Alarm #277 AGS #2 Coagulant Pump Failed to Start Alarm #278 AGS #2 Coagulant Pump Failed to Stop Alarm #279 AGS #2 Coagulant Valve Failed to Open Alarm #280 AGS #2 Coagulant Valve Failed to Close

Alarm #300 AGS #3 Level High Alarm #301 AGS #3 Level Low Alarm #302 AGS #3 Level Out of Range Alarm #303 AGS #3 Air Flow High Alarm #304 AGS #3 Air Flow Low Alarm #305 AGS #3 Air Flow Out of Range Alarm #306 AGS #3 Ammonia High Alarm #307 AGS #3 Ammonia Sensor Error Alarm #310 AGS #3 Effluent TSS High Alarm #311 AGS #3 Effluent TSS Sensor Error Alarm #312 AGS #3 D.O. High Alarm #313 AGS #3 D.O. Low Alarm #314 AGS #3 D.O. Sensor Error Alarm #315 AGS #3 Reactor pH High Alarm #316 AGS #3 Reactor pH Low Alarm #317 AGS #3 Reactor pH Sensor Error Alarm #318 AGS #3 Temperature Sensor Error Alarm #319 AGS #3 Redox High Alarm #320 AGS #3 Redox Low Alarm #321 AGS #3 Redox Sensor Error Alarm #323 AGS #3 Influent Flow Out of Range Alarm #324 AGS #3 Phosphorus High Alarm #325 AGS #3 Phosphorus Sensor Error Alarm #326 AGS #3 Air Flow Deviation PID Limit Alarm #329 AGS #3 Phase Failed to Start Alarm #330 AGS #3 Comm Loss on Critical Component Alarm #331 AGS #3 A Phase has Aborted Alarm #332 AGS #3 Phase Failed to Stop Alarm #333 AGS #3 Feed Valve Failed to Open Alarm #334 AGS #3 Feed Valve Failed to Close Alarm #335 AGS #3 Air Fill Valve Failed to Open Alarm #336 AGS #3 Air Fill Valve Failed to Close Alarm #337 AGS #3 Air Vent Valve Failed to Open Alarm #338 AGS #3 Air Vent Valve Failed to Close Alarm #339 AGS #3 Sludge Discharge Valve Failed to Open Alarm #340 AGS #3 Sludge Discharge Valve Failed to Close Alarm #341 AGS #3 Lower Level Valve Failed to Open Alarm #342 AGS #3 Lower Level Valve Failed to Close Alarm #343 AGS #3 Air Valve Beyond Deviation Limit	Alarm #347 AGS #3 Reactor Aborted by ANC, Press AGS Reset Aborted Phases Alarm #348 AGS #3 Aerate Not Ready, Reactor now Offline Alarm #349 AGS #3 Feed Not Ready, Reactor now Offline Alarm #350 AGS #3 Extended Feed Occurring, Next Feed not Ready Alarm #351 AGS #3 Feed Aborted Alarm #353 AGS #3 Air Valve Failed to Close Alarm #354 AGS #3 Water Detected in Sludge Decant Alarm #373 AGS #3 Coagulant Level High Alarm #374 AGS #3 Coagulant Level Low Alarm #375 AGS #3 Coagulant Level Out of Range Alarm #376 AGS #3 Coagulant Pump VFD Fault Alarm #377 AGS #3 Coagulant Pump Failed to Start Alarm #378 AGS #3 Coagulant Pump Failed to Stop Alarm #379 AGS #3 Coagulant Valve Failed to Open Alarm #380 AGS #3 Coagulant Valve Failed to Close

Alarm #600 Sludge Buffer 1 Level High Alarm #601 Sludge Buffer 1 Level Low Alarm #602 Sludge Buffer 1 Level Out of Range Alarm #603 Sludge Buffer TSS High Alarm #604 Sludge Buffer TSS Sensor Error Alarm #609 Sludge Buffer 1 Pump Comm Loss on Critical Component Alarm #610 Sludge Buffer 1 Pump Fault Alarm #611 Sludge Buffer 1 Pump Failed to Run Alarm #615 Sludge Buffer 1 Discharge Flow Low Alarm #616 Sludge Buffer 1 Discharge Flow Out of Range Alarm #620 Sludge Buffer 1 Feed Valve Failed to Open Alarm #621 Sludge Buffer 1 Feed Valve Failed to Close Alarm #624 Sludge Buffer 1 Sludge Valve Failed to Open Alarm #625 Sludge Buffer 1 Sludge Valve Failed to Close Alarm #626 Sludge Buffer 1 Supernate Valve Failed to Open Alarm #627 Sludge Buffer 1 Supernate Valve Failed to Close Alarm #632 Sludge Buffer 1 A Phase was not Ready, Now Offline Alarm #633 Sludge Buffer 1 A Phase has Aborted Alarm #634 Sludge Buffer 2 A Phase failed to Start Alarm #635 Sludge Buffer 2 A Phase failed to Stop	Alarm #700 Sludge Buffer 2 Level High Alarm #701 Sludge Buffer 2 Level Low Alarm #702 Sludge Buffer 2 Level Out of Range Alarm #703 Sludge Buffer 2 TSS High Alarm #704 Sludge Buffer 2 TSS Sensor Error Alarm #709 Sludge Buffer 2 Pump Comm Loss on Critical Component Alarm #710 Sludge Buffer 2 Pump Fault Alarm #711 Sludge Buffer 2 Pump Failed to Run Alarm #715 Sludge Buffer 2 Discharge Flow Low Alarm #716 Sludge Buffer 2 Discharge Flow Out of Range Alarm #720 Sludge Buffer 2 Feed Valve Failed to Open Alarm #721 Sludge Buffer 2 Feed Valve Failed to Close Alarm #724 Sludge Buffer 2 Sludge Valve Failed to Open Alarm #725 Sludge Buffer 2 Sludge Valve Failed to Close Alarm #726 Sludge Buffer 2 Supernate Valve Failed to Open Alarm #727 Sludge Buffer 2 Supernate Valve Failed to Close Alarm #732 Sludge Buffer 2 A Phase was not Ready, Now Offline Alarm #733 Sludge Buffer 2 A Phase has Aborted Alarm #734 Sludge Buffer 2 A Phase failed to Start Alarm #735 Sludge Buffer 2 A Phase failed to Stop

Alarm #910 Coagulant Feed System Fault Alarm #911 Coagulant Feed Tank Level High Alarm #912 Coagulant Feed Tank Level Low Alarm #913 Coagulant Feed Tank Level Out of Range Alarm #914 Coagulant Feed Pump Fault Alarm #915 Coagulant Feed Pump Failed to Run Alarm #916 Coagulant Feed Valve Failed to Open Alarm #917 Coagulant Feed Valve Failed to Close Alarm #932 Influent Splitter Coagulant Feed Pump Failed to Run Alarm #933 AGS 1 Coagulant Feed Pump Failed to Run Alarm #934 AGS 2 Coagulant Feed Pump Failed to Run Alarm #935 AGS 3 Coagulant Feed Pump Failed to Run	

Alarm #1000 AGS #1 Feed Phase Influent Vlv not in Auto	Alarm #1096 AGS #2 Feed Phase Influent Vlv not in Auto
Alarm #1001 AGS #1 Feed Phase Influent Vlv Fail to Open	Alarm #1097 AGS #2 Feed Phase Influent Vlv Fail to Open
Alarm #1002 AGS #1 Feed Phase Influent Vlv Fail to Close	Alarm #1098 AGS #2 Feed Phase Influent Vlv Fail to Close
Alarm #1003 AGS #1 Feed Phase Sludge Disch Vlv not Clsd	Alarm #1099 AGS #2 Feed Phase Sludge Disch Vlv not Clsd
Alarm #1004 AGS #1 Feed Phase Lower Level Vlv not Clsd	Alarm #1100 AGS #2 Feed Phase Lower Level Vlv not Clsd
Alarm #1005 AGS #1 Feed Phase Level Switch High	Alarm #1101 AGS #2 Feed Phase Level Switch High
Alarm #1006 AGS #1 Feed Phase Level XMtr Out of Range	Alarm #1102 AGS #2 Feed Phase Level XMtr Out of Range
Alarm #1007 AGS #1 Feed Phase Influent Pumps not Available	Alarm #1103 AGS #2 Feed Phase Influent Pumps not Available
Alarm #1008 AGS #1 Feed Phase Air Vlv not Closed	Alarm #1104 AGS #2 Feed Phase Air Vlv not Closed
Alarm #1012 AGS #1 Feed Phase Cntrl Offline Aerate or Offline	Alarm #1108 AGS #2 Feed Phase Cntrl Offline Aerate or Offline
Alarm #1013 AGS #1 Feed Phase Failed to Start	Alarm #1109 AGS #2 Feed Phase Failed to Start
Alarm #1014 AGS #1 Feed Phase Failed to Stop	Alarm #1110 AGS #2 Feed Phase Failed to Stop
Alarm #1015 AGS #1 Feed Phase Unknown Reason For Abort	Alarm #1111 AGS #2 Feed Phase Unknown Reason For Abort
Alarm #1018 AGS #1 Lwr Lvl Phase LL Vlv not in Auto	Alarm #1114 AGS #2 Lwr Lvl Phase LL Vlv not in Auto
Alarm #1019 AGS #1 Lwr Lvl Phase LL Vlv Fail to Open	Alarm #1115 AGS #2 Lwr Lvl Phase LL Vlv Fail to Open
Alarm #1020 AGS #1 Lwr Lvl Phase LL Vlv Fail to Close	Alarm #1116 AGS #2 Lwr Lvl Phase LL Vlv Fail to Close
Alarm #1021 AGS #1 Lwr Lvl Phase AV Vlv not in Auto	Alarm #1117 AGS #2 Lwr Lvl Phase AV Vlv not in Auto
Alarm #1022 AGS #1 Lwr Lvl Phase AV Vlv Fail to Open	Alarm #1118 AGS #2 Lwr Lvl Phase AV Vlv Fail to Open
Alarm #1023 AGS #1 Lwr Lvl Phase AV Vlv Fail to Close	Alarm #1119 AGS #2 Lwr Lvl Phase AV Vlv Fail to Close
Alarm #1024 AGS #1 Lwr Lvl Phase Sludge Disch Vlv not Clsd	Alarm #1120 AGS #2 Lwr Lvl Phase Sludge Disch Vlv not Clsd
Alarm #1025 AGS #1 Lwr Lvl Phase Influent Vlv not Closed	Alarm #1121 AGS #2 Lwr Lvl Phase Influent Vlv not Closed
Alarm #1026 AGS #1 Lwr Lvl Phase Hi Level at Receiving Basin	Alarm #1122 AGS #2 Lwr Lvl Phase Hi Level at Receiving Basin
Alarm #1030 AGS #1 Lwr Lvl Phase Cntrl Offline Aerate or Offline	Alarm #1126 AGS #2 Lwr Lvl Phase Cntrl Offline Aerate or Offline
Alarm #1031 AGS #1 Lwr Lvl Phase Failed to Start	Alarm #1127 AGS #2 Lwr Lvl Phase Failed to Start
Alarm #1032 AGS #1 Lwr Lvl Phase Failed to Stop	Alarm #1128 AGS #2 Lwr Lvl Phase Failed to Stop
Alarm #1033 AGS #1 Lwr Lvl Phase Unknown Reason For Abort	Alarm #1129 AGS #2 Lwr Lvl Phase Unknown Reason For Abort
Alarm #1036 AGS #1 Aerate Phase Air Vlv not in Auto	Alarm #1132 AGS #2 Aerate Phase Air Vlv not in Auto
Alarm #1037 AGS #1 Aerate Phase Air Seal Vlv not in Auto	Alarm #1133 AGS #2 Aerate Phase Air Seal Vlv not in Auto
Alarm #1038 AGS #1 Aerate Phase Air Seal Vlv Fail to Open	Alarm #1134 AGS #2 Aerate Phase Air Seal Vlv Fail to Open
Alarm #1039 AGS #1 Aerate Phase Air Seal Vlv Fail to Close	Alarm #1135 AGS #2 Aerate Phase Air Seal Vlv Fail to Close
Alarm #1040 AGS #1 Aerate Phase AS and AV Vlv not Clsd	Alarm #1136 AGS #2 Aerate Phase AS and AV Vlv not Clsd

Alarm #1041 AGS #1 Aerate Phase Sludge Disch Vlv not Clsd Alarm #1042 AGS #1 Aerate Phase Lower Level Vlv not Clsd Alarm #1043 AGS #1 Aerate Phase Influent Vlv not Clsd Alarm #1044 AGS #1 Aerate Phase Lvl Above and Aerate not Active Alarm #1045 AGS #1 Aerate Phase Level XMtr Out of Range Alarm #1046 AGS #1 Aerate Phase No Blowers Available Alarm #1048 AGS #1 Aerate Phase Cntrl Offline Alarm #1049 AGS #1 Aerate Phase Failed to Start Alarm #1050 AGS #1 Aerate Phase Failed to Stop Alarm #1051 AGS #1 Aerate Phase Unknown Reason For Abort Alarm #1054 AGS #1 Disch Phase Sludge Disch Vlv not in Auto Alarm #1055 AGS #1 Disch Phase Sludge Disch Vlv Fail to Open Alarm #1056 AGS #1 Disch Phase Sludge Disch Vlv Fail to Close Alarm #1057 AGS #1 Disch Phase Lower Level Vlv not Clsd Alarm #1058 AGS #1 Disch Phase AV Vlv not Auto and not Open Alarm #1059 AGS #1 Disch Phase AGS #2 SD Vlv not Clsd Alarm #1060 AGS #1 Disch Phase AGS #3 SD Vlv not Clsd Alarm #1062 AGS #1 Disch Phase Sludge Buff not Avail Alarm #1066 AGS #1 Disch Phase Cntrl Offline Aerate or Offline Alarm #1067 AGS #1 Disch Phase Failed to Start Alarm #1068 AGS #1 Disch Phase Failed to Stop Alarm #1069 AGS #1 Disch Phase Unknown Reason For Abort Alarm #1072 AGS #1 Disch Phase W/O Sludge Buffer Feed Alarm #1081 AGS #1 Chemical Phase Pump not in Auto Alarm #1082 AGS #1 Chemical Phase Coagulant Feed Pump FAILED to RUN Alarm #1083 AGS #1 Chemical Phase Chemical Disabled from HMI Alarm #1084 AGS #1 Chemical Phase Valve not in Auto Alarm #1087 AGS #1 Chemical Phase Cntrl Offline Aerate or Offline Alarm #1088 AGS #1 Chemical Phase Failed to Start Alarm #1089 AGS #1 Chemical Phase Failed to Stop Alarm #1090 AGS #1 Chemical Phase Unknown Reason For Abort	Alarm #1137 AGS #2 Aerate Phase Sludge Disch Vlv not Clsd Alarm #1138 AGS #2 Aerate Phase Lower Level Vlv not Clsd Alarm #1139 AGS #2 Aerate Phase Influent Vlv not Clsd Alarm #1140 AGS #2 Aerate Phase Lvl Above and Aerate not Active Alarm #1141 AGS #2 Aerate Phase Level XMtr Out of Range Alarm #1142 AGS #2 Aerate Phase No Blowers Available Alarm #1144 AGS #2 Aerate Phase Cntrl Offline Alarm #1145 AGS #2 Aerate Phase Failed to Start Alarm #1146 AGS #2 Aerate Phase Failed to Stop Alarm #1147 AGS #2 Aerate Phase Unknown Reason For Abort Alarm #1150 AGS #2 Disch Phase Sludge Disch Vlv not in Auto Alarm #1151 AGS #2 Disch Phase Sludge Disch Vlv Fail to Open Alarm #1152 AGS #2 Disch Phase Sludge Disch Vlv Fail to Close Alarm #1153 AGS #2 Disch Phase Lower Level Vlv not Clsd Alarm #1154 AGS #2 Disch Phase AV Vlv not Auto and not Open Alarm #1155 AGS #2 Disch Phase AGS #1 SD Vlv not Clsd Alarm #1156 AGS #2 Disch Phase AGS #3 SD Vlv not Clsd Alarm #1158 AGS #2 Disch Phase Sludge Buff not Avail Alarm #1162 AGS #2 Disch Phase Cntrl Offline Aerate or Offline Alarm #1163 AGS #2 Disch Phase Failed to Start Alarm #1164 AGS #2 Disch Phase Failed to Stop Alarm #1165 AGS #2 Disch Phase Unknown Reason For Abort Alarm #1168 AGS #2 Disch Phase W/O Sludge Buffer Feed Alarm #1177 AGS #2 Chemical Phase Pump not in Auto Alarm #1178 AGS #2 Chemical Phase Coagulant Feed Pump FAILED to RUN Alarm #1179 AGS #2 Chemical Phase Chemical Disabled from HMI Alarm #1180 AGS #2 Chemical Phase Valve not in Auto Alarm #1183 AGS #2 Chemical Phase Cntrl Offline Aerate or Offline Alarm #1184 AGS #2 Chemical Phase Failed to Start Alarm #1185 AGS #2 Chemical Phase Failed to Stop Alarm #1186 AGS #2 Chemical Phase Unknown Reason For Abort

Alarm #1192 AGS #3 Feed Phase Influent Vlv not in Auto Alarm #1193 AGS #3 Feed Phase Influent Vlv Fail to Open Alarm #1194 AGS #3 Feed Phase Influent Vlv Fail to Close Alarm #1195 AGS #3 Feed Phase Sludge Disch Vlv not Clsd Alarm #1196 AGS #3 Feed Phase Lower Level Vlv not Clsd Alarm #1197 AGS #3 Feed Phase Level Switch High Alarm #1198 AGS #3 Feed Phase Level XMtr Out of Range Alarm #1199 AGS #3 Feed Phase Influent Pumps not Available Alarm #1200 AGS #3 Feed Phase Air Vlv not Closed Alarm #1204 AGS #3 Feed Phase Cntrl Offline Aerate or Offline Alarm #1205 AGS #3 Feed Phase Failed to Start Alarm #1206 AGS #3 Feed Phase Failed to Stop Alarm #1207 AGS #3 Feed Phase Unknown Reason For Abort Alarm #1210 AGS #3 Lwr Lvl Phase LL Vlv not in Auto Alarm #1211 AGS #3 Lwr Lvl Phase LL Vlv Fail to Open Alarm #1212 AGS #3 Lwr Lvl Phase LL Vlv Fail to Close Alarm #1213 AGS #3 Lwr Lvl Phase AV Vlv not in Auto Alarm #1214 AGS #3 Lwr Lvl Phase AV Vlv Fail to Open Alarm #1215 AGS #3 Lwr Lvl Phase AV Vlv Fail to Close Alarm #1216 AGS #3 Lwr Lvl Phase Sludge Disch Vlv not Clsd Alarm #1217 AGS #3 Lwr Lvl Phase Influent Vlv not Closed Alarm #1218 AGS #3 Lwr Lvl Phase Hi Level at Receiving Basin Alarm #1222 AGS #3 Lwr Lvl Phase Cntrl Offline Aerate or Offline Alarm #1223 AGS #3 Lwr Lvl Phase Failed to Start Alarm #1224 AGS #3 Lwr Lvl Phase Failed to Stop Alarm #1225 AGS #3 Lwr Lvl Phase Unknown Reason For Abort Alarm #1228 AGS #3 Aerate Phase Air Vlv not in Auto Alarm #1229 AGS #3 Aerate Phase Air Seal Vlv not in Auto Alarm #1230 AGS #3 Aerate Phase Air Seal Vlv Fail to Open Alarm #1231 AGS #3 Aerate Phase Air Seal Vlv Fail to Close Alarm #1232 AGS #3 Aerate Phase AS and AV Vlv not Clsd	

Alarm #1233 AGS #3 Aerate Phase Sludge Disch Vlv not Clsd Alarm #1234 AGS #3 Aerate Phase Lower Level Vlv not Clsd Alarm #1235 AGS #3 Aerate Phase Influent Vlv not Clsd Alarm #1236 AGS #3 Aerate Phase Lvl Above and Aerate not Active Alarm #1237 AGS #3 Aerate Phase Level XMtr Out of Range Alarm #1238 AGS #3 Aerate Phase No Blowers Available Alarm #1240 AGS #3 Aerate Phase Cntrl Offline Alarm #1241 AGS #3 Aerate Phase Failed to Start Alarm #1242 AGS #3 Aerate Phase Failed to Stop Alarm #1243 AGS #3 Aerate Phase Unknown Reason For Abort Alarm #1246 AGS #3 Disch Phase Sludge Disch Vlv not in Auto Alarm #1247 AGS #3 Disch Phase Sludge Disch Vlv Fail to Open Alarm #1248 AGS #3 Disch Phase Sludge Disch Vlv Fail to Close Alarm #1249 AGS #3 Disch Phase Lower Level Vlv not Clsd Alarm #1250 AGS #3 Disch Phase AV Vlv not Auto and not Open Alarm #1251 AGS #3 Disch Phase AGS #1 SD Vlv not Clsd Alarm #1252 AGS #3 Disch Phase AGS #2 SD Vlv not Clsd Alarm #1254 AGS #3 Disch Phase Sludge Buff not Avail Alarm #1258 AGS #3 Disch Phase Cntrl Offline Aerate or Offline Alarm #1259 AGS #3 Disch Phase Failed to Start Alarm #1260 AGS #3 Disch Phase Failed to Stop Alarm #1261 AGS #3 Disch Phase Unknown Reason For Abort Alarm #1264 AGS #3 Disch Phase W/O Sludge Buffer Feed Alarm #1273 AGS #3 Chemical Phase Pump not in Auto Alarm #1274 AGS #3 Chemical Phase Coagulant Feed Pump FAILED to RUN Alarm #1275 AGS #3 Chemical Phase Chemical Disabled from HMI Alarm #1276 AGS #3 Chemical Phase Valve not in Auto Alarm #1279 AGS #3 Chemical Phase Cntrl Offline Aerate or Offline Alarm #1280 AGS #3 Chemical Phase Failed to Start Alarm #1281 AGS #3 Chemical Phase Failed to Stop Alarm #1282 AGS #3 Chemical Phase Unknown Reason For Abort	

Alarm #1384 SB #1 Feed Phase Feed Vlv not in Auto Alarm #1385 SB #1 Feed Phase Feed Vlv Fail to Open Alarm #1386 SB #1 Feed Phase Feed Vlv Fail to Close Alarm #1387 SB #1 Feed Phase Lvl Switch High Alarm #1388 SB #1 Feed Phase Level XMtr Out of Range Alarm #1391 SB #1 Feed Phase Basin Offline Alarm #1392 SB #1 Feed Phase Basin Failed to Start Alarm #1393 SB #1 Feed Phase Basin Failed to Stop Alarm #1394 SB #1 Feed Phase Unknown Reason For Abort Alarm #1397 SB #1 Sludge Disch Phase Sludge Vlv not in Auto Alarm #1398 SB #1 Sludge Disch Phase Sludge Vlv Fail to Open Alarm #1399 SB #1 Sludge Disch Phase Sludge Vlv Fail to Close Alarm #1401 SB #1 Sludge Disch Phase Supernate Vlv Fail to Close Alarm #1402 SB #1 Sludge Disch Phase Sludge Buff Pumps not Available Alarm #1405 SB #1 Sludge_Disch Phase Basin Offline Alarm #1406 SB #1 Sludge_Disch Phase Basin Failed to Start Alarm #1407 SB #1 Sludge_Disch Phase Basin Failed to Stop Alarm #1408 SB #1 Sludge_Disch Phase Unknown Reason For Abort Alarm #1411 SB #1 Water Disch Phase Supernate Vlv not in Auto Alarm #1412 SB #1 Water Disch Phase Supernate Vlv Fail to Open Alarm #1413 SB #1 Water Disch Phase Supernate Vlv Fail to Close Alarm #1417 SB #1 Water Disch Phase Sludge Vlv Fail to Close/Not Closed Alarm #1418 SB #1 Water Disch Phase Sludge Buff Pumps Not Available Alarm #1421 SB #1 Water Disch Phase Basin Offline Alarm #1422 SB #1 Water Disch Phase Basin Failed to Start Alarm #1423 SB #1 Water Disch Phase Basin Failed to Stop Alarm #1424 SB #1 Water Disch Phase Unknown Reason For Abort	Alarm #1432 SB #2 Feed Phase Feed Vlv not in Auto Alarm #1433 SB #2 Feed Phase Feed Vlv Fail to Open Alarm #1434 SB #2 Feed Phase Feed Vlv Fail to Close Alarm #1435 SB #2 Feed Phase Lvl Switch High Alarm #1436 SB #2 Feed Phase Level XMtr Out of Range Alarm #1439 SB #2 Feed Phase Basin Offline Alarm #1440 SB #2 Feed Phase Basin Failed to Start Alarm #1441 SB #2 Feed Phase Basin Failed to Stop Alarm #1442 SB #2 Feed Phase Unknown Reason For Abort Alarm #1445 SB #2 Sludge Disch Phase Sludge Vlv not in Auto Alarm #1446 SB #2 Sludge Disch Phase Sludge Vlv Fail to Open Alarm #1447 SB #2 Sludge Disch Phase Sludge Vlv Fail to Close Alarm #1449 SB #2 Sludge Disch Phase Supernate Vlv Fail to Close Alarm #1450 SB #2 Sludge Disch Phase Sludge Buff Pumps not Available Alarm #1453 SB #2 Sludge_Disch Phase Basin Offline Alarm #1454 SB #2 Sludge_Disch Phase Basin Failed to Start Alarm #1455 SB #2 Sludge_Disch Phase Basin Failed to Stop Alarm #1456 SB #2 Sludge_Disch Phase Unknown Reason For Abort Alarm #1459 SB #2 Water Disch Phase Supernate Vlv not in Auto Alarm #1460 SB #2 Water Disch Phase Supernate Vlv Fail to Open Alarm #1461 SB #2 Water Disch Phase Supernate Vlv Fail to Close Alarm #1465 SB #2 Water Disch Phase Sludge Vlv Fail to Close/Not Closed Alarm #1466 SB #2 Water Disch Phase Sludge Buff Pumps Not Available Alarm #1469 SB #2 Water Disch Phase Basin Offline Alarm #1470 SB #2 Water Disch Phase Basin Failed to Start Alarm #1471 SB #2 Water Disch Phase Basin Failed to Stop Alarm #1472 SB #2 Water Disch Phase Unknown Reason For Abort

Alarm #1500 Inf Buff #1 Level High Alarm #1501 Inf Buff #1 Level Low Alarm #1502 Inf Buff #1 Level Out of Range Alarm #1503 Inf Buff #2 Level High Alarm #1504 Inf Buff #2 Level Low Alarm #1505 Inf Buff #2 Level Out of Range Alarm #1523 Inf Buff Flow Out of Range Alarm #1532 Inf Buff Pump 1 Fault Alarm #1533 Inf Buff Pump 1 Fail to Start Alarm #1534 Inf Buff Pump 1 Fail to Stop Alarm #1535 Inf Buff Pump 2 Fault Alarm #1536 Inf Buff Pump 2 Fail to Start Alarm #1537 Inf Buff Pump 2 Fail to Stop Alarm #1538 Inf Buff Pump 3 Fault Alarm #1539 Inf Buff Pump 3 Fail to Start Alarm #1540 Inf Buff Pump 3 Fail to Stop Alarm #1541 Inf Buff Pump 4 Fault Alarm #1542 Inf Buff Pump 4 Fail to Start Alarm #1543 Inf Buff Pump 4 Fail to Stop	Alarm #1600 Post-Eq Level OUT OF RANGE Alarm #1601 Post-Eq Level HIGH Alarm #1602 Post-Eq Level SENSING FAULT Alarm #1603 Post-Eq Effluent Flow OUT OF RANGE Alarm #1604 Effluent Valve FAILED TO OPEN Alarm #1605 Effluent Valve FAILED TO CLOSE Alarm #1606 Effluent Valve Position OUT OF RANGE

7.0 AQUANEREDA OPERATION SUMMARY

7.1 OVERVIEW

Each of the AquaNereda® reactors can be individually set to any of the process control modes described in Section 4.1. All reactors set to run in Auto will operate in accordance with the scheduling and cycle structure provided by the Nereda® controller.

The cycle timing is interlocked between all reactors that are set to auto. Each cycle consists of three major Operations, each of which are a sequence of specific functions called Equipment Phases that progress in accordance with stopping conditions that have adjustable setpoints. The Operations are Feed, React, and Settle, and the Equipment Phases are each described later in this document. The Operations are described below:

1. Feed Operation: This Operation is the portion of the cycle when influent is fed to the reactor, and effluent is simultaneously discharged from the reactor. This Operation could also include an adjustable wait timer and a phase for adding chemical to the reactor influent.
2. React Operation: This Operation includes a phase for lowering the water level down to the process level, as well as several separate phases for aerating the reactor for different durations and with different stopping conditions. There could also optionally be a phase for adding chemical to the reactor and a phase for wasting sludge following the Feed Operation.
3. Settle Operation: This Operation includes a phase for aerating the basin to strip out nitrogen bubbles prior to settling. It also includes quiescent time for the sludge in the reactor to settle and a phase for discharging waste sludge from the system

7.2 EQUIPMENT AVAILABLE STATUS

A piece of equipment (e.g., motor or valve) is considered “ready” or “available” when it is in Auto and it has no failures or alarms.

7.3 EQUIPMENT PHASE ORGANIZATION

Each module in the Nereda® Controller has a PLC counterpart, the so-called equipment phases. The Nereda® Controller determines which equipment phase starts and stops. Also, additional parameters can be passed from the Nereda® Controller to the PLC such as a desired flow rate or a desired capacity. In the PLC, subsequently the corresponding equipment phase is executed. The equipment phases are described in dedicated sections, for each equipment phase, the following is described:

- Phase parameters
- Actions during start of the phase (start logic)
- Actions during operation (run logic)
- Actions during stopping of the phase (stop logic)
- Operating conditions

8.0 INFLUENT FEED

8.1 INTRODUCTION

Influent flow will be pumped to the AquaNereda® reactors from the Influent Wet Wells. A total of four (4) frequency controlled Influent Feed Pumps are installed, where the pump configuration is two (2) duty + two (2) standby serving two Influent Wet Wells. Each wet well will have one (1) duty and one (1) standby pump. An influent flow meter in between the pumps and the reactors will allow for controlling the pumps to meet a flow setpoint.

In automatic mode, the desired batch size for each cycle is determined by the Nereda® Controller based on a predictive algorithm. The default operational strategy will be to maintain a set flow rate to the reactor and automatically adjust the batch size for each cycle by adjusting the feed time to the reactor. Alternatively, the feed time can be fixed and the flow rate can be adjusted to provide the correct batch size. The Nereda® Controller will also monitor the water level in the wet wells and adjust pump operation as needed based on the water levels. The flow rates and start/stop timing for the influent pumps are all determined by the Nereda® Controller and passed on via the PLC to the pump VFDs.

8.2 AUTOMATION

Reactor feed flowcontrol
The duty pump(s) must be started when the ‘feed’ phase of the AquaNereda® reactor is in RUN. To control the influent feed flow to the reactor, the feed pumps must be PI-controlled on the flow setpoint from the Nereda® Controller.

If one pump is in operation at an adjustable maximum capacity, the second pump must be started**.** The capacity of the first pump is lowered to an adjustable capacity C2 then the second pump is started with capacity C2. After acceleration both pumps are controlled together on the flow setpoint.

Pump selection
Selection of the duty and standby pumps will be by means of a duty rotation program in the PLC.

Flow measurement failure
In case of flow meter failure, corrective actions must be taken in the PLC. The Nereda® Controller will still issue a flow setpoint to the PLC. In the PLC, the flow setpoint must be used to determine the number of pumps to be operated and the pump speed by using the theoretical pump capacity.

Interlocking
The flow control of the influent feed must be started when the equipment phase "Feed" of the AquaNereda® reactor is in the state RUN. When the feed phase is no longer active, the pump(s) must be stopped.

The feed to the reactor must be stopped in the following situations:

- Low Low level influent buffer

8.3 SETTINGS

The following settings are applicable for the Influent Feed:

- Settings for flow control.
- Settings for on/off switching of pumps.

8.4 SPECIFICATION SHEETS

Influent Feed Pump

Settings – HMI/SCADA

- Hand-Off-Auto
- Start/Stop
- Capacity setpoint (manual)
- Controller settings (gain, integration time)
- Low level for dry run protection

Automation

Automatic

In automatic mode, the duty pump is controlled as described in section 8.2.

Manual

In manual mode, the operator can start and stop the pump. The pump must be operated at a capacity setpoint, adjustable by the operator.

Interlocks

- Thermal overload motor
- Electric circuit failure
- Safety switch off
- Frequency inverter failure
- LL-flow (time delayed)

Presentation

- State (auto/manual/field control/safety switch)
- Started (read back start is true)
- Stopped (read back stop is true)
- Failure
- Actual pump capacity

Level measurement influent wet wells

HMI/SCADA

- Level (ft)

Switch Points	Action	Ad	Pv	Al	Alarm number
H		X		X	#1500
LL	Stop Influent Feed Pump	X		X	#1501
Deviation Alarm		X		X	#1502
Failure Measurement	Use level measurement 1, if both fail: Predictive control disabled by Nereda Controller				

Level switch influent wet wells
HMI/SCADA

- Level switch point

Switch Points	Action	Ad	Pv	Al	Alarm number
HH		X		X	#1500

Flow measurement influent metering chamber
HMI/SCADA

- Flow (m^3/h)

Switch Points	Action	Ad	Pv	Al	Alarm number
HH		X			
LL	Stop Influent Feed Pump	X			
Deviation Alarm		X		X	#1523
Failure Measurement	Determine the number of pumps and pump speed by using the theoretical pump capacity, see 8.2				

9.0 AQUANEREDA® REACTOR

9.1 INTRODUCTION

The processes in the AquaNereda® reactors are controlled by the Nereda® Controller. This control structure is modular. There are modules for the following processes:

AquaNereda® reactor:

- Feed (effluent discharge)
- Lower level
- Aerate
- Chemicals
- Wait (settle)
- Sludge discharge

In this Section the phases, valves and instruments of a reactor are described. Operation is similar for all reactors.

If the communication between the Nereda® controller and the PLC should fail, it switches to an adjustable Interim Recipe that is programmed into the PLC.

9.2 FEED PHASE

In this phase, the reactor is fed via the Influent Feed Pump(s). The switching and control of the pump(s) has been described under the process section "Influent Feed". The feed phase controls feed valve and Influent Feed Pumps.

Phase Parameters

Feed Flow Setpoint [1,895 m^3/hr]

Start logic

Open feed valve

Start Influent Feed Pump(s)

RUN logic

There is no active RUN logic. The pump(s) will be operated on the flow setpoint parameter from the Nereda® Controller.

Stop logic

Stop Influent Feed Pump(s)

Close feed valve

Operating conditions

1. Influent Valve is available

2. Sludge Waste Valve is available OR closed
3. Water Level Correction Valve is available OR closed
4. No High High level (feed) in the reactor
5. Level measurement available
6. Air flow reactor below an adjustable level AND Reactor Aeration Valve closed
7. Spare

…

16. Spare

9.3 PHASE LOWER LEVEL

The lower level phase controls Water Level Correction Valve and Sludge Decanter Vent Valve. The water from the level correction will be discharged back to the head of the plant via the plant drain.

Parameters

None

Start logic

Open Sludge Decanter Vent Valve.

Wait for an adjustable time.

Open Water Level Correction Valve.

RUN logic

None

Stop logic

Close Water Level Correction Valve.

Close Sludge Decanter Vent Valve.

Operating conditions

1. Water Level Correction Valve is available
2. Sludge Decanter Vent Valve is available or open.
3. Sludge Waste Valve is closed.
4. spare
   …
16. spare

9.4 PHASE AERATE

During the aeration phase, air is brought into the reactor. The desired air flow (0 – 3,488 Nm^3/h) is specified by means of a parameter from the Nereda® Controller. In the PLC this air flow must be translated into activation and control of the aeration system. The aeration system consists of a combination of blowers and aeration modulating control valves.

By means of aeration, the sludge discharge internal can be filled with air to create an airlock. This is indicated by a separate parameter from the Nereda® Controller. The Sludge Decanter Fill Valve must be opened when this parameter from the Nereda® Controller is active and closed when the parameter is not active. In addition, the sludge discharge internal can be vented (before end of aeration). This is indicated by another separate parameter from the Nereda® Controller.

Parameters

Aeration flow setpoint [0 – 3,488 Nm^3/h].

Sludge Decanter Fill Valve open [0/1].

Sludge Decanter Vent Valve open [0/1].

Start logic

Open Aeration Valve at minimum position [0-100%].

RUN logic

Control of Aeration Valve on flow setpoint from the Nereda® Controller.

Stop logic

Close Aeration Valve.

Operating conditions

1. Aeration Valve is available.
2. Sludge Decanter Fill Valve is available.
3. Sludge Decanter Vent Valve is available
4. Sludge Decanter Vent Valve is closed OR Sludge Decanter Fill Valve is closed
5. Reactor Sludge Waste Valve is closed.
6. Water Level Correction Valve is closed.
7. NOT (High level (aeration) in reactor and phase ‘aerate’ NOT (‘starting’ or ‘RUN’ or ‘stopping’))
8. Level measurement available.
9. Spare
   …
16. Spare

9.5 PHASE CHEMICALS

The chemicals phase is used to dose alum into the effluent channels of each reactor. Chemical Feed Pumps will pump the alum, and Chemical Feed Valves will direct it to each reactor.

Parameters

None (Alum dosing flow setpoint to be set at the local panel for the Chemical Feed Pumps)

Start logic

Open Chemical Feed Valve

Start Chemical Feed Pump

RUN logic

None

Stop logic

Stop Chemical Feed Pump

Close Chemical Feed Valve

Operating conditions

1. Chemical Feed Valve is available and Chemical Feed Valves for other reactors are closed.
2. Chemicals Phase not active for another reactor.
3. No error from the Chemical Feed Pumps.
4. Spare
   …
16. spare

9.6 PHASE WAIT

Parameters

None

Start logic

None

RUN logic

None

Stop logic

None

Operating conditions

1. Spare
   …
16. Spare

9.7 PHASE SLUDGE DISCHARGE

The sludge discharge phase controls the Reactor Sludge Discharge Valve and Sludge Decanter Vent Valve.

The amount of discharged sludge is monitored by measuring the level difference in the reactor during the state 'RUN'. If the level difference is lower than an adjustable value, an alarm is generated.

Parameters

None

Start logic

Open Sludge Decanter Vent Valve.

Wait for an adjustable time.

Open Sludge Discharge Valve.

RUN logic

None

Stop logic

Close Sludge Discharge Valve.

Close Sludge Decanter Vent Valve.

Operating conditions

1. Sludge Discharge Valve is available and Sludge Discharge Valves for other reactors are closed
2. Water Level Correction Valve is closed.
3. Sludge Decanter Vent Valve is available or open.
4. Phase 'feed' sludge buffer NOT aborted and NOT interlocked (for at least 1 sludge buffer)
5. Air flow reactor below an adjustable level AND Reactor Aeration Valve closed
6. Spare
   …
16. spare

9.8 SPECIFICATION SHEETS

Valves Reactor

Settings - SCADA/HMI

- Hand-off-auto
- Open / Close

Automation
Automatic
In automatic mode, the valves must be operated as described in the various equipment phases.

Manual
In manual control the operator can issue the following commands:

- Open
- Close

Interlocks

- Check on feedback failure (valve opening / closing)
- Electric circuit failure

Presentation

- State (automatic/ manual/ field control)
- Opened (read back open is true)
- Closed (read back close is true)
- Failure

Dry solids measurement reactor
HMI/SCADA

- Dry solids (mg/l)

Switch Points	Action	Ad	Pv	Al	Alarm number
Failure measurement				X	#111

Temperature measurement reactor
HMI/SCADA

- Temperature (ºC)

Switch Points	Action	Ad	Pv	Al	Alarm number
H		X			
Failure measurement				X	#118

DO measurement reactor

HMI/SCADA

- O2 concentration (mg/l)

Switch Points	Action	Ad	Pv	Al	Alarm number
Failure measurement	Action is taken by Nereda Controller, no action from PLC required.			X	#114

ORP measurement reactor

HMI/SCADA

- ORP (mV)

Switch Points	Action	Ad	Pv	Al	Alarm number
Failure measurement	Action is taken by Nereda Controller, no action from PLC required.			X	#121

Level measurement reactor

HMI/SCADA

- Level (m)

Switch Points	Action	Ad	Pv	Al	Alarm number
HH	Abort/interlock Feed Phase -> operation conditions not met	X			
H	Interlock Aerate Phase reactor -> operation conditions not met	X		X	#100
LL		X		X	#101
L1 start aeration	Stop Lower Level Phase reactor during Interim Mode	X			
L2 sludge discharge	Stop Sludge Discharge phase reactor during Interim Mode	X			
Level difference sludge discharge	Monitoring the amount of discharged sludge during Sludge Discharge Phase	X		X	#102
Failure measurement	Action is taken by Nereda Controller, no action from PLC required.			X	

NH4 measurement reactor

HMI/SCADA

- NH4 concentration (mg/l)

Switch Points	Action	Ad	Pv	Al	Alarm number
H	High ammonium alarm only enabled during Feed Phase	X		X	#106
Failure measurement	Action is taken by Nereda Controller, no action from PLC required.			X	#107

PO4 measurement reactor

HMI/SCADA

- PO4 concentration (mg/l)

Switch Points	Action	Ad	Pv	Al	Alarm number
Failure measurement	Action is taken by Nereda Controller, no action from PLC required.			X	#125

pH measurement reactor

HMI/SCADA

- pH (-)

Switch Points	Action	Ad	Pv	Al	Alarm number
L		X		X	#116
H		X		X	#115
Failure measurement				X	#117

Water detection sludge decant reactor

HMI/SCADA

- Level / pressure switch point

Switch Points	Action	Ad	Pv	Al	Alarm number
L	*Pressure measurement:* Water detection alarm only enabled during ‘Aeration’ phase, after an adjustable time (0-30 min)	X		X	#154
Failure measurement					

10.0 BLOWER SECTION

10.1 INTRODUCTION

The common header aeration system supplies process air to the AquaNereda® reactors. The air flow to each AquaNereda® reactor is controlled by an air flow modulating control valve.

For the aeration of the AquaNereda® reactors, four (4) frequency-controlled blowers are installed. The blower configuration is three (3) duty + one (1) standby, therefore the configuration is limited to a maximum of three (3) blowers in simultaneous operation.

The number of blowers in operation and the capacity of these blowers is controlled based on the total air demand of all reactors, determined by summation of the of air flow setpoints for all reactors.

Note that the PLC-system must ensure that the blowers and valves are switched correctly during states 'starting' and 'RUN' of the aeration phase.

10.2 AUTOMATION

The blower system includes the following components:

- Blowers
- Air flow control valves

The aeration phase of each reactor provides a START command, STOP command and an air flow setpoint. The control valve must be controlled so that the air flow to the reactor is within 5% of the setpoint, where 100% is the design capacity of the air flow.

*Please note that this is **not** the same type of control as a frequently applied system based on oxygen demand (feedback control principle). The AquaNereda system determines the air demand based on different control modes and various parameters such as the NH_4, NO_3, Redox and O_2-measurements in the reactors.*

Insufficient air capacity
If the header pressure drops below an adjustable LL-switchpoint for an adjustable time (min) during the phase 'aeration', then an alarm signal 'insufficient air capacity' must be set.

Pressure measurement
If the header pressure exceeds an adjustable H-switchpoint for an adjustable time (min), then an alarm signal 'header pressure high' is set. When header pressure exceeds an adjustable HH-switchpoint for an adjustable time then an alarm signal 'header pressure too high – blowers off' is set and the blowers are switched off.

10.3 AIR FLOW CONTROL

The air flow to each AquaNereda® reactor is controlled by a modulating control valve. To determine the actual air flow to each AquaNereda® reactor, the flow will be measured by means of an air flow measurement. This measurement will provide direct feedback of the action of the modulating control valve.

Based on the total requested air flow (summation air flow setpoints) of the reactors, the air flow to the reactors is controlled as follows:

- The air flow to each reactor is regulated by PI-control of the modulating control valve on the air flow setpoint for that reactor.
- Only for the reactor with the highest valve position (0-100%), the given air flow set point is increased with an adjustable offset:

  $F_{reactor} = F_{setpoint} + \Delta F$

The reactor with the highest air demand, i.e. highest valve position, can change during the cycle.

If the requested air flow to a reactor is not achieved at maximum open position of the control valve for an adjustable time, an alarm message "insufficient air flow" must be generated *(Note: this signal must be suppressed during stopping of the aeration phase).*

Flow measurement failure
In case of flow meter failure, the air flow will be determined by means of calculation in the PLC.

In the ideal situation, the characteristic of the control valve head loss and valve position will be linear. In that case, the air flow dictated by the air flow setpoint from the Nereda® Controller, will correspond linearly proportional to the valve position.
In case of a non-linear valve characteristic, the relation between valve position and air flow rate must be calculated in the PLC in order to get a linear relationship.

10.4 BLOWER CONTROL

The number of blowers in operation on the header will be determined by means of the overall requested air flow by the Aeration phases in STARTING/RUN. In this way extra delay due to switching on/speeding up blowers one by one after each other, is avoided. This overall request air flow is then reduced by an adjustable ΔF to reduce energy consumption, and to prevent valves closing because too much air is being pushed through. As a result of this adjustable ΔF, one of the valves will always be fully open, and may not completely reach its setpoint. The flow at which the blowers should be controlled is:

$$F_{BlowerSetpoint} = \left(\sum_{i=1}^{N_{reactors}} F_{Reactor(i)} \right) - \Delta F$$

As soon as the aeration of a reactor starts, the total air flow demand will increase by a certain percentage. Based on this total air flow demand and the blower capacity ranges it must be determined how many blowers should be in operation to be able to meet the desired total air flow demand.

If the blowers are not available, the signal 'No blowers available' must be set *(Note: this signal must be suppressed during stopping of the aeration phase).*

A typical procedure for switching blowers on/off to the header system is described below. The procedure may be changed in respect to the blower's technical specifications.

Blower switching and capacity
The number and capacity of blowers have to be determined according to setpoints below. The number of blowers has to be selected based on the total air flow requested by the reactors. There are setpoints for starting and stopping each blower, which will cause any blowers beyond the first to start or stop if requested air flow exceeds or falls below the setpoint values for a set amount of time.

Adjustable values:

- Blowers full capacity (SCFM)
- Blower min capacity (SCFM)
- Start 2nd blower (SCFM)
- Start 3rd blower (SCFM)
- Stop 3rd blower (SCFM)
- Stop 2nd blower (SCFM)

A requested airflow of 0% (or 0 SCFM) should **not** stop the blower(s). Blower(s) will remain in operation at minimum capacity as long as an aeration phase is in RUN. If a blower should be stopped due to the low aeration capacity request, the NC will stop the aeration phase.

Blower selection
Selection of the duty and standby blowers will be by means of a duty rotation program in the PLC.

10.5 SETTINGS

- Settings for blowers and air flow control
- Settings for insufficient air flow
- Insufficient air capacity

10.6 INTERLOCKS/ALARMS

- Insufficient air flow (for each reactor) *(available air flow lower than demand)*
- Insufficient air capacity *(header pressure too low)*
- No blowers available *(alarm)*

10.7 PRESENTATION

- Blowers in current configuration
- Flow to each reactor [SCFM]
- Control valve position [%] of each control valve
- Flow setpoint to the blowers (calculated)
- Header pressure [psi]

10.8 SPECFICATION SHEETS

Blowers

Settings – HMI/SCADA

- Hand-off-auto
- Start/Stop
- Air flow setpoint (Manual)
- Controller settings (gain, integration time)

Automation

Automatic

In automatic mode, the blowers are controlled as described in Section 10.2.

Manual

In manual mode, the operator can start and stop the blower. The blower must be operated at an air flow setpoint, adjustable by the operator.

Interlocks

- Thermal overload (TS)
- Electric circuit failure
- Safety switch off
- Frequency inverter failure

Presentation

- State (automatic/ manual/ field control/ safety switch)
- Started (read back start is true)
- Stopped (read back stop is true)
- Failure
- Actual blower capacity [Nm^3/h]
- Actual blower power consumption [kW]

Control valves

Settings – HMI/SCADA

- Hand-off-auto
- Open / Close
- Valve position (Manual)

Automation
Automatic
In automatic mode, the valves must be operated as described under section 10.2**Error! Reference source not found.**.
Manual
In manual mode the operator can issue the following commands:

- Open
- Close
- Stop
- Fixed valve position

Interlocks

- Check on feedback failure (valve opening / closing)
- Electric circuit failure
- Safety switch off
- Valve actuator failure

Presentation

- State (automatic/ manual/ field control)
- Valve position
- Valve opening / closing
- Opened (read back open is true)
- Closed (read back close is true)
- Failure

Flow measurement air flow reactor

HMI/SCADA

- Flow [Nm^3/h]

Switch Points	Action	Ad	Pv	Al	Alarm number
Deviation alarm		X		X	#126
Failure measurement	Air flow will be determined by means of calculation in the PLC				

11.0 SLUDGE BUFFER

11.1 INTRODUCTION

The sludge of the sludge buffer is pumped to the digester/sludge thickener. The supernatant water is pumped to the influent buffer tank/head of the plant.

For each sludge buffer, one (1) frequency-controlled pump is installed for both sludge discharge and supernatant water discharge. The pump will operate at different speeds for sludge discharge and supernatant discharge depending on the flow setpoint from the Nereda® Controller.

In this chapter the phases, valves, instruments and equipment of sludge buffer 1 are described. The phases for sludge buffer 2 must be realized in the same way.

11.2 AUTOMATION

The sludge buffer is controlled by the Nereda® Controller. If the communication between the Nereda® controller and the PLC should fail, it switches to an adjustable Interim Recipe that is programmed into the PLC.

The pumps must be stopped if the level in the buffer is lower than an adjustable low level.

For the sludge buffer following phases are described:

- Feed
- Wait (settle)
- Sludge discharge
- Water discharge

Flow measurement failure
In case of flow meter failure, corrective actions must be taken in the PLC. The Nereda® Controller will still issue a flow setpoint to the PLC. In the PLC, the flow setpoint must be used to determine the number of pumps to be operated and the pump speed by using the theoretical pump capacity (Q-H curve table in PLC).

Sludge buffer not available
In case a sludge buffer is not available to receive sludge from the AquaNereda® reactors, the Nereda® Controller generates a warning which will be displayed on the HMI/SCADA.

11.3 PHASE FEED

In this phase, the sludge buffer is filled by means of the sludge discharge phase of the AquaNereda® reactor, described in Section 9.8. This is only the description for the start phase.

Parameters
None

Start logic
- Open Sludge Buffer Inlet Valve

RUN logic
None
Stop logic

- Close Sludge Buffer Inlet Valve

Operating conditions

1. Sludge Buffer Inlet Valve available
2. No High level in the sludge buffer
3. High High level switch not activated
4. Level measurement available
5. spare

   …

16. spare

11.4 PHASE WAIT

Parameters

None

Start logic

None

RUN logic

None

Stop logic

None

Operating conditions

2. Spare
…
Spare

11.5 PHASE SLUDGE DISCHARGE

The sludge discharge phase controls the sludge/supernatant discharge pump. The discharge pumps must be PI-controlled on the flow setpoint from the Nereda® Controller.

Parameters

- Flow setpoint 'sludge discharge' (m^3/h)

Start logic

- Open Sludge Buffer Sludge Valve
- Start Sludge Buffer Pump

RUN logic

There is no active RUN logic. The (duty) pump will be in operation continuously on the flow setpoint from the Nereda® Controller.

Stop logic

- Sludge Buffer Pump
- Close Sludge Buffer Sludge Valve

Operating conditions

1. Sludge Buffer Sludge Valve is available and Sludge Buffer Sludge Valve of the other buffer is closed
2. Sludge Buffer Pump available
3. Sludge Buffer Supernatant Valve is closed
4. spare
…
16. spare

11.6 PHASE WATER DISCHARGE

The water discharge phase controls the sludge/supernatant discharge pump. The discharge pumps must be PI-controlled on the flow setpoint from the Nereda® Controller.

Parameters

- Flow setpoint 'supernatant water discharge' (m^3/h)

Start logic

- Open Sludge Buffer Supernatant Valve
- Start Sludge Buffer Pump

RUN logic

There is no active RUN logic. The pumps will be in operation continuously on the flow setpoint from the Nereda® Controller.

Stop logic

- Stop Sludge Buffer Pump
- Close Sludge Buffer Supernatant Valve

Operating conditions

1. Sludge Buffer Supernatant Valve is available and Sludge Buffer Supernatant Valve of the other buffer is closed
2. Sludge Buffer Pump is available
3. Sludge Buffer Sludge Valve is closed
4. Level measurement available
5. spare
   …
16. spare

11.7 SPECIFICATION SHEETS

Sludge / supernatant discharge pumps
***Settings** – SCADA/HMI*

- Hand-off-auto
- Start/Stop
- Capacity setpoint (Manual)
- Controller settings (gain, integration time)
- settings Low level for dry run protection

Automation
Automatic

In automatic mode, the pumps are controlled as described in the equipment phase descriptions.

Manual

In manual mode, the operator can start and stop the pump. The pump must be operated at a capacity setpoint, adjustable by the operator.

Interlocks

- Thermal overload motor
- Electric circuit failure
- Safety switch off
- Frequency inverter failure
- LL-flow (time delayed)

Presentation

- State (automatic/ manual/ field control/ safety switch)
- Started (read back start is true)
- Stopped (read back stop is true)
- Failure
- Actual pump capacity

Valves sludge buffer
Settings – HMI/SCADA

- Hand-off-auto
- Open / Close

Automation
<u>Automatic</u>

In automatic mode, the valves must be operated as described in the various equipment phases.

<u>Manual</u>

In manual mode the operator can issue the following commands:

- Open
- Close

Interlocks

- Check on feedback failure (valve opening / closing)
- Electric circuit failure

Presentation

- State (automatic/ manual/ field control)
- Opened (read back open is true)
- Closed (read back close is true)
- Failure

Level measurement sludge buffer
HMI/SCADA
Level (ft)

Switch Points	Action	Ad	Pv	Al	Alarm number
H	Abort/interlock Feed Phase sludge buffer -> operation conditions not met	X		X	#600
L	Stop sludge / water discharge pumps	X		X	#601
Failure measurement	Abort/interlock Feed Phase sludge buffer -> operation conditions note met			X	#602

TSS measurement discharged sludge/supernatant
HMI/SCADA
TSS concentration (mg/l)

Switch Points	Action	Ad	Pv	Al	Alarm number
H		X		X	#603
Failure measurement				X	#604

Flow measurement discharged sludge/supernatant
HMI/SCADA
Flow (m^3/h)

Switch Points	Action	Ad	Pv	Al	Alarm number
H		X			
L	Stop sludge/water discharge pump(s)	X		X	#615
Deviation Alarm		X		X	#616
Failure measurement					

12.0 EFFLUENT/POST-EQUALIZATION

12.1 INTRODUCTION

The effluent from the AquaNereda® reactors is collected in the effluent gutter and drained to the post-equalization tank. The primary function of the Post-Equalization basin (Post-Eq) is to reduce the rate of flow to the downstream equipment. The decant flow is sent to the Post-Eq and then sent forward to the downstream equipment with a modulating Effluent Control Valve. This allows a more stable, consistent flow to be fed to the downstream equipment over a longer duration of time; which allows this equipment to be sized for a flow less than the actual decant flow from the AGS reactors.

12.2 AUTOMATION

The Post-EQ is controlled by the PLC. Post-EQ equipment is interlocked with the level. The level setpoints for the Post-Eq are listed in the table below.

L_3	High Alarm	Go to Maximum Allowable Valve Open Position
L_2	Valve Open	Effluent Control Valve in Flow Control
L_1	All Off	Close Valve completely

The level setpoints are verified to prevent invalid entries.
$L_3 > L_2 > L_1$

TYPICAL OPERATION

The primary function of the Effluent Control Valve is to smooth out the flow from the Post-Eq Basin. The effluent valve allows a more stable, consistent flow to be fed to the post treatment equipment.

At the beginning of any AGS decant, the batch size of the decanting AGS is calculated. This batch volume is used to determine the effluent flow setpoint (with a 10% buffer added). This calculation is only done once per AGS decant.

NOTICE

If the level transducer of the decanting AGS is failed, the PLC assumes the AGS has a full batch.

To control the valve, a flow PID loop is used in conjunction with a 5-point linear curve (for valve characterization). After the initial batch size is determined, the valve position is determined on the 5-point curve relative to the calculated flow setpoint. This initial valve position is fed into the flow PID loop as a feed-forward value (or starting point). The flow PID loop is then used to control the valve for the remaining decant.

The position of the valve is regulated by a Proportional-Integral-Derivate (PID) loop in the control system PLC. The PID loop monitors the effluent flow and adjusts the valve position to keep the flow within range of the calculated setpoint. If the effluent flow falls below the setpoint, the valve will be opened further. If the effluent flow rises above the setpoint, the valve will close further.

Every five minutes (during a decant), the remaining AGS plus Post-Eq combined batch size is recalculated and a new flow setpoint is determined (with a 10% buffer added).

If the flow meter fails, the valve will open to the Maximum Allowable Valve Opening.

The PID loop used for effluent flow control will need to be "tuned" to provide accurate control. There are three tuning parameters for any PID loop. For this application, the Rate term is lock at zero to disable it.

- Gain (Proportional)
- Reset (Integral)
- Rate (Derivative)

These parameters are typically setup to match the site operating conditions and do not need to be adjusted on a regular basis.

NOTICE

The 5-point curve represents the characteristics of the valve, and does not change based on the batch size. Each of the five points matches a valve open position (%) with a flow (m^3/h). These five points need to be determined on the actual equipment, and then entered on the HMI.

LEVEL TRANSDUCER FAILURE

If the level sensor fails, the Post-Eq will assume a high level when calculating the batch size.

12.3 SPECIFICATION SHEETS

Post-EQ Flow Control valve

Settings – HMI/SCADA

- Hand-off-auto
- Open / Close
- Valve position (Manual)

Automation

Automatic

In automatic mode, the valves must be operated as described under section 12.2**Error! Reference source not found.**.

Manual

In manual mode the operator can issue the following commands:

- Open
- Close
- Stop
- Fixed valve position

Interlocks

- Check on feedback failure (valve opening / closing)
- Electric circuit failure
- Safety switch off
- Valve actuator failure

Presentation

- State (automatic/ manual/ field control)
- Valve position
- Valve opening / closing
- Opened (read back open is true)
- Closed (read back close is true)
- Failure

Level measurement effluent

HMI/SCADA

Level [ft]

Switch Points	Action	Ad	Pv	Al	Alarm number
H				X	#1601
Failure measurement				X	#1602

Flow measurement effluent

HMI/SCADA
Flow (m^3/h)

Switch Points	Action	Ad	Pv	Al	Alarm number
Deviation Alarm		X		X	#1603
Failure measurement					

13.0 INTERIM RECIPE

13.1 INTRODUCTION

The Interim Recipe is a safeguard located in and controlled by the PLC that is to be used in exceptional cases. This comprises of a series of equipment phases which are carried out sequentially on phase time basis.

13.2 CONFINGURATION

The commands that are sent to the phases by the Interim Recipe have to be handled in the same way as the commands given from the Nereda® Controller.

In the Interim Recipe only one phase can be active at a time. The next phase may only be started when the previous one is completed (READY / INTERLOCKED).

13.3 INTERIM SCHEDULER REACTORS

An Interim Recipe for a reactor must be started when:

- The operation mode for the Nereda® Controller is switched via the PLC to 'Interim' (automatically in case of communication failure or manually by operator),
- AND the Interim Recipe for the reactor is set to ‘On' (only possible if no phase Aborted).

Before the Interim Recipes for the AquaNereda® reactors are started for the first time, an adjustable start-up delay time (minutes) must have elapsed. After expiration of the delay time, all the reactors are in an order determined by the previous feed phases. The Nereda® Controller also takes into account the actual feed-status of the reactors during interim mode while scheduling the first reactor to feed after switching from ‘interim’ to ‘auto’ mode.
Therefore, the PLC must keep track of the last feed phase of each reactor (MinutesSinceLastFeed signal). Based on this time it will determine a reactor number for the first, second, third, etc. reactor to start the Interim Recipe). The reactor fed the longest time ago has to start as the first reactor.

The first reactor of a treatment line starts its Interim Recipe with the feed phase and a cycle time of $CT_{reactor\ actual}$. The second reactor (of the same line) starts feeding $CT_{reactor\ actual}/N_{available\ reactors}$ minutes after the previous reactor has started feeding.

Before feeding, the second reactor starts its interim recipe in step 3. It starts at the same time as the first reactor and follows the regular Interim Recipe steps according to the procedure prescribed in the table below. Since the second reactor should be ready to feed after $CT_{reactor\ actual}/N_{available\ reactors}$ minutes, the aerate time will be reduced to:

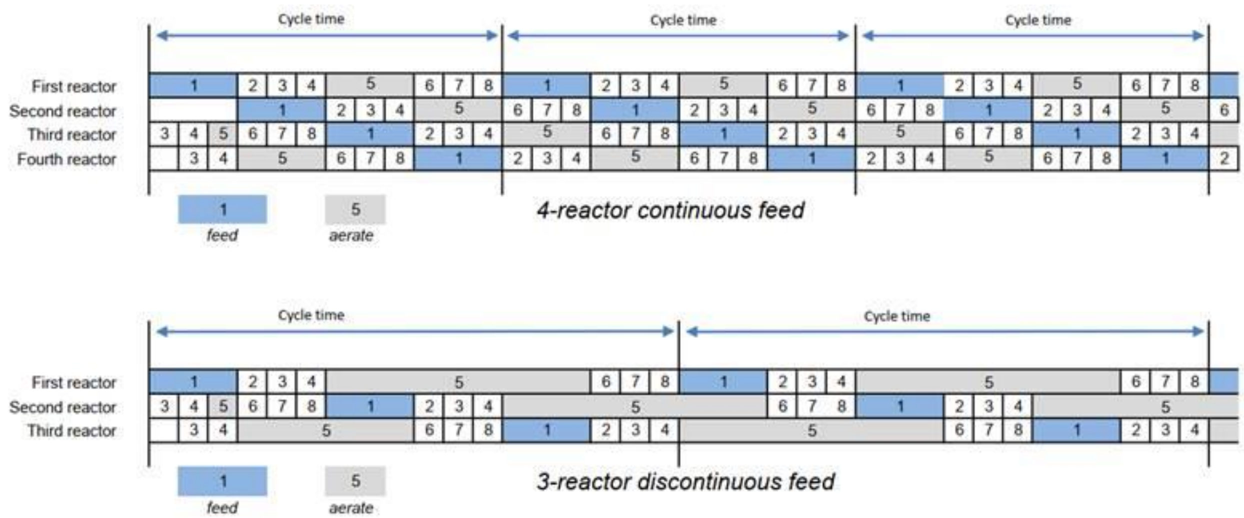
$$\frac{CT_{reactor\ actual}}{N_{available\ reactors}} - T_{step\ 3} - T_{step\ 4} - T_{step\ 6} - T_{step\ 7} - T_{step\ 8} \text{ minutes}$$

If the calculated aeration time is less than 15 minutes, the reactor should not start but wait for its ‘feed’ time to become active.

Consequently, reactor i in a treatment line of more than two reactors also starts its interim recipe in step 3. However, it has to wait for $(i-2) \times T_{step\ 3}$ minutes before starting, since only 1 reactor can be in step 3 at the same time. Since reactor i should be ready to feed after $(i-1) \times CT_{reactor\ actual}/N_{available\ reactors}$ minutes, the aerate time will be adjusted to:

$$\frac{(i-1) \times CT_{reactor\ actual}}{N_{available\ reactors}} - (i-1) \times T_{step\ 3} - T_{step\ 4} - T_{step\ 6} - T_{step\ 7} - T_{step\ 8} \text{ minutes}$$

By way of illustration, the diagram below shows the Interim Recipe scheduling for a 4-reactor continuous feed and a 3-reactor discontinuous feed configuration.



Interim Recipe scheduling 4-reactor continuous and 3-reactor discontinuous feed

Note: if there are two lines, the same procedure described above is applied to line 2. The first reactor of line 2 starts feeding $CT_{reactor\ actual}/(2 \times N_{available\ reactors})$ after the first reactor of line 1 has started feeding.

If during the Interim Recipe an active phase, with the exception of the phase Sludge discharge, reaches the Aborted state, or if the phase which has to be started is not ready, the corresponding reactor must be stopped and switched out of interim control mode by the PLC (aborting the Interim Recipe for this reactor, i.e. interim mode set to 'Off'). After solving the problem, the operator can reset the phase, they can also switch the reactor back into interim mode.

Reactor cycle time

The reactors must be operated with a pre-set adjustable nominal cycle time which is the same for all reactors. The actual cycle time ($CT_{reactor\ actual}$) for a reactor depends on the number of available reactors:

$$CT_{reactor\ actual} = \frac{N_{available\ reactors}}{N_{total\ reactors}} \times CT_{nominal} \quad \text{[min]}$$

With $N_{available\ reactors}$= number of reactors with interim mode set to 'on' ($with\ N_{available\ reactors} \geq 2$)

To synchronize the reactors mutually, the next available reactor starts feeding $CT_{reactor\ actual}/N_{available\ reactors}$ minutes after the previous reactor started feeding.

Influent buffer
With an influent buffer available, the phase times for each phase must be calculated as follows:

- All phases except *aerate*: fixed, adjustable time.
- *Aerate:* cycle time minus phase times of all other phases.

When the number of available reactors changes during operation, the interval time must be recalculated immediately. With *N-1* (N≥2) available reactors, the actual cycle time of remaining available reactors is thereby shortened, the actual phase time of all equipment phases except phase 'aerate' remain the same.

13.4 INTERIM RECIPE AQUANEREDA® REACTOR

An Interim Recipe for the AquaNereda® reactor can consist of the following steps (*values to be determined during start-up):*

Interim Recipe AquaNereda® Reactor

Step	Active Phase	Duration / Capacity (adjustable via HMI/SCADA)
1	Feed	0-1895 m^3/h 0-60 minutes (OR stop on Low Level influent buffer)
2	Wait	0-60 minutes
3	Sludge Discharge**	0-30 minutes (OR stop on Reactor level <= L1)
4	Lower Level	0-15 minutes (OR stop on Reactor level <= L1)
5	Aerate	0-10 minute air fill time airlock sludge decant 0-100% aeration capacity (variable calculated phase time*)
6	Wait	0-60 minutes
7	Sludge discharge	0-30 minutes (OR stop on Reactor level <= L2)
8	Wait	0-60 minutes

Pre-set nominal cycle time: $CT_{nominal}$: 30-360 minutes
* Calculated Aerate Phase time = cycle time – SUM (phase times 1-4, 6-8)
** If the recipe has had a sludge discharge in Step 4, it should skip the sludge discharge in Step 7

During the feed phase, once the level in the influent buffer has reached an adjustable Low level, or when an adjustable feed time has elapsed, the feed phase of the reactor must stop.

Before aeration, the level in the reactor must be lowered to an adjustable value L1.

The phase time of all equipment phases in the recipe must be adjustable per step, except for step 5: Aerate phase. The phase time for the aerate phase must be calculated as the nominal cycle time minus the sum of the other phases. Note that this must be a continuous calculation as the feed phase, lower level phase and the sludge discharge phase do not stop solely based on time.

A reactor can only discharge sludge when a sludge buffer is available. When no sludge buffer is available the sludge discharge phase in the recipe must be skipped.

13.5 INTERIM SCHEDULER SLUDGE BUFFERS

If a reactor wants to discharge sludge, an available sludge buffer must be selected. A sludge buffer is available when:

- Interim Action = On
- No recipe running on the sludge buffer
- All phases are Ready

For the selected sludge buffer the Interim Recipe must be started.

13.6 INTERIM RECIPE SLUDGE BUFFER

The Interim Recipe for the sludge buffer has to be activated simultaneously with the sludge discharge phase of the AquaNereda® reactor.

An Interim Recipe for the Sludge buffer can consist of the following steps:

Interim Recipe Sludge Buffers

Step	Active Phase	Duration / Capacity (adjustable via HMI/SCADA)
1	Feed	0-30 minutes
2	Wait	0-30 minutes
3	Sludge Discharge	0-30 minutes 0-23 m^3/h
4	Water Discharge	0-30 minutes 0-92 m^3/h

If an active phase reaches the Aborted state, the Interim Recipe for this sludge buffer must be aborted.

13.7 SETTINGS

On the HMI/SCADA the operator must be able to adjust the following parameters for the Interim Recipe:

- Interim Recipe start-up delay time
- AquaNereda® reactor cycle time

14.0 COAGULANT FEED

14.1 INTRODUCTION

Coagulants such as Alum, Ferric, or Polyaluminum Chloride (PACL) can be added to the system to help remove chemically reactive phosphorus. The coagulant can be fed into the AGS reactors. Coagulant feed pumps are provided by others, and there will be one chemical feed valve at each reactor for a total of three.

14.2 AUTOMATION

The coagulant feed valves to each reactor are controlled by the Nereda® Controller during the Chemical Phase as described in Section 9.6. The dosing rate for the chemical pumps will be set locally at the pump, and chemical dosing will be based on time and/or a signal from the reactor's phosphate analyzer.

14.3 SPECIFICATION SHEETS

Chemical Valves Reactor
Settings - SCADA/HMI

- Hand-off-auto
- Open / Close

Automation
Automatic

In automatic mode, the valves must be operated as described in Section 9.6.

Manual

In manual control the operator can issue the following commands:

- Open
- Close

Interlocks

- Check on feedback failure (valve opening / closing)
- Electric circuit failure

Presentation

- State (automatic/ manual/ field control)
- Opened (read back open is true)
- Closed (read back close is true)
- Failure

APPENDIX 1 - SYSTEM SETPOINTS

Security levels are accumulative. The "Operator" has access to only the Operator setpoints. The "Supervisor" has access to the Operator and Supervisor setpoints. The "Engineer" and "AASI" accounts have access to all setpoints.

Description	Default	Units	Min	Max	Security
AGS – Aeration					
Maximum Air Flow Rate Per Basin	3488	Nm^3/h	1.0	10000.0	Supervisor
D.O. High Limit	2.5	mg/L	0.1	5.0	Supervisor
D.O. Low Limit	0.5	mg/L	0.1	5.0	Supervisor
Initial Delay	5.0	Minutes	1.0	10.0	Supervisor
High Air Flow	--	Nm^3/h	0.1	4000.0	Supervisor
Low Air Flow	--	Nm^3/h	0.1	4000.0	Supervisor
AGS – Instrumentation					
High Ammonia	20.0	mg/L	0.01	20.0	Supervisor
High MLSS	10000	mg/L	50	20000	Supervisor
High Nitrate	10.00	mg/L	0.01	20.0	Supervisor
High Reactor pH	8.5		4.00	13.00	Supervisor
Low Reactor pH	6.5		4.00	13.00	Supervisor
High Temperature	35	Deg C	0.00	50.00	Supervisor
High Phosphorus	10.0	mg/L	0.01	20.0	Supervisor
High Redox	400	mV	-750	750	Supervisor
Low Redox	-400	mV	-750	750	Supervisor
High High Level (feed interlock)	7.0	m	0	25	Supervisor
High Level (aerate interlock)	6.45	m	0	25	Supervisor
Low Level	4.2	m	0	25	Supervisor
Sludge Discharge Level Difference	0.2	m	0	5	Supervisor
Sludge Buffer – Process Variables					
High Level	4.72	m	1.00	23.00	Supervisor
Low Level	0.15	m	0	10.0	Supervisor
Sludge Flow High	105	m^3/h	0	500	Supervisor
Sludge Flow Low	15	m^3/h	0	500	Supervisor
End Phase Level	0.3	m	0	16	Supervisor

- Each AGS has independent setpoints

Description	Default	Units	Min	Max	Security
AGS – Interim Recipes					
Cycle Times					
Feed Phase	60	Minutes	5.0	500.0	Supervisor
Lower Level Phase	10.0	Minutes	5.0	500.0	Supervisor
Air Seal Phase	3.0	Minutes	5.0	500.0	Supervisor
Aeration	175.0	Minutes	5.0	500.0	Supervisor
Settle Phase	12.0	Minutes	5.0	500.0	Supervisor
Sludge Wasting	0.0	Minutes	5.0	500.0	Supervisor
Phase Time	10.0	Minutes	1.0	20.0	Supervisor
AGS Stop Level Correct Level	6.25	m	2.00	30.00	Supervisor
AGS Stop Sludge Discharge Level	6.05	m	0.50	30.00	Supervisor
Sludge Buffer – Interim Recipes					
High Level	4.72	m	1.00	23.00	Supervisor
Feed Phase	10	Minutes	0	900	Supervisor
Initial Settling	15	Minutes	0	900	Supervisor
Sludge Pumping	69	Minutes	0	900	Supervisor
Supernatant Pumping	55	Minutes	0	900	Supervisor
Total Cycle Time	149	Minutes	0	900	Supervisor
Sludge Discharge Flow	23	m^3/h	0	200	Supervisor
Supernatant Discharge Flow	92	m^3/h	0	400	Supervisor
End Phase Level	0.3	m	0	16	Supervisor
System Setup – Instrumentation					
AGS Level Enable?	Yes	- -	- -	- -	Engineer
- Offset	6.05	m	0.00	3.00	Engineer
- Span	7.35	m	2.00	35.00	Engineer
AGS Air Flow Enable?	Yes	- -	- -	- -	Engineer
- Offset	0.0	Nm^3/h	-10.0	10.0	Engineer
- Span	4000	Nm^3/h	2.0	7000.0	Engineer
AGS Ammonia Enable?	Yes	- -	- -	- -	Engineer
AGS Dissolved Oxygen Enable?	Yes	- -	- -	- -	Engineer
AGS pH Enable?	Yes	- -	- -	- -	Engineer
AGS Ammonia Enable?	Yes	--	--	--	Engineer
AGS Phosphorus Enable?	Yes	- -	- -	- -	Engineer
AGS Redox Enable?	Yes	- -	- -	- -	Engineer
AGS Temperature Enable?	Yes	- -	- -	- -	Engineer
AGS Reactor TSS Enable?	Yes	- -	- -	- -	Engineer
AGS Effluent TSS Enable?	Yes	--	--	--	Engineer
Sludge Buffer Level Enable?	Yes	- -	- -	- -	Engineer
- Offset	.23	m	0.00	3.00	Engineer
- Span	7.04	m	2.00	35.00	Engineer
Sludge Buffer Flow Enable?	Yes	- -	- -	- -	Engineer
- Offset	0	m^3/h	0.00	3.00	Engineer
- Span	110	m^3/h	2.00	300	Engineer
Sludge Buffer TSS Enable?	Yes	--	--	--	Engineer

Description	Default	Units	Min	Max	Security
Nereda Controller					
Run Interim if Communication is Lost	Yes	- -	- -	- -	Engineer
Loss of Communication Delay	4.0	Minutes	1.0	15.0	Engineer
Restart Delay after power loss, comm loss	2.0	Minutes	5.0	30.0	Engineer
System Setup – Valve Stroke Times					
AGS Influent Valve	15	Seconds	3	300	Engineer
AGS Sludge Discharge Valve	15	Seconds	3	300	Engineer
AGS Water Level Correction Valve	15	Seconds	3	300	Engineer
AGS Air Valve	15	Seconds	3	300	Engineer
AGS Air Fill Valve	15	Seconds	3	300	Engineer
AGS Air Vent Valve	15	Seconds	3	300	Engineer
Sludge Buffer Feed Valve	15	Seconds	3	300	Engineer
Sludge Buffer Sludge Discharge Valve	15	Seconds	3	300	Engineer
Sludge Buffer Water Discharge Valve	15	Seconds	3	300	Engineer
Influent Buffer					
Basin Level					
Level High	5.49	m	1.00	50.00	Operator
Level Low	0.61	M	0.5	50.00	Operator
Reactor Flow					
Reactor Flow High	2000	m^3/h	0	3000	Operator
Reactor Flow Low	840	m^3/h	0	3000	Operator

Description	Default	Units	Min	Max	Security
Post-Equalization Setup					
Basin Level					
High Alarm (Go to Maximum Allowable Valve Open Position)	2.74	m	0.2	50.00	Operator
Full On (Effluent Valve in Flow Control)	0.76	m	0.2	50.00	Operator
All Off (Close Valve completely)	0.46	M	0.2	50.00	Operator
Post-Eq Effluent Valve Setup					
Effluent Flow PID Loop (for Valve)					
Local Setpoint	1356	m^3/h	50	2000	Supervisor
Manual Output	- -	%	0	100	Supervisor
Controller Gain (Proportional)	35	(*100)	1	32767	Engineer
Reset (Integral)	80	Min/rpt (*100)	1	32767	Engineer
Deadband	25	m^3/h	0	200	Engineer
Output Upper Limit	100	%	10	100	Engineer
Output Lower Limit	0	%	0	100	Engineer
Feed Forward Output	- -	%	0	100	Engineer
Feed Forward Duration	120	Seconds	1	600	Engineer
Coagulant Feed Setup					
Reactor Mode					
AGS #1 Feed Time	15.0	Minutes	0.0	90.0	Operator
AGS #1 Feed Offset Time	5.0	Minutes	0.0	90.0	Operator
AGS #2 Feed Time	15.0	Minutes	0.0	90.0	Operator
AGS #2 Feed Offset Time	5.0	Minutes	0.0	90.0	Operator
AGS #3 Feed Time	15.0	Minutes	0.0	90.0	Operator
AGS #3 Feed Offset Time	5.0	Minutes	0.0	90.0	Operator

Description	Default	Units	Min	Max	Security
Operator Setup					
Real Time Clock - Day	n/a	n/a	1	31	Operator
Real Time Clock - Hour	n/a	n/a	0	23	Operator
Real Time Clock - Minute	n/a	n/a	0	59	Operator
Real Time Clock - Month	n/a	n/a	1	12	Operator
Real Time Clock - Second	n/a	n/a	0	59	Operator
Real Time Clock - Year	n/a	n/a	2012	2099	Operator

System Setup - Analog Scaling					
AGS #1 Level Enabled	Yes	- -	- -	- -	Engineer
AGS #1 Level Offset	5.53	m	0.00	14.00	Engineer
AGS #1 Level Span	7.03	m	2.00	40.00	Engineer
AGS #1 Dissolved Oxygen Enabled	Yes	- -	- -	- -	Engineer
AGS #1 Dissolved Oxygen Offset	0.0	mg/l	0.0	2.0	Engineer
AGS #1 Dissolved Oxygen Span	10.0	mg/l	2.0	20.0	Engineer
AGS #1 TSS Enabled	Yes	- -	- -	- -	Engineer
AGS #1 TSS Offset	0	mg/l	0	100	Engineer
AGS #1 TSS Span	10000	mg/l	50	30000	Engineer
AGS #1 ORP Enabled	Yes	- -	- -	- -	Engineer
AGS #1 ORP Offset	-300	- -	-1000	1000	Engineer
AGS #1 ORP Span	600	- -	100	5000	Engineer
AGS #1 pH Enabled	Yes	- -	- -	- -	Engineer
AGS #1 pH Offset	0.0	- -	0.0	10.0	Engineer
AGS #1 pH Span	14.0	- -	2.0	14.0	Engineer
AGS #1 Temperature Enabled	Yes	- -	- -	- -	Engineer
AGS #1 Temperature Offset	-50	Deg C	-100	100	Engineer
AGS #1 Temperature Span	82	Deg C	10	200	Engineer
AGS #1 Ammonium Enabled	Yes	- -	- -	- -	Engineer
AGS #1 Ammonium Offset	0.0	mg/l	0.0	2.0	Engineer
AGS #1 Ammonium Span	40.0	mg/l	0.5	60.0	Engineer
AGS #1 Phosphorus Enabled	Yes	- -	- -	- -	Engineer
AGS #1 Phosphorus Offset	0.0	mg/l	0	100	Engineer
AGS #1 Phosphorus Span	20.0	mg/l	0.5	40.0	Engineer

Description	Default	Units	Min	Max	Security
System Setup - Analog Scaling (continued)					
AGS #2 Level Enabled	Yes	- -	- -	- -	Engineer
AGS #2 Level Offset	5.53	m	0.00	14.00	Engineer
AGS #2 Level Span	7.03	m	2.00	40.00	Engineer
AGS #2 Dissolved Oxygen Enabled	Yes	- -	- -	- -	Engineer
AGS #2 Dissolved Oxygen Offset	0.0	mg/l	0.00	2.00	Engineer
AGS #2 Dissolved Oxygen Span	10.0	mg/l	2.00	20.00	Engineer
AGS #2 TSS Enabled	Yes	- -	- -	- -	Engineer
AGS #2 TSS Offset	0	mg/l	0	100	Engineer
AGS #2 TSS Span	10000	mg/l	50	30000	Engineer
AGS #2 ORP Enabled	Yes	- -	- -	- -	Engineer
AGS #2 ORP Offset	-300	- -	-1000	1000	Engineer
AGS #2 ORP Span	600	- -	100	5000	Engineer
AGS #2 pH Enabled	Yes	- -	- -	- -	Engineer
AGS #2 pH Offset	0.0	- -	0.0	10.0	Engineer
AGS #2 pH Span	14.0	- -	2.0	14.0	Engineer
AGS #2 Temperature Enabled	Yes	- -	- -	- -	Engineer
AGS #2 Temperature Offset	-50	Deg C	-100	100	Engineer
AGS #2 Temperature Span	82	Deg C	10	300	Engineer
AGS #2 Phosphorus Enabled	Yes	- -	- -	- -	Engineer
AGS #2 Phosphorus Offset	0.0	mg/l	0	100	Engineer
AGS #2 Phosphorus Span	20.0	mg/l	0.5	40.0	Engineer
AGS #2 Ammonium Enabled	Yes	- -	- -	- -	Engineer
AGS #2 Ammonium Offset	0.0	mg/l	0.0	2.0	Engineer
AGS #2 Ammonium Span	40.0	mg/l	0.5	60.0	Engineer
IB #1 Level Enabled	Yes	- -	- -	- -	Engineer
IB #1 Level Offset	0.71	m	0.00	14.00	Engineer
IB #1 Level Span	7.03	m	2.00	40.00	Engineer
IB #2 Level Enabled	Yes	- -	- -	- -	Engineer
IB #2 Level Offset	0.71	m	0.00	14.00	Engineer
IB #2 Level Span	7.03	m	2.00	40.00	Engineer

Description	Default	Units	Min	Max	Security
System Setup - Analog Scaling (continued)					
AGS #3 Level Enabled	Yes	- -	- -	- -	Engineer
AGS #3 Level Offset	5.53	m	0.00	24.00	Engineer
AGS #3 Level Span	7.03	m	2.00	40.00	Engineer
AGS #3 Dissolved Oxygen Enabled	Yes	- -	- -	- -	Engineer
AGS #3 Dissolved Oxygen Offset	0.0	mg/l	0.00	2.00	Engineer
AGS #3 Dissolved Oxygen Span	10.0	mg/l	2.00	20.00	Engineer
AGS #3 TSS Enabled	Yes	- -	- -	- -	Engineer
AGS #3 TSS Offset	0	mg/l	0	100	Engineer
AGS #3 TSS Span	10000	mg/l	50	30000	Engineer
AGS #3 ORP Enabled	Yes	- -	- -	- -	Engineer
AGS #3 ORP Offset	-300	- -	-1000	1000	Engineer
AGS #3 ORP Span	600	- -	100	5000	Engineer
AGS #3 pH Enabled	Yes	- -	- -	- -	Engineer
AGS #3 pH Offset	0.0	- -	0.0	10.0	Engineer
AGS #3 pH Span	14.0	- -	2.0	14.0	Engineer
AGS #3 Ammonium Enabled	Yes	- -	- -	- -	Engineer
AGS #3 Ammonium Offset	0.0	mg/l	0.0	2.0	Engineer
AGS #3 Ammonium Span	40.0	mg/l	0.5	60.0	Engineer
AGS #3 Phosphorus Enabled	Yes	- -	- -	- -	Engineer
AGS #3 Phosphorus Offset	0.0	mg/l	0	100	Engineer
AGS #3 Phosphorus Span	20.0	mg/l	0.5	40.0	Engineer
AGS #3 Temperature Enabled	Yes	- -	- -	- -	Engineer
AGS #3 Temperature Offset	-50	Deg C	-100	100	Engineer
AGS #3 Temperature Span	82	Deg C	10	300	Engineer
SB #1 Level Enabled	Yes	- -	- -	- -	Engineer
SB #1 Level Offset	0.25	m	0.00	14.00	Engineer
SB #1 Level Span	7.03	m	2.00	40.00	Engineer
SB #2 Level Enabled	Yes	- -	- -	- -	Engineer
SB #2 Level Offset	0.25	m	0.00	14.00	Engineer
SB #2 Level Span	7.03	m	2.00	40.00	Engineer

Description	Default	Units	Min	Max	Security
System Setup - Analog Scaling (continued)					
Influent Flow Enabled	Yes	- -	- -	- -	Engineer
Influent Flow Offset	0	m^3/hr	0.00	2.00	Engineer
Influent Flow Span	3000	m^3/hr	1.00	30.00	Engineer
Post-Eq Level Enabled	Yes	- -	- -	- -	Engineer
Post-Eq Level Offset	0.86	m	0.00	8.00	Engineer
Post-Eq Level Span	7.03	m	2.00	40.00	Engineer
Effluent Flow Enabled	Yes	- -	- -	- -	Engineer
Effluent Flow Offset	0	m^3/h	0	10000	Engineer
Effluent Flow Span	3000	m^3/h	10	20000	Engineer
Effluent Valve Position Feedback Enabled	Yes	- -	- -	- -	Engineer
Effluent Valve Position Feedback Offset	0	%	-10	25	Engineer
Effluent Valve Position Feedback Span	100	%	10	120	Engineer

HARDWARE SETTINGS

Description	Value	Units
VFD Parameter References		
Influent Pump Minimum Speed	30.0	Hz
AGS Blower Minimum Speed	30.0	Hz
Sludge Buffer Pump Minimum Speed	30.0	Hz

Process Start-up Guidelines

AquaNereda®

Table of Contents

THIS DOCUMENT IS CONFIDENTIAL

1 INTRODUCTION

This document presents the intended start-up protocol for the AquaNereda® Aerobic Granular Sludge Technology system including associated preparatory tasks, sludge seeding strategy, and analytical monitoring program. The objectives of this protocol are:

- To provide guidelines regarding the preparatory actions to be completed before start-up.
- Describe the general start-up strategy to be adopted.

Aqua-Aerobic System, Inc.'s (AASI) and the Client's obligations to be considered for this project are noted as follows:

- AASI will lead discussions on seeding the AquaNereda system and prepare a start-up operations protocol based on the seeding plan.
- AASI will provide a minimum of (2) weeks of onsite process support including process training.
- The Client will seed the AquaNereda reactor(s) with a specified amount of conventional activated sludge and/or aerobic granular sludge.
- During start-up, the AquaNereda effluent targets will be those of the existing discharge permit or the design effluent targets.
- The start-up effluent targets must be achieved from the beginning of start-up thus initial percentage of design flows and loads diverted to the AquaNereda reactor(s) are to be based on the seeded capacity.
- If necessary, further diversion of flows and loads to the AquaNereda reactor(s) will be managed in controlled steps while still achieving effluent requirements until the design values are reached or the complete plant flow has been diverted.
- Reach the initial required capacity and meet effluent compliance within the shortest period possible.
- Maintain stable process conditions within the AquaNereda reactors at all times.
- When start-up is complete – that is, the plant is in stable operation – the guarantee period will commence.

2 RESPONSIBILITES & COMMUNICATION

General responsibilities and communication guidelines are provided below:

- An AASI field process specialist will manage the operations protocol following mechanical and electrical checkout and execute the necessary operational changes through the duration of the start-up phase.
- An AASI field process specialist will be on-site for a portion of the start-up phase. This individual will provide training to the operational team to prepare the plant's staff to operate the system, to familiarize them with the Aquasuite® Nereda® Controller, and to provide direction in process monitoring and analysis tasks.
- Upon leaving the site, an online remote monitoring service will be in place to provide access to the Controller and SCADA system allowing for off-site observation by both the plant staff and AASI.
- All progress, events, related consequences, and proposed mitigating actions related to the start-up phase will be recorded by the AASI field process specialist.
- Regular meetings between AASI and the clients will be held through the start-up period.
- Any process modifications performed by the operational staff, including proposed changes to the Controller, during the start-up period must be communicated to and approved by AASI. In an emergency situation, the operating team onsite has full autonomy to act accordingly, bearing in mind, however, the instructions provided during the training sessions as well as following good operational practices to avoid mechanical, electrical, and electronic damages and prevent process disturbances.
- An AASI process engineer will be nominated to serve as the main communication line through the first year of operation following the field process specialist's involvement. This individual will manage the submitted data and inquiries from the plant staff following the start-up phase. It is advised that the plant staff also select an operational coordinator to serve as the main point of contact during this period.
- Lab data is to be transmitted to the dedicated process engineer on a bi-weekly basis during the first three months of operation and monthly through the remaining first year of operation.

3 PREPARATION FOR START-UP

3.1 Preparatory Actions

The purpose of the pre-requisite conditions summarized in this section is to ensure that an efficient and successful startup of the AquaNereda reactor(s) may be achieved in the shortest period possible. It also ensures that the efforts of the AASI staff deployed to site for assistance during the start-up phase may be focused on their primary responsibilities as prescribed during this part of the project.

The start-up phase of the project will only be initiated once the plant is confirmed to be in a state of readiness as defined by the following conditions:

- Designed, engineered, and constructed under internationally recognized and good engineering practices.
- Commissioning items as detailed in the O&M Manual are signed off by the Client as having been successfully completed, and the civil structure as well as the mechanical, electrical, and electronic equipment are fully operational and free from defects.
- A maintenance team is confirmed to be available to fix equipment faults at short notice and ensure that all equipment is properly maintained, cleaned, and calibrated in accordance with the original equipment manufacturers' official instructions and/or per the frequency required onsite.
- An operational team is confirmed to be available onsite to be trained by AASI and thereafter to be responsible for the plant's operating and monitoring tasks.
- A remote tour of the plant and communication's verification check has been carried out.
- The pre-treatment works is operating properly and efficiently in accordance with its specifications (i.e., no screen by-passes, efficient grease and grit removal, etc.), the sludge treatment is achieving the solids capture efficiency prescribed in the AquaNereda design, and the influent characteristics are aligned with the flows and loads defined in the design operating window.
- The reactor(s) have been confirmed to be seeded with biomass conforming to the requirements as specified within this report.
- Confirmation has been received that a reputable laboratory and/or laboratory equipment is available, fully equipped, and ready for use by qualified laboratory technicians.
- Confirmation has been received that all required consumables for equipment and instrumentation are in stock and available onsite.

Note: Preparatory activities for the start-up phase of the project can be found in the Field Checkout and Startup Papers documents within the O&M Manual.

3.2 Seeding Guidelines

The process of seeding refers to the transfer of biomass (i.e. activated sludge and/or aerobic granules) under controlled conditions to the AquaNereda reactors for the purpose of the process start-up of the plant. The seeding process will be managed and implemented by AASI.

The seeding strategy is pre-determined by AASI and considers the following factors:

- Expected load to be treated during the start-up phase
- Effluent quality requirements to be adhered to during the start-up phase
- Quantity of activated sludge or granules available
- Time required to have the sludge seeding completed
- Time frame for the start-up phase
- Simplicity of the seeding procedure and associated costs

The Client must prepare the installation to receive the biomass for seeding and ensure that the AquaNereda reactor(s) will be seeded with biomass complying with the quality requirements as stipulated herein. During the seeding process, the most important factors to consider are the preservation of the good quality of the biomass and avoiding the unexpected losses of sludge. The start-up of the AquaNereda process must not be initiated before the seeding phase is successfully completed. The seeding phase should be undertaken as quickly as possible to avoid either exposing the biomass to extended anaerobic conditions or enlarged endogenous respiration phases with no substrate.

Conventional activated sludge may alternatively be directly discharged into the influent buffer tank (if applicable) or AquaNereda reactor(s). If the biomass is discharged directly into the influent buffer tank, it will be necessary to provide a temporary screening step (for example, a ‘basket’ sieve with a slot opening of 6mm) before the sludge is actually transferred to the buffer tank. This is required in order to avoid the risk of clogging in the feed pipelines by way of coarse materials/debris being transferred along with the biomass. From the influent buffer tank the sludge could thereafter be transferred to the AquaNereda reactor(s) using the feed distribution system.

Aerobic granular biomass must be discharged under controlled conditions directly into the AquaNereda reactor(s) to ensure that the integrity of their structure is safeguarded.

3.3 Biomass Quality Control

The AquaNereda reactor(s) will be seeded with mixed liquor suspended solids (MLSS) in the form of conventional, waste, or return activated sludge from a nearby treatment plant. The objective of seeding is to obtain a concentration of MLSS specified by AASI of healthy activated sludge and/or aerobic granular sludge in the reactor(s) to be seeded.

Before transferring the biomass, it is imperative that the Client take a sample from the source and measure the SVI5/30 and MLSS as well as conduct a quality check of the sludge and/or granules by sight and smell. When seeding with activated sludge, it is preferable that the source sludge have good settling properties (SVI_{30} <120 mL/g or max of 150 mL/g) and exhibiting suitable bio-P and nitrogen removal activity. If the biomass does not appear acceptable, for example (but not limited to) sludge containing mineral oil, grease, fat, abnormal smell or color and other abnormal features, an alternative source must be identified and utilized instead.

The amount of biomass transferred during the seeding process must be controlled considering the combination of the volume required and the biomass concentration in the source(s). Supplementation of biomass quantities during an on-going seeding process can be confirmed by way of MLSS measurements taken from the reactor(s). For a reference of the start-up biomass quality, a sample volume of 2 liters must be taken from each AquaNereda reactor actually seeded to perform MLSS and sludge volume standard tests immediately before operation is formally initiated.

4 START-UP STRATEGY

During start-up, the operation will be based on meeting effluent compliance while treating a percentage of the design ADWF flow load, as specified by AASI, in one, some, or all of the reactors. During this initial period, the MLSS concentration will increase and, if seeded with activated sludge, the biomass settleability will gradually improve and hence the SVI decrease allowing for the amount of flow treated in the AquaNereda system during the start-up phase to be gradually increased. Due to these improvements, it is possible to decrease the settling time in a stepwise approach and therefore have more biological time available in the cycle. Consequently, with higher biomass concentrations and higher biological time, it will be possible to gradually increase the treatment capacity of the AquaNereda reactor(s).

Site-specific start-up control strategies and settings will be employed for the key start-up stages outlined in the following section. The start-up plan may need to be adjusted according to the expected influent loads and flows at the time, depending on conditions at the headworks, influent flow and load, and the biological performance to meet the effluent quality requirements within the shortest period possible. It is therefore recommended that the Client allows for some contingency for start-up performance in the schedule.

4.1 Control Strategies

The Aquasuite® Nereda® Controller will be provided with standard control strategies for the reactor(s) and sludge buffer(s) which may be used and adjusted according to the start-up strategy:

- Single phase (for example test feed, test aerate, test discharge, test lower level, test sludge discharge, test water discharge, etc.)
- Operation with constant cycle and phase times
- Dynamic operation controlled on measured process parameters such as ammonia, phosphate, redox, dry solids, etc., depending on the site.

During start-up, the best control mode will be selected depending on the situation onsite and may be changed for operational convenience. The standard start-up control strategy is configured to provide as much flexibility as possible, although it may be adjusted during start-up to improve the reactor(s) performance and/or improve the sludge settleability. Controller settings and control strategy set-points will continue to be updated throughout the start-up period. All recommendations will be based on instrument data received from site and any available laboratory results.

5 MONITORING & REPORTING

The monitoring activities are of utmost importance to evaluate the overall performance of a treatment plant and, in particular, to provide valid and accurate data to inform operational decisions and assist in accelerating the start-up phase. The main monitoring activities include the following:

- Execution of an analytical program and data assessment
- Assessment of online data
- Execution of daily visual inspections
- Execution of equipment maintenance
- Assessment of operational expenditure

It is mandatory that remote online monitoring of the performance of the plant is possible by the AASI start-up team from the onset of the start-up phase. All online measurements must be up and running as soon as the reactor(s) and sludge buffer(s) reach the operational water level and the start-up control strategy is running.

An analytical testing program is needed to control the start-up progress and fine-tune the cycle settings. The monitoring program enables the required performance and progress assessment of the AquaNereda installation. This monitoring program is of utmost importance to ensure a quick start-up and ability to achieve effluent requirements. The analytical results must be regularly updated in a database in order to allow the operations team to evaluate the main process control parameters and overall plant performance.

Further information on analytical testing, online data monitoring, inspections and maintenance activities can be found in the Maintenance Schedule and Process Manual sections of the AquaNereda O&M Manual.

PROCESS MANUAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

AquaNereda®

Aerobic Granular Sludge Technology

Process Manual

Contents

6306 N. Alpine Rd. Loves Park, IL 61111-7655 **p** 815.654.2501 **f** 815.654.2508 **www.aqua-aerobic.com**

AquaNereda® Aerobic Granular Sludge Technology Introduction

This manual contains a general description of an Aqua-Aerobic Systems, Inc.'s AquaNereda® Aerobic Granular Sludge Technology, and provides information needed to operate and optimize the process. The purpose of this manual is to assist a wastewater treatment plant operator in monitoring and controlling an AquaNereda system. For detailed procedures, technical and safety information, specific process design parameters, and equipment descriptions, refer to the remaining sections of the Operation and Maintenance Manual.

It is important to ensure that the following pre-requisites are satisfied in order to realize the successful operation and performance of the plant. The AquaNereda installation must be:

- Designed, engineered, and constructed under internationally recognized, good engineering practice and in accordance with the AquaNereda design package, as well as the specified design and construction specifications applicable to the project.
- Free from civil, mechanical, electrical, and electronic defects.
- Operated with the process design window and limitations (influent characteristics and effluent compliance targets) as is specified for the plant / project. For the relevant details in this regard, refer to Process Design Report found in Section 3 of the O&M Manual.
- Operated by skilled staff trained in the use of the AquaNereda technology and in accordance with the requirements of this manual.
- Maintained and operated in accordance with the original equipment manufacturers requirements and under direction from Aqua-Aerobic System, Inc.'s instructions and manuals.

<u>THIS DOCUMENT IS CONFIDENTIAL</u>

AquaNereda® Aerobic Granular Sludge Technology
Technology Operation

Technology Overview

Aerobic systems are used in conventional biological wastewater treatment plants to purify wastewater. In conventional activated sludge (CAS) systems, bacteria are present as a suspension of flocs that are separated from the purified wastewater, after treatment, by sedimentation in separate clarifiers. The settled biomass flocs are then pumped back to the biological treatment step to enable the bacteria to resume their purification task. The bacteria flocs are small in size and have a low density, slightly higher than water, which means that they settle relatively slowly in the clarifiers. Consequently, settling of the flocs requires large clarifiers. The structure and the relatively poor settling characteristics of activated sludge flocs typically limit their concentration in the bioreactor to between 3,000-5,000 mg/L. In the case of discontinuous feed activated sludge systems, such as sequencing batch reactors (SBR), the solids-liquid separation occurs within the reactor over a relatively long settle. The biomass concentration range in an SBR is also in the range of 3,000-5,000 mg/L.

Within the AquaNereda® Aerobic Granular Sludge Technology, the bacteria are not predominantly present as flocs but rather as large granules (typically 0.2-4.0 mm in diameter) as shown in Figure 1. Sludge develops into these dense microbial aggregates through normal, everyday operation as a result of the batching process with optimized cycle structures. These granules provide both biological nutrient removal (BNR) and rapid settling abilities: the sedimentation rate or settling velocity of the bacteria granules is up to 35 times higher than that of bacterial flocs. Overcoming the limitations imposed on the system by the low settling rate of the flocs allows the operating bacteria concentration in the bioreactor to be as high as 8,000-15,000 mg/L, thus requiring smaller reactors. Combined with the ability to achieve enhanced biological phosphorus removal (EBPR) and simultaneous nitrification and denitrification (SND) without selector basins, the AquaNereda technology results in an overall compact site footprint.

Figure 1. AquaNereda® Aerobic Granular Sludge

Granulation

Granules are self-forming in a properly designed and operated in AquaNereda plant, and the granular biomass is robust. Granules develop within the reactor when seeded from CAS due to the natural selection mechanisms of the process such as applying an increased sedimentation stress whereby the slowest settling sludge is wasted from the system.

Due to this increased sedimentation stress and the continuous biomass growth, the faster settling flocs are selectively retained in the system, grow in size, and become granules. Start-up is thus an example of Darwin's natural selection whereby only bacteria able to adapt to the increased sedimentation stress by forming granules will survive. As the heavier flocs increase in size and become granules, the bacteria organize into a layered microbial community (see Figure 2) resulting in an aerobic treatment zone along the outer edges of the granule and anoxic/anerobic conditions in the interior of the granule where oxygen is unable to penetrate.

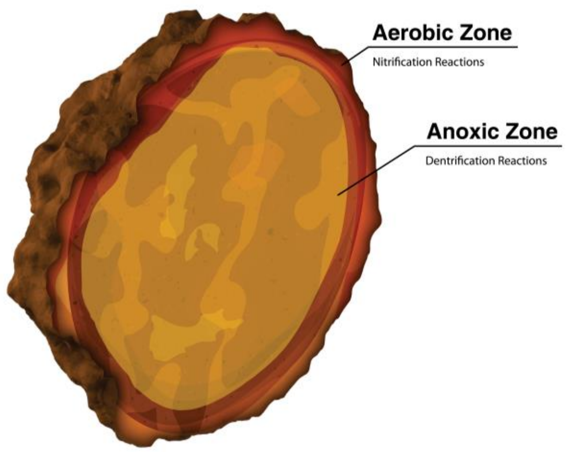


Figure 2. Aerobic granule during React phase

System Advantages

A consequence of these unique process features is that the AquaNereda technology can operate in an efficient SBR configuration where the full biological nutrient removal (BNR) treatment steps and sedimentation take place within a single bioreactor in consecutive, time-based phases. Due to the enhanced settling characteristics of the granular sludge, more efficient treatment (increased process reaction time) is achieved when compared to conventional SBR technologies. The sludge characteristics and mode of operation used in the AquaNereda technology leads to the following key advantages:

1. **Small footprint**
   As a result of the high biomass and fast settling velocity, the required bioreactor volumes are smaller. Furthermore, clarification (settling) is performed in the bioreactor itself without the use of separate clarifiers which results in further reduction in volume. AquaNereda is a compact system which significantly reduces the required treatment plant footprint.
2. **Low investment cost**
   As a result of the compact size, less civil works and less mechanical equipment (such as recirculation pumps, mixers, or moving decanting systems) is required and furthermore, the bioreactor design has a single compartment without separate selectors or anaerobic/anoxic zones.

3. **Low operational costs**
   Due to the unique operating configuration of the Aqua Nereda system, several energy consumption pieces of equipment (such as return sludge pumps, internal recycle pumps, clarifiers, and mixer in unaerated zones are not required); in addition, all data collected and analyzed to date indicates that the oxygen uptake efficiency is higher which further reduces energy consumption.

AquaNereda® Cycle

The AquaNereda system operates as a batching process. The following consecutive operations take place in the AquaNereda reactor (see Figure 3).

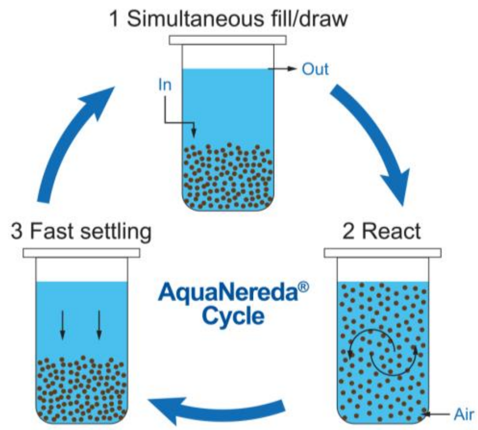


Figure 3. AquaNereda® Cycle

Phase Descriptions

1. **FILL/DRAW**
   During the Fill/Draw operation, the wastewater is introduced into the reactor. In this phase, the reactor has been "conditioned" by terminating flow (and the associated organic loading) to the reactor and allowing anaerobic conditions to develop in the absence of aeration during the previous cycle's Settle phase. Without any aeration or mixing energy, the reactor contents exist in a stratified condition. The granular biomass is settled in the bottom portion of the reactor while the top portion contains the treated effluent from the previous batch.

   The settled sludge zone contains the majority of the microbiology. This microbial life continues a certain level of respiration into the previous Settle phase and the current Fill/Draw phase effectively depleting the settled sludge zone of any DO to create an anaerobic environment.

   The supernatant layer above the settled sludge zone represents a significant fraction of the reactor volume. Since the majority of the microbial life has settled to the bottom of the reactor, the relative effect of microbial respiration in the supernatant layer (compared to the sludge mass layer) is generally reduced. Therefore, the DO concentration in the supernatant layer typically rangers from 0.5 to 1.5 mg/L and up to 2.0 mg/L prior to the start of the Fill/Draw phase. The residual soluble levels of organic material in the supernatant – determined by BOD_5 or COD measurements – are present in concentrations below the anticipated effluent value along with total suspended solids (TSS), ammonia, total nitrogen (TN), and total phosphorus

(TP), depending on the treatment objectives.

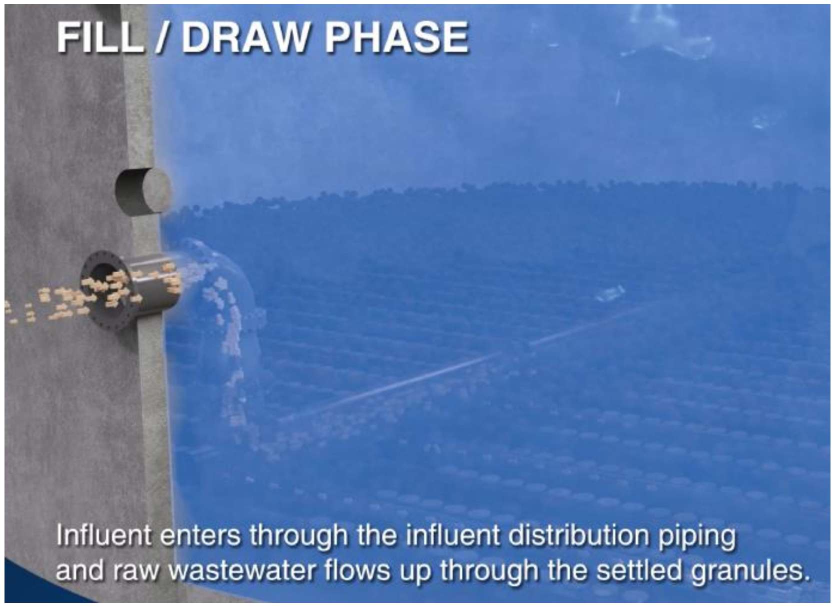


Figure 4. AquaNereda® Fill/Draw Phase

As the Fill/Draw phase of operation begins, wastewater flow is initiated at the bottom of the reactor under plug flow conditions. As wastewater enters the bottom of the reactor, the clear supernatant is displaced towards the top of the reactor exiting via a series of effluent weirs. As a result of the plug flow conditions and the excellent settling characteristics of the granular biomass, there is no contact between the purified effluent at the top of the reactor and the raw wastewater entering from below which allows for the effluent to be decanted/displaced from the reactor by the influent feed. In contrast to conventional SBR systems, AquaNereda does not require a separate decant step.

At this point, the blowers are off to prevent the aeration system from providing oxygen to the reactor, and the stratified condition of the reactor that existed in the preceding Settle phase will remain into this phase. Typically, 20-50% of the reactor volume is replaced with each feed batch.

Process Considerations	**Mechanical Considerations**
Anaerobic conditions (DO ≈ 0 mg/L)	Aeration system off
Denitrification	Influent valve open / transfer pump on
Phosphorus release	Sludge wasting off
Sludge conditioning	Effluent displaced

As raw wastewater enters the reactor and flows through the settled granular biomass layer, the residual DO that may have existed in this layer is rapidly depleted as a result of microbial respiration and denitrification of the leftover nitrate. The wastewater flows through the settled biomass which generates a high substrate gradient leaving the biomass saturated with substrate. This provides the desired anaerobic conditions in the lower layer of the reactor. During this phase, the anaerobic environment optimizes the conversion of readily biodegradable substrate into storage polymers by slow-growing bacteria.

The result of this conversion is the release of phosphorus into the bulk liquid. This phosphorus will be distributed throughout the reactor and taken up in the subsequent React phases. Due to this release, there is a steady increase in the concentration of phosphorus in the settled sludge bed during the Fill/Draw phase. This also serves as a selection mechanism for the development of granules as the biopolymers that are a byproduct of the phosphorus release will help bind the biomass into a granular structure. This increase is significantly greater than what could be attributed to the contribution of phosphorus present in the raw wastewater and allows for luxury uptake of phosphorus during the following React phase.

As flow enters the reactor, the concentration of the Total Kjeldahl Nitrogen (TKN) in the reactor also increases through the sludge bed. The TKN consists of organic nitrogen and unionized ammonia (NH3-N) in the raw wastewater. By the process of hydrolysis (with or without oxygen present), the majority of the ammonia is converted to ammonium nitrogen (NH4+-N). The ammonia nitrogen is then oxidized through the nitrification process in the subsequent React phase where ammonia nitrogen is converted to nitrate nitrogen (NO3-N). Active nitrification does not occur during the Fill/Draw phase as the aeration system is off.

In summary, the Fill/Draw phase of operation is characterized by the influent waste stream entering the reactor and flowing upward in vertical plug-flow conditions through the settled granular biomass while the upper supernatant layer is displaced. The environment is classified as anaerobic with DO concentrations at or near 0 mg/L with nearly depleted nitrates. As such, slow-growing bacteria is dominant allowing for strong phosphorus release into the bulk liquid. In essence, this phase is utilized for denitrification, biological phosphorus release, and conditioning of the sludge mass.

2. **REACT**

During the React phase of the cycle, wastewater no longer enters the reactor, and the aeration system starts to deliver oxygen (and mixing energy) to the reactor. Just prior to the blowers turning on, the process depth is slightly reduced via the water level correction to avoid any sludge being displaced through the effluent weirs. Then an air sealing of the sludge decanting pipe is performed to prevent washout of the biomass during aeration. The introduction of oxygen converts the reactor from an anaerobic environment to an aerobic environment. Due to the majority of the solids being bound up within the granules, the viscosity of the bulk liquid is low enough such that the aeration system can deliver a sufficient amount of energy to maintain completely mixed conditions during the React phase without a mechanical mixer.

The layered structure of the granules allows multiple biological process to take place: aerobic conditions in the bulk liquid and outer edges of the granule while anoxic conditions dominate the granule interior as oxygen is depleted through the granule layers. This promotes both nitrification and denitrification throughout the React phase. While aerating, the carbon reduction will be enhanced in the outer (aerobic) layer of the biofilm while the stored slowly biodegradable carbon in the granules is utilized for luxury phosphorus uptake. The aeration system is on during this phase in order to deliver oxygen to the reactors. The blowers may be ramped up and down via VFDs or cycled in an on/off pattern to target the desired DO concentration.

Process Considerations	**Mechanical Considerations**
Aerobic/anoxic conditions	Aeration system on/off
Carbon reduction	Influent valve closed / transfer pump off
Nitrification/Denitrification	Sludge wasting off
Phosphorus uptake	No effluent displaced

The oxygen demand in the system is due to the aerobic metabolism of the organic constituents (i.e., BOD5 reduction) and the nitrification of ammonia. The aeration system is sized to meet this oxygen demand based on given design flows and loadings. The DO profile in the reactor will normally reveal a pattern of increasing DO concentration during the aerated periods followed by decreasing DO concentration during the non-aerated periods. The DO concentration will reach a peak value at the end of each aeration period at which point the aeration system will be shut off to avoid over-aerating the system. The aeration system can be controlled in response to the ammonia concentration through the use of an ammonia probe or via DO and pH. As the degree of treatment increases, a steady decline in the oxygen uptake rate (OUR) of the biomass will result. The exact magnitude of this decline will be affected by the loading to the system and the duration of each of the individual phases of a complete treatment cycle. The amount of soluble organic material (as evidenced by the BOD5 or COD concentrations) in the reactor will decrease during the React phase.

With enough aeration time and suitable low sludge loading rates, nitrifiers will accumulate in the outer layers with the nitrate produced being simultaneously denitrified in the core of the granules using the organic substrate accumulated in the fill phase. The concentration of TN present in the reactor will steadily decline as the React phase is completed. Nitrification is a two-step process involving two individual groups of microorganisms, namely Nitrosomonas and Nitrobacter, along with other nitrifying bacteria such as Nitrosococcus as well. These microorganisms are located in the outer layer of the granules. This process does not remove nitrogen from the wastewater; it merely converts it from one form of nitrogen to another. In the presence of oxygen, ammonia nitrogen is first converted to nitrite (NO2-N) by the Nitrosomonas. The nitrite nitrogen is then converted to nitrate nitrogen (NO3-N) by the Nitrobacter. Since the Nitrobacter are generally much faster “workers” than the Nitrosomonas, the NO2-N in the reactor is usually negligible.

Nitrogen is ultimately removed from the wastewater through the denitrification process. Denitrification is performed by a broad range of microorganisms collectively known as heterotrophs that are present in and throughout the granule, but denitrification will occur specifically in the anoxic layer of the granules. The nitrate diffuses into the anoxic layer where, in the absence of oxygen, these heterotrophs convert the NO3-N to nitrogen gas (N2). The nitrogen gas is subsequently released from the reactor into the atmosphere. During these denitrification periods, pulse aeration can be used to promote the contact between the nitrate rich effluent and the biomass bed before (i.e. pre-denitrification) or after (post-denitrification) the aeration process step. Part of the React operation can be maintained under anoxic conditions to extend the efficiency of the nitrate removal process

The anaerobic fill followed by aeration also facilitates the phosphate uptake necessary for efficient biological phosphate removal. The onset of aerobic conditions in the reactor allows the microorganisms to uptake phosphorus during the React phase. Therefore, the phosphorus that was previously released into the bulk liquid during the Fill/Draw phase is now taken back up into the cell mass. Because the microorganisms were depleted of phosphorus in the previous phase, they are likely to take in more phosphorus than the amount that is necessary to meet their nutrient requirements. The term used to describe this phenomenon is "enhanced biological phosphorus removal."

In summary, the React phase features an aerated and mixed reactor, with both aerobic and anoxic conditions within the granule, with an environment controlled by ramping blowers up/down and/or cycling blowers on/off. Effluent quality parameters will provide the operator with a basis for determining the necessity of adjusting the duration of the React phase and/or the aeration cycle structure.

3. **SETTLE**

In this operation the biomass is separated from the effluent. During the Settle phase, the reactor exists in quiescent conditions. Wastewater is not entering the reactor, and the aeration system is off. The absence of flow and aeration activity produces an ideal environment for solids-liquid separation. Rapid settling occurs due to the high density of the granular sludge relative to CAS systems. The Settle phase also helps the reactor begin conditioning the sludge for the subsequent anaerobic Fill/Draw phase.

At this point in the cycle, the preceding phases have accomplished all of the process objectives related to the reduction of organic compounds, TN, and TP. The reactor acts as a "static clarifier" as opposed to a "flow-through clarifier." As there is no flow entering or exiting the reactor, the settling of granular biomass is not affected by system hydraulics. The ideal settling of granular biomass and perfectly quiescent settling environment is unique to true batch style systems such as AquaNereda.

Process Considerations	**Mechanical Considerations**
Quiescent conditions	Aeration system off
Static clarifier	Influent valve closed / transfer pump off
Settling of granular biomass	No effluent displaced
	Sludge withdrawal during a period of settle

Along with the production of biopolymers during the anerobic Fill/Draw phase, one of the mechanisms of granulation is the selection of heavier particles through the wasting of the lighter, more flocculent material while the denser particles are retained in the reactor. In each cycle, the sludge fraction with the poorest settling properties is extracted from the reactor. Sludge wasting of the lighter flocculent sludge will also occur during this phase.

The technology, like other secondary treatment systems, is dependent on the development of a mixed culture of bacteria and other microbial life forms to accomplish treatment objectives. As a result of the biological degradation of organic matter and the accumulation of inert material present in most wastewaters, it is necessary to discharge certain quantities of solids from the reactors in order to maintain an appropriate concentration of mixed liquor suspended solids (MLSS) in the reactor and thus control the F/M ratio. This phase of operation within the treatment cycle is designed as a time increment that typically occurs simultaneously with the Settle phase.

In summary, wasting in an AquaNereda system essentially serves two purposes:

- Selective wasting of the flocculent sludge to encourage granulation
- Excess sludge wasting to maintain an appropriate operating MLSS and F/M ratio

The programmable logic controller (PLC) is programmed to initiate wasting as required with operator inputs to adjust to changing influent conditions. Because the sludge removed during the selective wasting phase is typically in the range of 0.1 to 0.3%, the sludge is generally sent to a sludge buffer tank for thickening prior to solids handling. This is discussed in the following section.

Ancillary Basins

Sludge Buffer Tank

The sludge buffer serves to thicken the wasted sludge (in particular the selectively wasted sludge) prior to solids handling. This tank is essentially a gravity thickener that enables the AquaNereda system to send a thicker sludge more in line with waste from CAS processes to the solids handling train while avoiding an additional hydraulic input. The sludge buffer will thicken the wasted sludge to approximately 0.8-1.0% before being pumped to solids handling while the supernatant is pumped back to the head of the plant.

Water Level Correction Tank

The primary function of the water level correction basin is to equalize discharge of the AquaNereda reactor's level correction that occurs at the beginning of the React phase. This is to prevent any sludge from "jumping" over the V-notches into the effluent weir system. Although this return stream could be sent directly back to the headworks, this tank will capture any fluctuations of flow allowing for a lower pumped flow rate back to the head of the plant.

System Control

The AquaNereda plant, including bioreactor(s), influent buffer tank(s), sludge buffer tank(s), water level correction tank(s), and effluent butter tank(s) (as applicable), is controlled through a dedicated batch software – Aquasuite® Nereda® Controller. This SMART tool includes operating control strategies (combining sequential operations and phases) and provides comments (based on information received from sensors/analyzers) to the PLC which executes the actions. If the Controller ever fails, the PLC switches to an interim control strategy that is programmed and available through the PLC. The controls configuration is shown in Figure 5.

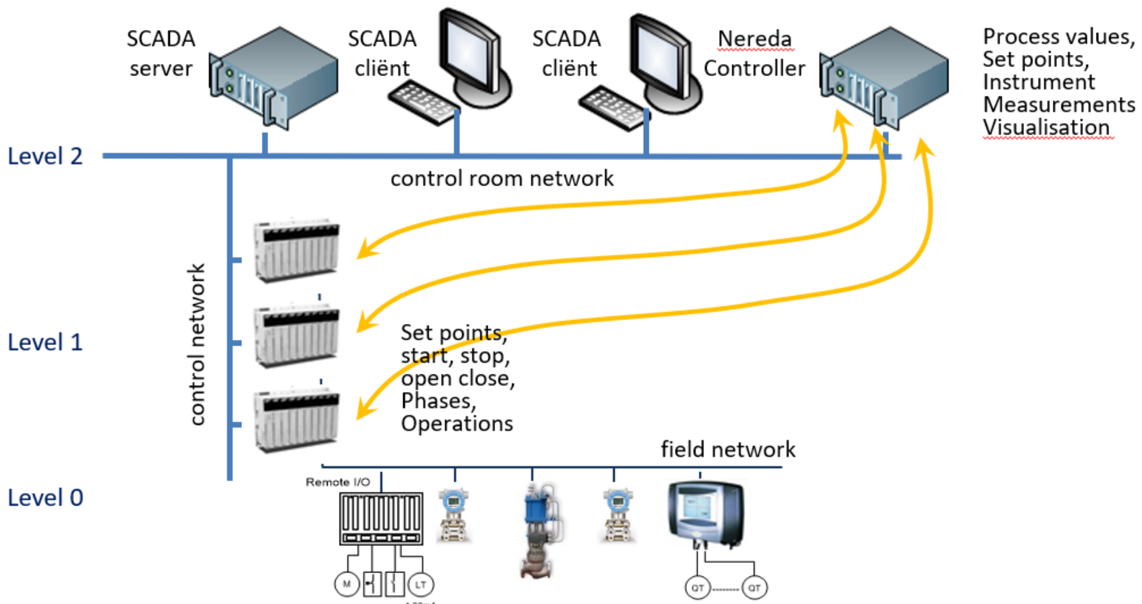


Figure 5. AquaNereda® System Controls

Upstream Operation

Pre-treatment

Although the pre-treatment works is not strictly part of the AquaNereda process-related installation, its design and operation are of critical importance to the successful operation of an AquaNereda plant. In order to protect the internal mechanisms within the AquaNereda reactor, and the influent distribution pipe network at the bottom of the reactor, it is essential that the influent to the reactor passes through suitably sized screens (as defined by the project specifications). The following precautions must be taken:

- Screening facilities with standby provision must be operational at the inlet works ahead of the AquaNereda system.
- Bypassing of the screens to the AquaNereda system must be prevented. If a screening failure does occur (e.g. both a duty and standby screen fails simultaneously) then it is strongly recommended that all flow to the AquaNereda system is temporarily halted or diverted (where possible) until the requisite screening is returned to operation.
- Any inorganic material entering the reactor that can block the orifices in the influent distribution pipework will result in serious malfunctioning of the system and may require the emptying of the tank in order to clean the pipework.
- If a screening failure or accidental bypass occurs, then an immediate action must be taken by the operators to address the inoperability of the screens to minimize the quantity of unscreened influent entering the reactors. The same would apply for any grit and/or FOG removal infrastructure installed ahead of the AquaNereda reactors.

Influent Buffer(s) and Feed Pumps

The operation of control of the influent buffer tank(s) and feed pumps is controlled by the Nereda Controller as follows:

1. The feed pumps will be started when a feed phase of one of the reactors is in Run mode.
    - If the recipe is running in automatic mode from the Controller:
        - The feed pumps will be controlled on a flow setpoint from the Controller. This flow setpoint is calculated based on a prediction of the influent flow to the treatment plant and the predicted and actual levels in the influent buffer.
    - If the recipe is running in manual mode from the Controller:
        - The feed pumps will be controlled by a flow setpoint defined by the operator.
        - The pumps will be switched off at the end of the FEED/DECANT phase or when the level in the buffer tank reaches its specified lower level.
2. To protect the sludge/granules from extreme pH and conductivity values, the feed pumps will not start if one or two of the following conditions are detected:
    - If the influent pH is lower or higher than the setpoint (typically 5.5 and 9.5, respectively).
    - If the influent conductivity is lower or higher than the setpoint (typically 100 and 5,000 µS/cm, respectively).

These setpoints are adjusted on the PLC and may be site-specific.

AquaNereda® Reactors

Process Cycle

A typical AquaNereda process cycle is presented in Figure 6. Each reactor completes a cycle by executing a pre-determined control strategy. The control strategy is a repeating cycle of operations and each operation consists of several process steps executed in various phases.

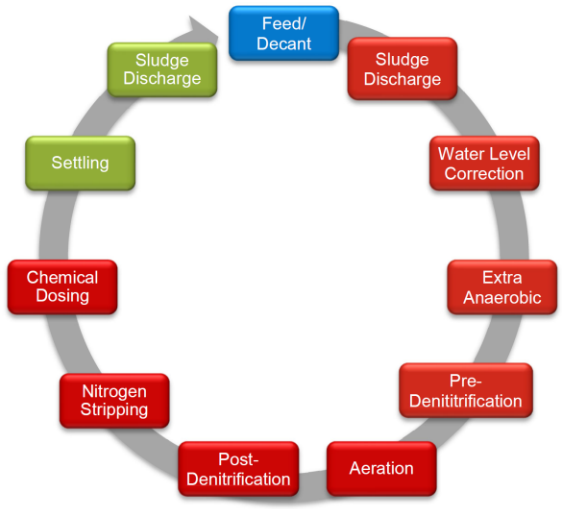


Figure 6. Detailed AquaNereda® Treatment Cycle

The AquaNereda process can be optimized by adjusting the control strategy phase times and other control setpoints to meet the effluent requirements. The following detailed operations and process steps are included in a typical control strategy and implement according to the particular operating strategy deemed applicable for a plant:

The detailed operation and process steps are summarized below:

Feed Operation

a. Feed/Decant – influent is fed into the settled sludge blanket at the bottom of the reactor under anaerobic conditions and effluent is discharged at the top of the reactor.
    i. The maximum feed time is set in the Controller. The feed phase runs in accordance to the predicted batch size calculated in the Controller, the maximum phase time available, and the feed flow rate setpoint.
    ii. If an extremely high wastewater flow reaches the plant (for example during a wet weather event), the Controller will automatically re-adjust the cycle scheduling: first the aeration phase time is decreased to a minimum and, if required, the subsequent feed phase time is increased to its maximum by the Controller.
    iii. Feed can either be implemented through a continuous or intermittent flow regime and is dependent on the projects specific operating strategy applied.

React Operation

a. Water level correction – the water level is dropped by approximately 15 cm just before the aeration phase is initiated.
    i. The purpose of this step is to ensure that there are no suspended solids discharged over

the effluent decanter weirs due to the bulking of the mixed liquor that occurs during aeration. This step may also be combined with the excess sludge discharge. Supernatant generated during the water level correction prior to aeration may be discharged to the effluent stream, influent buffer, effluent buffer, or sludge buffer as may be applicable to the plant's design or operating strategy.

b. Anaerobic wait – a minimum anerobic time is an important factor to achieve an efficient release of phosphorus and ultimately to ensure a high phosphorus removal efficiency.
    i. It is common practice to allow an extra anaerobic wait time after a shorter feed phase to ensure at least 60 minutes between the start of the feed phase and the start of the mixing/aeration phase.
c. Pre-denitrification – anoxic phase for optimized nitrate removal using pulse aeration (combination of aeration/mixing and waiting phases) can be applied in order to mix the contents of the reactor.
    i. Typically, the pre-denitrification process is controlled through time and/or process stopping conditions that are configured in the reactors' control strategy according to the effluent requirements (e.g., of parameters used in stopping conditions are: NH4, NO3, redox, etc.).
d. Air sealing – the sludge decant pipes are sealed with air to avoid sludge accumulation inside the pipes during the main aeration phase.
e. Main aeration – aerobic phase with oxygen supplied by the diffuses to biologically remove carbon, nitrogen, and phosphorous.
    i. Typically, the main aeration phase time is controlled through time and/or process stopping conditions that are configured in the reactors' recipe according to the effluent requirements (e.g. of parameters used in stopping conditions are: NH4, PO4, NO3, pH, DO, redox, etc.).
f. Post-denitrification – anoxic phase for optimized nitrate removal using pulse aeration (combination of aeration/mixing and waiting phases) can be applied in order to mix the contents of the reactor.
    i. This process step is not always required and is typically only implemented if the TKN/COD ration of the influent is high, the Total Nitrogen consent levels are very low, and/or the temperature of the mixed liquor in the reactor is very low.
    ii. Typically, the post-denitrification process is controlled through the time and/or process stopping conditions that are configured in the reactors' recipe according to the effluent requirements (e.g. of parameters used in stopping conditions are NH4, NO3, DO, redox, etc.)
g. Stripping – degasification of nitrogen gas by mixing (with air), after the biological process step is completed in order to dislodge nitrogen bubbles attached to the biomass and to prevent fine flocs floating to the surface during the subsequent settling phase.
h. Chemical dosing – chemical precipitation of phosphates with metal salts by dosing during the influent and/or return streams or directly to the bioreactors during the aeration phase to provide additional phosphorus removal, if required/applicable.
    i. Chemical dosing when directly in the reactors may be combined with post-denitrification process or occur in the following settle operation during an aeration/mixing phase before the settling phase.

Settle Operation

a. Settling – to allow the sludge to settle to the bottom of the reactor to form a dense sludge blanket leaving the treated supernatant in the upper part of the reactor ready for decanting.
b. Sludge discharge – to waste sludge from the system.
    i. As mentioned above, this phase can be performed after the feed phase depending on project specifics and operation strategy.

The Controller synchronizes the schedule of all reactors running in automatic mode in accordance with the plant configuration and the selected methods for operation (hydraulic scheduling and/or quality scheduling).

Aeration Control

The Controller offers different methods to control the amount of oxygen supplied to the reactor and the selection can be made by the operators in order to better suite the reactors' performance. The aeration control methods are explained below:

- **Fixed aeration capacity**
  A constant percentage of the aeration capacity is defined. This method is not optimal and should only be used if the online sensors (oxygen and/or redox) are out of order.
- **Oxygen setpoint**
  An oxygen setpoint is defined, and the aeration capacity is continuously calculated to keep a constant oxygen concentration in the reactors. This is the most typical method to control the aeration capacity in biological reactors. It is usually efficient in a wide range of aerobic biological systems. If the DO sensor becomes unavailable, the Controller automatically switches to fixed aeration capacity as the backup option.
- **Redox setpoint**
  A redox setpoint is defined, and the aeration capacity is continuously calculated to keep a constant redox value in the reactors. This method is indicated as a back-up for the oxygen setpoint control. If the redox sensor becomes unavailable, the Controller automatically switches to fixed aeration capacity as the backup option.

Sludge Wasting from Reactors

The optimum wasting of excess sludge from the AquaNereda reactors is crucial to grow granules and hence to achieve a successful operation of the system.

Regardless of the method of sludge wasting applied, the Controller typically regulates the volume of sludge wasted based on time, DS, reactor level, and sludge buffer level. If the sludge buffer(s) is unavailable, the sludge discharge phase is skipped, and a water level phase runs to ensure the correct process water level in the reactor is achieved before the aeration phase starts.

Two methods of wasting sludge, referred to "After Settle" or "After Feed," are possible, depending on the plant configuration.

Sludge Discharge After Settling

Once the biological phase is completed, the sludge begins to settle. After a set settling period (starting when the biological steps are completed), the sludge wasting valve is opened and excess sludge is discharged into the sludge buffer tank or other (as applicable). Sludge discharge "after settling" is typically applied in gravity feed configurations (without influent buffer).

The length of the settling phase determines what is called the "Selection Pressure" (see Figure 7 below) which is defined as the minimum settling velocity of the sludge particle required to ensure that it remains in the reactor. Sludge particles that settle fast enough to be below the level of the desludging pipes when the valve is opened will remain in the system whereas sludge that settles more slowly will be above the pipes and will be removed in the waste stream. Increasing the Selection Pressure (by shortening the settling phase before the discharge valve opens), increases the amount of sludge removed and accelerates the natural selection of the faster settling sludge and granules. The Selection Pressure, however, most be optimally controlled to ensure that high quantities of sludge are not removed because this will affect the F/M ratio within the system and the sludge retention time, thus ultimately influencing the treatment capacity.

Note: The figure and dimensions indicated below are typical for explanatory purposes only and do not represent project-specific details.

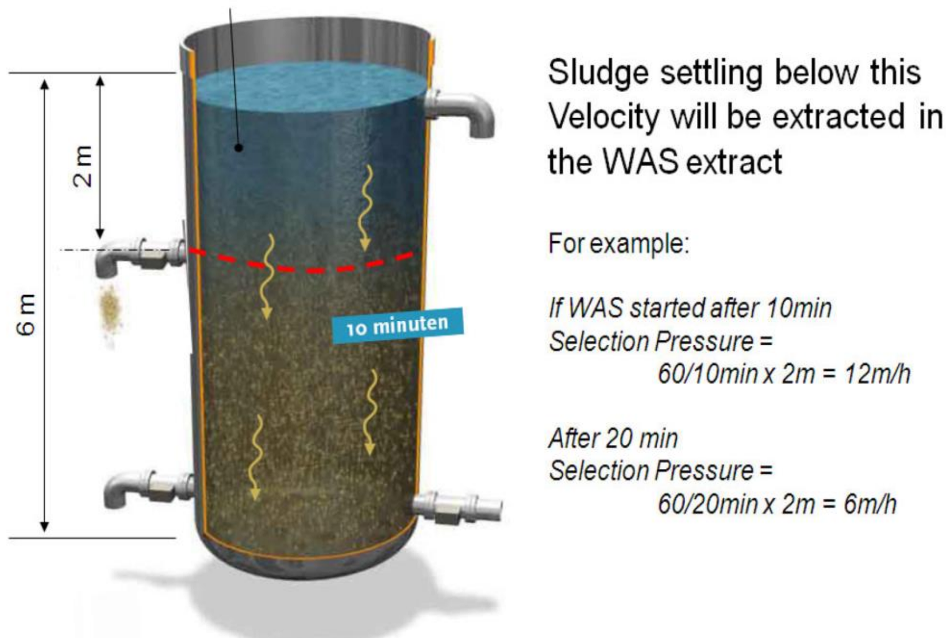


Figure 7. Selection pressure

Sludge Discharge After Feeding

When using this method, the wasting of sludge occurs immediately after the feed phase. In general, the volume removed from the reactor during the sludge discharge after the feed phase is sufficient to achieve a safe process water level in the reactor and in many occasions the sludge discharge volume is twice the volume needed for water level correction only. Sludge discharge "after feeding" is only applied in pumped feed with influent buffer configurations. The features of this wasting method are described below:

- The method relies on the upflow velocity in the tank during the feed operation to displace the more slowly settling particles out of the sludge blanket into the wasting zone in the vicinity of the desludging pipes.
- In this method, the selection pressure is controlled by adjusting the upflow velocity. It is increased by controlling the feed pumping rate to wash out the fine particles of the sludge blanket.

Process Conditions

The process operating conditions of the reactors (e.g., MLSS, exchange ratio, sludge load, sludge age, etc.) should be adjusted whenever required in order to respond to seasonal fluctuations in the influent quality and/or changes in the biomass characteristics. The goal is to optimize the biological operating conditions to achieve the effluent target.

The process operating conditions defined for the plant's nominal capacity is as specified in the project's Process Design Report is.

Sludge Buffer Tank(s)

Process Cycle

Sludge buffer tank(s) (where applicable) are provided to absorb the very high peak flows (that are of short duration) associated with the sludge wasting operation. They perform a hydraulic balancing function to decrease the flow rates discharged to the downstream sludge handling facilities (or other project-specific destination).

The following operating philosophy applies at plants where the sludge buffer has a balancing function and no pre-thickening of the sludge takes place:

- The contents of the sludge buffer tank(s) are typically kept mixed by either submersible/bridge mounted mixers or floor mounted air diffusers.
- Sludge pumps are typically responsible to empty the tank between the sludge discharges.

Alternatively, when the sludge buffer has a pre-thickening function prior to the sludge disposal it is then operated as follows in a cyclic concept including the following main phases shown in Figure 8.

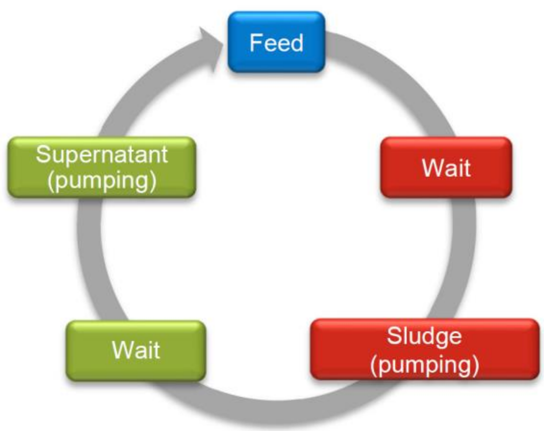


Figure 8. Sludge Buffer Cycle

The AquaNereda pre-thickening process can be optimized by adjusting the control strategy phase times and other control setpoints to meet the sludge thickening requirements. The following operations and process steps are included in a typical control strategy and are implemented according to the particular operating strategy deemed applicable for a plant.

Operations and process steps for sludge buffers with pre-thickening are summarized below:

Feed Operation

a. Feed – excess sludge from the AquaNereda reactor is discharged to a sludge buffer tank. The feed phase of a sludge buffer coincides with the sludge discharge from a reactor.

Sludge Operation

a. Wait – the excess sludge is allowed to settle for a few minutes. This time must be adjusted according to the sludge characteristics.
b. Sludge (pumping) – the thickened sludge is typically drawn off through a suction pipe network in the bottom of the buffer tank.
    i. Onsite observation should be used to establish the minimum and maximum sludge pumping times and flow rates.
    ii. Typically, the pumping velocity rate should be limited to a maximum of 1 m/h to allow an efficient thickening process. The sludge pumping phase is controlled on time and by an online dry solids meter installed in the sludge delivery pipe which will define the moment when the sludge pumping phase typically ends. The dry solids setpoint can be adjusted by the operator in the Controller to improve solids capture and/or the dryness of the thickened sludge.

Supernatant Operation

a. Wait – if needed, a certain time can be set for the transition from sludge to supernatant pumping.
b. Supernatant – once the sludge blanket has been cleaned from the buffer and a low solids concentration is detected, the supernatant (clear water) phase is started which returns the supernatant back to the front of the plant.
    i. Typically, the TSS concentration in the supernatant from the sludge buffers should not exceed 150 mg/L.

The Controller synchronizes the schedule of all reactors and sludge buffers running in automatic mode in accordance with the plant configuration and the selected methods for operation of the sludge buffer(s). The different operation methods for the sludge buffer are detailed in Aquasuite® Nereda® Controller Manual.

- **Fixed cycle time**
  Applicable for plants with reactors that operate in a very constant cycle time basis.
- **Synchronized with the reactor cycle times**
  Preferable for plants with sludge selection after settle and with reactors that operate with a variable cycle time.
- **Synchronized with selection after feed**
  Applicable for plants with sludge selection after feed and with reactors that operate with variable cycle time.

Process Conditions (applicable for sludge pre-thickening)

The process operating conditions of the sludge buffer tank(s) with pre-thickening, for example dry solids, sludge pumping velocity, etc., should be adjusted whenever required in order to respond to seasonal fluctuations in the sludge production and/or changes in the biomass characteristics. The goal is to optimize the solids capture efficiency and maintain a high dry solids concentration in the thickened sludge.

The process operation conditions defined for the plants nominal capacity are specified in the project

Process Design Report.

Chemical Dosing

If needed, the biological P-removal can be supplemented with chemical phosphorus precipitation with a metal salt dosing. The chemical dosing (location, type of metal and dosage) is project-specific and decided according to the effluent quality requirements and the wastewater characteristics. The dosing can occur in one or more of the following locations in the process: 1) influent to the reactors, 2) directly in the reactors during the mixing/aeration phase, 3) in a post-treatment after the reactors, and 4) in the return liquors line.

Downstream Operation

Effluent Buffer Tank(s)

Effluent buffer tank(s) (where applicable) are provided to absorb high effluent peak flows. They perform a hydraulic balancing function to decrease the flow rates discharged to the downstream effluent pipelines and treatment units.

Solids Treatment

Although the sludge treatment (where applicable) is not strictly part of the AquaNereda process-related installation, its design and operation are of critical importance to the successful operation of an AquaNereda plant and for this reason is specifically mentioned here. The AquaNereda installation requires frequently desludging (typically every cycle) to maintain high selection pressure and good granulation. The ability to remove excess sludge from the reactors is critical to process performance and in turn this means that the downstream solids handling facilities must be reliable and have sufficient capacity. In turn, any return liquors from the sludge handling should not adversely impact the AquaNereda installation.

It is of crucial importance that the sludge treatment facility works efficiently, and the following precautions must be taken:

- Thickening and dewatering equipment (as applicable) must exhibit the necessary availability and reliability at all times to ensure the efficient operation of the sludge treatment facility.
- The maximum concentration of the total suspended solids (TSS) returned to the main plant must not exceed the limits as specified in the plant's design.
- The polymer preparation and dosing unit(s) must be operational and polymer dosage must be adjusted as required to improve the efficiency of the sludge treatment.
- Sufficient stock of polymer must be available onsite to avoid the shutdown of the sludge facility.
- Sludge storage facilities must allow for sufficient volume of storage in proper coordination with the availability of the sludge collection services.

AquaNereda® Aerobic Granular Sludge Technology
General Process Control

Background Information

1 System Design Organic Loading

The system organic loading (F) is defined as the daily mass of BOD_5 that is fed to the AquaNereda system, and it is calculated using the following equation:

$$F = Q \times BOD_5 \times 8.34$$

Where,

F = System organic loading (lbs BOD_5/day)
Q = Average flow rate (MGD)
BOD_5 = Average influent BOD_5 concentration (mg/l)

The operating system organic loading should be calculated on a routine basis. If this value is significantly different from the design value, adjustments can be made to the system operation in order to maximize treatment efficiency. It is generally the intent to adjust the operating mass (or target MLSS concentration) as needed so the operating mass target is based on the same proportion that the actual load represents of the design organic load. In other words, if a plant is running at 30-40% of design organic load, then the system should probably be operating roughly 40-50% of design mass (MLSS concentration), and 50% of design aeration. These are rules of thumb that need to be adjusted based on other factors such as minimum operating temperature, influent nitrogen loading and effluent requirements. The duration of the Sludge Waste phase can also be adjusted in order to maintain an appropriate mass of mixed liquor suspended solids (MLSS) in the system. This is discussed in greater detail in the next few sections.

2 System Design Mass

The system mass (M) is defined as the mass of mixed liquor suspended solids (MLSS) existing in the AquaNereda system and it is calculated using the following equation:

$$M = Vol \times MLSS \times 8.34$$

Where,

M = System mass (lbs MLSS)

Vol = System volume (MG)

$MLSS$ = System MLSS concentration (mg/l)

The system MLSS concentration is measured simply by taking a sample of mixed liquor from the reactor and analyzing it for total suspended solids (TSS). For this AquaNereda system, the system volume is simply the volume of the reactor at the time of sampling. In order to calculate the volume of the reactor, the side water depth (SWD) at the time of sampling must be measured. With a known reactor wall height, a measurement from the top of the reactor to the water surface can be used to determine - the SWD as follows:

$$SWD = \text{Wall Height} - \text{Measured Distance}$$

It is recommended to take a MLSS sample during the React phase while the blowers are at or near 100% operation. This allows for the basin to be as completely mixed as possible. The sample can be taken anywhere in the tank, since the tank should be mixed independent of the sampling location.

The MLSS value can then be utilized to determine the system mass (M) using the following equation:

$$M = Vol \times MLSS \times 8.34$$

If the organic loading to the plant is at or near the design value, then the system should be operated at the design mass. Otherwise, the "target" value for the system mass may need to be adjusted in order to maintain a successful wastewater treatment system. In general, the targeted mass will be dependent on the actual versus design loading for organics, and nitrogen, with consideration given to other factors such as minimum operating temperature, and hydraulic load. Examples of how to target an operating mass are presented in later chapters. A process engineer at Aqua-Aerobic Systems, Inc. may be contacted for assistance in the determination of this new target value.

Maintenance of the exact target value for the system mass is normally difficult, and it is not a strict requirement for successful wastewater treatment. Observations with respect to the efficiency of solids/liquid separation should also be utilized to develop a suitable operating system mass for the reactor.

3 System Design Food-to-Mass Ratio

The F/M ratio relates the amount of food entering the treatment system to the amount of mass available to treat the incoming food. The system F/M ratio is calculated by dividing the system organic loading (F) by the system mass (M). The operating F/M ratio should be calculated for every sample of mixed liquor taken, and adjustments to the system mass should be made as necessary. If the influent concentrations and temperatures are within the design values, then the system F/M ratio should be maintained at or near the design value. However if the actual influent varies from the design influent in regards to temperature, influent concentrations or flows then adjustments need to be made to the targeted F/M ratio. The F/M ratio can be controlled by measuring the system organic loading and maintaining an appropriate system mass. Observations with respect to the treatment efficiency and the settling characteristics of the sludge should also be utilized to develop a suitable operating mass for this AquaNereda® system.

An extremely low F/M ratio (relative to the design value) indicates that the system has a large amount of mass relative to the amount of "food" being supplied by the influent wastewater. This means that the microorganisms in the reactor are living under near-starvation conditions. If the system operator determines that the operating F/M ratio is too low, then the operating F/M can be increased by simply decreasing the system mass. This is accomplished by <u>increasing</u> the duration of the Waste Sludge phase. An extremely high F/M ratio relative to the design value indicates that the system is receiving a large amount of food relative to the mass of the microorganisms existing in the reactor. This means that the reactor <u>may</u> not contain enough biomass to provide the required level of treatment. Typically this can be observed by having higher than desired <u>soluble</u> effluent parameters, such as BOD_5 or NH3-N. If the system operator determines that the operating F/M ratio is too high, then the operating F/M can be decreased by simply increasing the system mass. This is accomplished by <u>decreasing</u> the duration of the Waste Sludge phase.

In summary, the F/M ratio is controlled by measuring the system organic loading (F) and adjusting the system mass (M) as necessary.

4 System Design Sludge Age

Another operating parameter that should be calculated on a regular basis is the sludge age, or solids retention time (SRT). The sludge age is defined as the average number of days that the microorganisms are kept in the AquaNereda system before they are either discharged (in the effluent) or wasted from a reactor. Knowledge of the system sludge age assists the operator in the development of successful operating strategies.

The system sludge age can be calculated by dividing the operating system mass (M) by the daily mass of solids leaving the system. The mass of solids leaving the system is equal to the sum of the mass of solids discharged in the effluent and the mass of solids wasted from the system. The following simplified equation can be used to calculate the system sludge age:

$$SRT = \frac{M}{S_{eff} + S_w}$$ where,

Where,

SRT = Sludge Age (days)

M = System Mass (lbs MLSS)

S_{eff} = Daily mass of effluent solids (lbs TSS/day)

S_w = Daily mass of wasted solids (lbs TSS/day)

The system mass (M) can be calculated using the equations shown in the “System Design Mass” section of this document. The daily mass of effluent solids (S_{eff}) can be calculated using the following equation:

$$S_{eff} = Q \times TSS_{eff} \times 8.34$$

Where,

Q = Average flow rate (MGD)

TSS_{eff} = Effluent TSS concentration (mg/l)

The daily mass of wasted solids (S_w) can be calculated using the following equation:

$$S_w = Q_w \times TSS_w \times 8.34$$

Where,

Q_w = Daily volume of wasted sludge (MGD)

TSS_w = Waste sludge TSS concentration (mg/l)

As the flow and loading to the plant fluctuate, a target sludge age may be selected by monitoring the process, observing trends, and considering seasonal effects. For example, reactions in the reactor typically occur faster during the summer months due to higher average wastewater temperatures. Therefore, a lower sludge age may be utilized to achieve an adequate level of treatment during the summer. Due to the colder average temperatures during the winter months, it may be necessary to operate the AquaNereda® system at a greater sludge age in order to meet the required treatment objectives during the winter.

The minimum sludge age is generally greater for a system that requires nitrification than for one that does not require nitrification. This is due to the fact that nitrifying organisms (*Nitrobacter* and *Nitrosomonas*) require more time to develop than most other microorganisms that are typically found in a secondary treatment system. A sludge age of ≥5 days is typically required to ensure that nitrification can occur. Higher sludge ages may be required during the winter months. This is due to the slower growth and metabolic rates of nitrifying organisms at colder temperatures.

If it is determined that the sludge age is too high, the duration of the Sludge Waste phase should be <u>increased</u>. This increases the amount of solids wasted from the system and decreases the sludge age. If it is determined that the operating sludge age is too low, the duration of the Sludge Waste phase should be <u>decreased</u>. This increases the system mass (M), thereby increasing the system sludge age (SRT).

Consideration of all relevant factors (temperature, pH, MLSS concentration, F/M ratio, BOD_5 removal, settling characteristics, nitrification, and any other process variables) should be made when a change to the operating sludge age is made in a system. An operator should allow plenty of time (at least several days) to see the effect of changes in sludge wasting. Therefore, care must be taken not to "over-waste sludge" from the system.

System F/M and Mass Control Calculations

The **example calculations** below show values for the organic loading, reactor volume, system mass, F/M, and sludge age of a system. Once the system is in operation, the calculations shown can be used as examples for calculating these parameters. **Please note this calculation is only an example and is to be used as a reference only. Actual plant values will need to be substituted into the equations to be accurate for your system.**

1 Design Organic Loading

This system has a design average flow rate (Q) of 1.0 MGD and a design average influent BOD_5 concentration of 250 mg/l. Therefore, the design system organic loading is calculated as follows:

$$F(des) = 1.0\ \text{MGD} \times 250\ \text{mg/l} \times 8.34\ \text{lbs/gal}$$
$$= 2{,}085\ \text{lbs } BOD_5\text{/day}$$

2 Reactor Volume Calculation

The reactor volume is then calculated using one of the following equations:

$$Vol = \text{Length} \times \text{Width} \times \text{SWD} \times \#\text{ of Basins} \quad \text{(for rectangular or square basins)}$$

$$Vol = 3.14 \times \text{Radius}^2 \times \text{SWD} \times \#\text{ of Basins} \quad \text{(for circular basins)}$$

For example, the volume of a 60 ft X 60 ft reactor at the 20 ft design process water level is calculated as follows:

$$Vol\ (\text{at LWL}) = 60\ \text{ft} \times 60\ \text{ft} \times 20\ \text{ft} \times 1\ \text{Basin}$$
$$= 72{,}000\ \text{ft}^3$$

This volume can be expressed in million gallons (MG) as follows:

$$Vol\ (\text{at LWL}) = \frac{72{,}000\ \text{ft}^3 \times 7.48\ \text{gal/ft}^3}{1{,}000{,}000\ \text{gal/MG}}$$
$$= 0.539\ \text{MG}$$

3 System Design Mass

This system has a design MLSS concentration of 8,000 mg/l defined at the 20 ft LWL. Therefore, the design system mass is calculated as follows:

$$M(des) = 0.539\ \text{MG} \times 8{,}000\ \text{mg/l} \times 8.34\ \text{lbs/gal}$$
$$= 35{,}962\ \text{lbs MLSS}$$

4 System Design F/M

The design organic loading (F) for this system is 2,085 lbs BOD_5/day, and the design system mass (M) is 35,962 lbs. Therefore, the design F/M ratio for this system is calculated as follows:

$$F/M(des) = \frac{2{,}085 \text{ lbs } BOD_5/\text{day}}{35{,}962 \text{ lbs MLSS}}$$

$$= 0.058 \text{ lbs } BOD_5/\text{lb MLSS-day}$$

$$= 0.058 \text{ days}^{-1}$$

5 System Design Sludge Age

This system has a design average flow rate (Q) of 1.0 MGD and an anticipated effluent TSS concentration of 10 mg/l. Therefore, the design mass of effluent solids is calculated as follows:

$$S_{eff}\,(des) = 1.0 \text{ MGD} \times 10 \text{ mg/l} \times 8.34$$

$$= 83.4 \text{ lbs TSS/day}$$

Based upon the influent parameters, the estimated daily mass of wasted solids, per the design calculations, is 2,000 lbs/day. Therefore, the design sludge age (SRT) is calculated as follows:

$$SRT(des) = \frac{35{,}962 \text{ lbs MLSS}}{83.4 \text{ lbs TSS/day} + 2{,}000 \text{ lbs TSS/day}}$$

$$= 17.3 \text{ days}$$

Process Control Techniques

Process related troubleshooting requirements are typically related to a loss of treatment efficiency for one reason or another. Several factors may need consideration in the evaluation of a system to determine a cause or causes for a decline in treatment efficiency. The recommended sampling and testing program, in conjunction with maintaining good records, will allow the operator to detect trends of operation of the AquaNereda®. The operator can then adjust the conditions in the reactor to either avoid unnecessary problems or to minimize losses in treatment efficiency.

The "Process Control Techniques" section that follows has been developed to assist the operator in maintaining a stable and efficient treatment process. The "Process Control Techniques" section answers many of the most common questions that arise during operation of an AquaNereda® system. Instructions for the tests required to maintain an efficient treatment process are described in this section. If there are any questions in regards to the information presented in the "Process Control Techniques" section, or other process or mechanical issues, feel free to contact an applications engineer at Aqua Aerobic Systems.

1 Selecting a Target MLSS

Each AquaNereda® is designed with a given MLSS concentration, typically 8,000 mg/l. The target value for your system can be seen on the AquaNereda® design summary in the Process Section of the O&M manual. It should be noted that the design MLSS value is based on the assumption the system is operating at the design flow and load at the minimum temperature listed on the design summary (unless otherwise specified).

When selecting a target MLSS concentration there are a few parameters that need to be considered:

1. The current operating percent of design organic load
2. The current operating percent of design nitrogen load (for plants that need to nitrify or denitrify)
3. The minimum in-basin temperature the MLSS will be operating at for the period in question.

Some rules of thumb for selecting a target MLSS concentration are:

1. For plants that do not have a nitrogen effluent requirement, assuming a relatively consistent organic load on a day to day basis like many municipal plants may see, then determine the % of design load on an organic basis. Take this percentage, add 10-20% to this value, convert it to a % of design MLSS concentration and set this as your target MLSS concentration. The 10-20% factor is based on accounting for variations in load from a day to day basis. This is assuming that the plant does not have an effluent nitrogen requirement. If a plant has an effluent nitrogen requirement, then the % of design load on nitrogen is typically the controlling factor. An example of the approach of setting the target MLSS based on % of design organic load is as follows:
2. Plant is receiving 400 lbs/day of organic load. The system was designed for 1000 lbs/day of BOD at full load with all the reactors on line. The plant is at 40% of design organic load (400/1000). Therefore based on the instructions above, the system would set the target MLSS concentration at 40 + (10 to 20%) = 50-60% of the design MLSS. If the plant were designed at 8,000 mg/l of MLSS this would equate to roughly 4000 – 4,800 mg/l MLSS at LWL.
3. For plants that have a nitrogen effluent requirement, the % of design nitrogen load needs to be

considered. If the % of design organic load is greater than the % of design nitrogen load then the % of design organic load can control the MLSS target and you should follow the example given in A above. For example if a plant is at 40% of design organic load, but only 25% of design nitrogen load, then the organic load controls the target MLSS. However if the actual nitrogen load % is greater than the actual organic load % (such as 60% of design nitrogen load versus 40% of design organic load) than the nitrogen loading should control the target MLSS. It is often the case that the nitrogen loading controls the target MLSS, and not the organic load. If a plant is at 60% of design nitrogen load, then it would be recommended to run 70-80% of design MLSS in order to allow the system to completely nitrify in the coldest temperatures. An example of the approach of setting the target MLSS based on the % of design nitrogen load is as follows:

4. Plant is receiving 60 lbs/day of nitrogen but is designed at 100 lbs/day of nitrogen load with all basins on line. This equates to 60% of design nitrogen load. The same plant is receiving 40% of design organic load. The plant should set its target MLSS based on the nitrogen load. If the plant's original design target MLSS was 8,000 mg/l, then the target MLSS would roughly 70-80% of 8,000 mg/l or 5,600-6,400 mg/l during cold weather operation.
5. The target MLSS concentration is linked directly to the operating temperature for any plant that needs to nitrify or denitrify. As noted above, each AquaNereda® system is designed on paper to fully nitrify at the minimum temperature listed on the design summary. Therefore it is possible to operate at lower target MLSS in the summer (when nitrifiers are working faster) than during the winter.
6. It is typically recommended to have a minimum of 15% of design organic load to a system (for nitrification plants) to keep all of the basins on line. The minimum organic load is 25% for systems that are targeting denitrification, since they need soluble carbon in order to drive the denitrification reaction. If the plant is running at less than 15% of design load (for nitrification only plants) or 25% of design load (for denitrification plants) then there are two options: Either a basin (or basins) can be taken off line, or supplemental carbon can be added to the system. If supplemental carbon would be necessary then the amount of carbon added would be as needed to make up the difference between the actual organic load and the targeted 15% or 25% value. For example if a plant had an actual load of 11 lbs/day and the target is 25 lbs/day of organic load, then supplement will be needed as the difference between 25 lbs and 11 lbs, or 14 lbs of supplemental carbon.
7. Single basin operation is only possible if there is a Pre-Equalization basin ahead of the AquaNereda® reactor.
8. The effluent values for soluble parameters such as BOD, NH3 and NO3 should be observed to confirm if the plant has enough active mass. If any of the soluble parameter effluent values are greater than desired and the plant is within its design loading limitations then either the system mass needs to be increased or the aeration system operation needs to be adjusted (provided the other parameters – temperature, phase times, etc. – are within an acceptable range).
9. If the plant sees high peaking factors as compared to the average load, then consideration needs to be given to setting the target MLSS based on the peak values. Whether or not this approach is taken will depend on the frequency of the peak loads. One approach that is often taken when looking at peak loads is to take the average of the 3 highest influent values and set this as the actual load when doing the % of design load calculations. This serves to dampen out infrequent peaks that may be non-representative.

2 Treatment Cycles per Day

Each AquaNereda® reactor is designed to operate at a designated number of complete treatment cycles per day. Variation of the hydraulic loading as compared to the basis of design may dictate a revision in the number of treatment cycles to provide optimization of treatment efficiency in the AquaNereda® system. Specifically the system has the ability to carry a longer Settle phase for improved solids liquid separation while in start-up period, and also the ability to sequence the aeration system on/off more to improve the ability to denitrify if the system is operated in fewer cycles. There is also the ability to aerate more hours per day if running fewer cycles, since the system is not going through the non-aerated phases of Fill/Draw and Settle as many times. For multi tank systems, a reduction in the quantity of basins in operation may be considered. However, if a plant is not receiving its design organic or hydraulic load, there are a number of factors that need to be considered before a change is made to the mode of operation. These factors are discussed in detail in the following paragraphs.

2.1 Plants that are hydraulically underloaded

Often when plants are going through their initial stages of operation, they receive less than their design average flow. Generally, adjustments may be made to the aeration counters and/or the MLSS concentration in the reactor to improve the efficiency of the treatment process. It may also be possible to adjust the duration of each phase while maintaining the same overall number of treatment cycles per day (see the Process Section of the O&M Manual). In some cases, the system may be so underloaded that the changes listed above are not sufficient to optimize the treatment process. In these cases, it may lead to improved process control and improved effluent quality if the plant is operated at fewer cycles per day than specified in the original design. This is due to the increased cycle times used when operating at fewer cycles per day. The increased cycle times lead to more flexibility in adjusting the cycle structure and aeration counters to meet specific treatment objectives, such as nitrification or denitrification.

In order to determine if a change in the number of treatment cycles completed per day is in order, or a change to single basin operation should be made, the operator must determine the average daily flow and maximum daily flow that the plant is receiving. If the plant is dramatically hydraulically underloaded (less than 50% of the maximum design flow as shown on the design), then a reduction in the number of cycles of operation may be beneficial. Another consideration when changing cycle quantity is that you are also changing the frequency of Sludge Wasting. When the cycle quantity changes the Sludge Waste duration needs to change accordingly to maintain the desired number of minutes per day of wasting.

Once the average daily flow and maximum daily flow are determined, the operator can use the following example calculation to determine the optimum number of treatment cycles per day.

<u>Example</u>

Design Conditions

Dual Basin System, 5 cycles per basin per day

Design Avg. Flow = 0.666 MGD   Design Maximum Flow = 1.000 MGD

Process Water Level (WL) = 20.0 ft

Cycle Times

Fill/Draw = 60 minutes

React = 208 minutes

Settle/Sludge Wasting = 20 minutes

Two (2) Square Basins, 35 ft x 35 ft

Actual Conditions

Avg. Daily Flow = 0.100 MGD Maximum Daily Flow = 0.20 MGD

The volume per cycle can easily be calculated by taking the design maximum flow off the AquaNereda® design summary in the Process Section of the O&M manual, and dividing it by the design number of cycles for all of the tanks operating. For example, a dual basin system designed at 5 cycles per day per basin, with a design maximum flow of 1 MGD would have a batch size of 1 MG/10 cycles = 0.1 MG.

Note that every time the operator changes the quantity of cycles that the system is operating, it affects the hydraulic capacity of the system. Increasing the quantity of cycles increases the hydraulic capacity and decreasing the quantity of cycles decreases the hydraulic capacity. The change in hydraulic capacity is directly proportional to the change in quantity of cycles. For example if the operator changes from 5 cycle per day operation to 4 cycle per day operation then he has reduced the hydraulic capacity by (1 – 4/5) = 0.2, or 20%.

Since the actual conditions show that the maximum daily flow received at the example plant is only 0.20 MGD and the plant has the capacity to treat 0.10 MG per treatment cycle, then 2 treatment cycles per day (1 per basin x 2 basins) could be used to treat the influent wastewater. In order to be able to process potential peak flows greater than 0.20 MGD and keep the system out of Storm Flow mode, it would be recommended that this plant operate at 2 cycles per basin per day (4 cycles per day total).

At 2 cycles per basin per day, the maximum hydraulic capacity of the plant would be decreased from the design value of 1.0 MGD to:

Maximum Hydraulic Capacity (MGD) = 4 cycles per day x 0.10 MG per cycle

= 0.40 MGD

If a pre-equalization basin is not included, the operator must consider the likelihood of peak flows in excess of this value. If a diurnal (non-constant) flow pattern is present, the operator must also consider the possibility that a peak flow greater than the maximum volume treated per cycle may enter the reactor during one “Fill/Draw” phase. Either one of the conditions listed above could send the system into storm flow mode. The operator should compare the likelihood of storm flow conditions to the benefits derived from operating at fewer cycles per day. If the decision is made to change the number of cycles the system completes in a day, the duration of each treatment cycle is changed at the operator interface at the control panel (or at the SCADA system if applicable). In order to change the quantity of cycles per day the system operates, the operator simply needs to modify the phase durations so that the total times add up to a different value. Different cycle durations are shown below:

1 cycle per day = 1440 minutes

2 cycles per day = 720 minutes

3 cycles per day = 480 minutes

4 cycles per day = 360 minutes

5 cycles per day = 288 minutes

6 cycles per day = 240 minutes

8 cycles per day = 180 minutes

Note that it is not a strict requirement to run a whole number of cycles per day. Many designs are dome based on a round number of minutes per cycle (i.e. 300 minutes), which equates to 4.8 cycles per day.

2.2 Plants that are hydraulically overloaded

For plants that are hydraulically overloaded, an increase in the number of treatment cycles per day may be possible - as long as processes preceding or following the AquaNereda® system are designed to handle the additional flow. If the plant is hydraulically overloaded on a seasonal or short term basis, increasing the treatment cycles per day may allow the system to handle the increased load and flow. If the plant is hydraulically overloaded on a long-term basis, then an expansion of the treatment plant may be required.

For plants that are hydraulically overloaded on a short term or seasonal basis, increasing the treatment cycles per day would have the benefits of increasing the maximum hydraulic capacity of the plant and avoiding storm flow conditions in the system under normal flow conditions. Increasing the cycle quantity may decrease operational flexibility due to the shortening of the React phase, and could theoretically lead to less complete treatment of the influent wastewater. In addition, the oxygen delivery capability of the system must be analyzed to verify that the system is capable of handling the increased flow and load to the plant.

2.3 Summary

For plants that are not at design flow, a change in the number of treatment cycles completed per day may be beneficial. Factors such as maximum daily flow, influent loading, oxygen delivery capacity and effluent requirements must be considered. A change in the number of treatment cycles performed per day is recommended <u>only</u> when it will improve the treatment process and effluent quality. It is generally recommended that the operator contact a process engineer at Aqua-Aerobic Systems if there are questions in regards to the optimum cycle structure for their plant at the current load conditions. For plants that are not at design organic load, it is recommended that the operator refer to the sections on F/M and MLSS in the “System Mass Control” section of this process manual.

3 Dissolved Oxygen Control

The control of dissolved oxygen (D.O.) levels in an AquaNereda® system is an important part of overall process control. The concentration of D.O. in the reactor has a profound effect on many different operational parameters including BOD_5/COD removal, nitrification, denitrification, and phosphorus removal. In addition, proper control of D.O. levels helps to optimize the use of electricity through efficient control of the aeration system in the reactor.

In general, the recommended D.O. concentrations in the reactors, during the React phase is approximately 2.0 mg/l for nitrification only plants, and 0.5 to 1.5 mg/l for plants that require TN removal. These D.O. targets are based on the desire to optimize the rate of nitrification and denitrification. Normally the D.O. is controlled based on the reading from a DO sensor, which will target the desired setpoint by controlling the aeration system.

Depending on the denitrification level to be targeted, forced "off" times may be incorporated to the cycle structure to allow the D.O. to drop to the targeted < 0.5 mg/l during the anoxic periods. To enhance granulation and biological phosphorus removal, a D.O. concentration near zero during the Fill/Draw phase is required.

A D.O. profile is available in each cycle via the HMI or SCADA system (if available). The operator shall ensure that the on-line sensor is calibrated. Calibration and cleaning of the probe should be performed to the manufacturer's recommendations. A D.O. profile should be verified once per week, to determine that adequate D.O. levels are present to achieve the required process objectives. See the "Dissolved Oxygen Profile Procedure" in this manual for instructions on how to perform a D.O. profile.

The D.O. profile will assist the operator in determining when adjustments to the aeration counters or the duration of specific treatment phases are necessary to maintain the proper D.O. levels in the reactor. Numerous factors may affect the amount of aeration system "on" time required to achieve the required D.O. levels. For example, changes in flow, organic load, temperature, and sludge age affect the oxygen demand and resulting D.O. levels.

Plants that are organically underloaded may be able to decrease the number of blowers or aerators operating and still maintain a desirable D.O. residual in the basin. Or, it may be possible to operate two or more aeration devices at the beginning of the aeration cycle and shut off units as the oxygen demand decreases in the latter stages of the aeration cycle. D.O. profiles would be required to determine if these options are feasible.

A sudden drop in D.O. may indicate a significant increase in organic loading, and the aeration counters for the system may need to be adjusted to give the system more aeration "on" time. If the system has multiple aeration devices, an additional unit may need to be operated. A sudden increase in the D.O. concentration in the reactor may be a sign of decreased organic load, or a sign of a toxic load passing through the plant which is adversely affecting the biomass.

Each AquaNereda system has been supplied with a PLC based control system with aeration timers that are adjustable for each aeration device. Some rules for the aeration timers when operating in "Time Mode" in an AquaNereda.

3.1 Setting the aeration timers

Each AquaNereda has been designed (on paper) based on the flow and load values listed in the design in the Process Section of the O&M manual. If the plant actually received flows and loads equal to the design, then we would say the plant is at 100% of design load. The majority of systems do not start-up or operate for most of their life at 100% of design load. Therefore energy savings and process benefits can be derived by reducing the operation of the aeration system to coincide with the actual loading in lieu of the design load. Listed below are some rules of thumb and examples on how to optimize the operation of the aeration system.

1. The first task in determining if the aeration system operation can be reduced is to confirm the operating % of design load. The design load for both organics (BOD or COD) and nitrogen (NH3 or TKN) needs to be determined. As an example a plant designed for 1.0 MGD at 250 BOD and 45 TKN would have a design load of (1.0 MGD x 8.34 x 250 mg/l BOD) = 2085 lbs/day BOD and (1.0 MGD x 8.34 x 45 mg/l TKN) = 375 lbs/day TKN.
2. Determine the actual plant influent loading. If the plant described in the paragraph above were seeing influent of 250 mg/l BOD and 45 mg/l TKN, but at a flow of 0.25 MGD, it would be operating at 0.25/1.0 = 25% of design load. Don't forget that the sidestreams, like digester supernatant, are part of the load to the plant for BOD, TSS, TKN and Total P and need to be added on to the influent loading.
3. Confirm the "design" aeration time values from the control description in the Process Section of the O&M manual.
4. Set the aeration timers to coincide with the actual load, while taking into account diurnal variation and peak day loads. Once the % of design load is determined, it is usually recommended to add 10-20% to this value to use as a starting point for setting the aeration timers.
5. Check the D.O. in the basin via a D.O. probe to confirm that the targeted D.O. concentrations are being achieved.
6. Note that for plants that are designed for low total nitrogen, additional denitrification time may be required. The React phase will start with an aeration period where the influent TKN/NH3 is nitrified, and some of the nitrate will be denitrified inside the granules, but some aeration "off" periods can be introduced to achieve lower TN.
7. After an aeration timer adjustment the operator should perform a D.O. profile, and take effluent BOD, NH3 and NO3 samples and adjust the aeration timers as needed.

3.2 Effects of high DO on treatment process

In an AquaNereda process, high DO concentrations may lead to some process issues. In systems that require denitrification, operating at high D.O. levels could lead to problems in achieving the desired effluent nitrate or total nitrogen levels. At high DO concentrations, the aerobic layer in the granule could be large, not allowing enough anoxic layer where denitrification occurs. In systems designed for biological phosphorus removal, the efficiency of phosphorus removal by the biomass may decline if high dissolved oxygen is present in the reactor during the Fill/Draw phase.

Over-aeration also leads to inefficient use of electricity, since the aeration system is operating more than is required to meet the oxygen requirement of the biomass. High D.O. concentrations can be caused by a plant that is organically underloaded, by improper aeration counter settings, or by the system receiving a toxic influent, limiting the ability of the biomass to utilize oxygen. Through the performance of regular D.O. profiles, and tracking of the influent organic load and toxicity, the cause of the increased D.O. concentration can usually be determined. Adjustments to the aeration counters on the system control panel should be made as necessary to achieve the desired oxygen concentrations.

4 Nutrient Addition

In general, domestic wastewater has adequate concentrations of the nutrients necessary for bacterial growth and reproduction, and addition of nutrients to domestic wastewater should not be necessary.

However, wastewater from industrial sources, or wastewater that is a mixture of domestic and industrial wastewater, may lack the necessary nutrients to optimize bacterial growth. In these cases, the nutrients phosphorus (P) and nitrogen (N) are often added to the wastewater to promote bacterial growth.

To promote bacterial growth in the system, as well as to prevent issues related to lack of nutrients, a food to nutrient ratio of 100:5:1 (BOD_5:N:P) is generally recommended. However, the degradability of the influent TOC or COD may affect the amount of nutrients required. If the influent TOC or COD is biodegradable and it greatly exceeds the influent BOD_5, then additional nutrients may be required. The way to test the TOC or COD degradability would be to run an ultimate BOD test, in lieu of a 5 day BOD test. The ultimate BOD (BOD_u) test would be a 28 day BOD analysis and would better simulate what would be broken down in the treatment system than a 5 day BOD test. Once the ultimate BOD (or biodegradable TOC or COD) is determined, then the nutrients should be added based on this value, not the BOD_5 value.

Another quicker option as a way to test for degradable carbon would be to run a Total Organic Carbon, or TOC test. This test takes just a couple hours, and would be more representative of degradable carbon coming into the system than a COD test.

The nutrients should be in a form that makes them readily available to the biomass. Nitrogen should be in the form of ammonia, and phosphorus should be in the orthophosphate form. Orthophosphate represents the soluble fraction of the total phosphorus that is readily available to the biomass. If the influent wastewater does not contain nutrients in the 100:5:1 ratio, then nutrient addition is recommended to maintain the proper food to nutrient ratio. It is recommended that nutrient addition take place during the fill phase of the cycle structure, so that nutrients are available to the biomass along with the influent food source.

In order to determine the proper amount of nutrients to be added to the system, the operator should know the BOD_5, BOD_u, COD or TOC, TKN, NH_3-N, and Total Phosphorus and ortho-phosphorus concentrations in the influent waste stream. It should be noted that return streams such as digester supernatant in a plant would increase nutrient loadings to the reactors, while metal salt addition would decrease nutrient availability.

4.1 Nitrogen Addition

For wastewater that is nitrogen deficient, nitrogen is generally added to wastewater in the form of ammonium hydroxide NH_4-OH, or urea ($CO(NH_2)_2$). Other nitrogen sources are available, and the choice of chemical used can be made based on availability, price, availability of storage space, and chemical handling capabilities. An example is shown below for the addition of liquid 29% ammonium hydroxide (as NH_3) to a wastewater with a BOD_5 of 1,000 mg/l to reach a BOD_5:N ratio of 100:5.

Average Flow = 28,800 gallons/day (0.0288 MGD) Influent BOD_5 = 1,000 mg/l

Desired N/BOD_5 ratio = 5/100

= 0.05

Lbs “N” required/day = (1,000 mg/l BOD_5)(0.0288 MGD)(8.34 lbs/gal)(0.05)

= 12.0 lbs “N” required/day

If ammonium hydroxide with a concentration of 29% as NH_3 is used,

Specific gravity = 0.90 Formula Weight (NH_3) = 17 Formula Weight (N) = 14

$$\text{Quantity of Ammonium Hydroxide Required} = \frac{(12.0\ \text{lbs/day})(17)}{(14)(0.29)(0.90)(8.34\ \text{lbs/gal})}$$

Ammonium Hydroxide Required = 6.7 gallons/day (25,300 ml/day)

Therefore a metering pump would be set for (25,300 ml/day)/(1440 min/day) = 17.6 ml/min to feed the required nitrogen to the system **for this example**.

4.2 Phosphorus Addition

For wastewaters that are phosphorus deficient, phosphorus is often added to wastewater in the form of phosphoric acid (H_3PO_4). An example is shown below for the addition of 85% phosphoric acid to the influent wastewater. Phosphorus should be added in the ratio of 100:1, (BOD_5:P).

Average Flow = 28,800 gallons/day (0.0288 MGD) Influent BOD_5 = 1,000 mg/l

Desired P/BOD_5 ratio = 1/100

= 0.01

lbs “P” required/day = (1,000 mg/l BOD_5)(0.0288 MGD)(8.34 lbs/gal)(0.01)

= 2.4 lbs “P” required/day

If phosphoric acid with a concentration of 85% H_3PO_4 is used,

Specific gravity = 1.7 Formula Weight (H_3PO_4) = 97.97 Formula Weight (P) = 30.97

$$\text{Quantity of phosphoric acid required} = \frac{(2.4\ \text{lbs/day})(97.97)}{(30.97)(0.85)(1.7)(8.34\ \text{lbs/gal})}$$

= 0.6 gallons/day (2,400 ml/day)

Therefore, a metering pump should be set up to add (2,400 ml/day)/(1440 min/day) = 1.7 ml/min of phosphoric acid **for this example**.

The calculations shown above are for example purposes only. If nutrient addition is required to your system, then the corresponding flow, BOD_5, COD or TOC, and chemical strength data should be inserted into the calculations shown above to determine the rate of nutrient addition required for your influent wastewater.

If the wastewater lacks alkalinity, then the addition of nutrients may affect the pH of the system due to the high strength of the chemicals being added. The pH should be monitored at points prior to and after the chemical addition point if possible. If the system has effluent nutrient limits, then the addition of chemicals to the system should be closely monitored, with both influent and effluent nutrient testing recommended.

5 Nitrification

Many AquaNereda® systems are designed to perform nitrification in order to meet effluent limits for ammonia, TKN or total nitrogen. Nitrification is defined as the oxidation of ammonia to nitrate (nitrite is an intermediate product that is further oxidized into nitrate in this process). Autotrophic bacteria present in the aerobic layers of the granule perform the two-stage nitrification reaction. Oxidation of ammonia to nitrite is the first step in the process of nitrification. This first step is known as nitritation and is performed by a number of nitrifying bacteria including *Nitrosomonas, Nitrosococcus, Nitrosopira, Nitrosolubus* and *Nitrosovibrio*. The second step is the conversion of nitrite to nitrate and this step is performed by the nitrite oxidizing bacteria *Nitrobacter* and *Nitrospira.* Nitrification in an AquaNereda® system occurs in the aerated portions of the React phase.

The rate of nitrification in the treatment system is controlled by many factors. The primary factors associated with nitrification are as follows:

1. Temperature
2. Sludge Age, MLSS and Mixed Liquor Volatile Suspended Solids (MLVSS) Concentration
3. Dissolved Oxygen (D.O.) Levels
4. pH/Alkalinity
5. Inhibitory Substances
6. BOD5/TKN Ratio

Each of these factors will be discussed in detail in the paragraphs below. It is recommended that the operator track these factors on a regular basis, along with influent and effluent ammonia, nitrate, and TKN concentrations to determine if the nitrification process is working efficiently. While tracking the above items listed above, it is important to record the cycle time and phase when the sample or test is taken. Knowledge of these parameters under normal conditions will provide invaluable assistance when troubleshooting is required.

Keep in mind that the nitrifying bacteria does not “eat” or consume the ammonia, it is actually carbonate alkalinity or carbon dioxide that is used by the nitrifiers as their carbon source in the nitrification process. The ammonia is used as an energy source in the nitrification reaction, but it is not actually consumed by the nitrifiers. This is why it is critical to have adequate alkalinity available in a wastewater that needs to be nitrified.

It should also be noted that the nitrifying bacteria are the most sensitive to washout, temperature and toxicity of all the bacteria in the system. If the system is upset by one of those factors the ability to nitrify is typically the first to go and can take longer time to recover.

1.1 Temperature

Temperature is a very important factor in determining the rate of nitrification in the system, but it is a factor that the operator has little control over. Nitrifying bacteria reproduce more slowly and are less active as wastewater temperatures decrease. Therefore, the rate of nitrification in an AquaNereda® system would generally be expected to decrease with decreasing temperature. After a population of nitrifying bacteria is developed in a basin, if the temperature drops below 10°C it is normally possible to maintain the nitrifier population, but if the population is lost, it may not be possible to re-establish the nitrifiers until wastewater temperatures rise. The minimum temperature where consistent nitrification can be expected is in the range of 8-10°C (46.4-50°F). Below this range, nitrification may occur, but it is unpredictable. It is important to maintain a stable operation and avoid over-wasting sludge or shocking the biomass during cold weather operation. It is generally recommended to increase the operating MLSS concentration (and thereby the nitrifier population) and sludge age during cold weather operations to help offset the lower nitrification reaction rate at lower temperatures. By closely monitoring the effluent ammonia, it can be determined if more biomass is necessary. Operating at a higher MLSS concentration in cold weather is acceptable as long as it does not affect the system settleability to the point where the effluent TSS concentration increases. In addition, taking precautions to prevent excess cooling of the wastewater in the reactor during abnormally cold conditions can help to maintain nitrification rates.

For warm weather operation, a nitrifying bacteria population should be maintainable up to approximately 35°C. At temperatures greater than 35°C, the elevated temperatures may have an adverse effect on nitrification, as well as BOD_5 removal and settling.

It is recommended that the operator track and record the basin temperature on a daily basis when basin temperatures are expected to be outside the design temperature range.

1.2 Sludge Age, MLSS and MLVSS Concentration

The operating sludge age, MLSS, and MLVSS concentrations are important parameters to monitor because the nitrifying bacteria have a slower growth rate than most bacteria encountered in wastewater treatment. Because of this fact, systems that require nitrification generally operate at longer sludge ages than those that do not require nitrification. For this reason, it is desired that a minimum sludge age of 5 - 10 days be maintained during cold weather operations in AquaNereda® systems that require nitrification. The targeted sludge age will depend on a combination of influent TKN, temperature, D.O. and MLVSS. The MLVSS concentration should be measured as well, as this value will provide an approximate indication of the amount of active mass present in the system. It is recommended that the operating sludge age be calculated a minimum of one time per week, or any time that a change to the sludge wasting schedule occurs. The operating sludge age may be adjusted as necessary by changing the length of the Waste Sludge phase. Decreasing the sludge waste time will increase the sludge age and the volume of mass in the system.

1.3 Dissolved Oxygen (DO) Concentration

A D.O. concentration of approximately 2.0 mg/l is generally recommended during aerated periods for plants that require nitrification. In granular sludge processes D.O. concentrations less than 2.0 mg/l but greater than 1.0 mg/l are acceptable for nitrification and will enhance simultaneous denitrification. Nitrification will decrease at D.O. concentrations less than 1.0 mg/l. D.O. concentrations greater than 4.0 mg/l are considered excessive and are not required for nitrification to occur. If D.O. concentrations greater than 4.0 mg/l are occurring in an AquaNereda basin, it may be possible to decrease the amount of aeration system "on" time, as long as D.O. concentrations are maintained above 2.0 mg/l. Note that the rate of nitrification does not increase at D.O. concentrations greater than 2.0 mg/l, so operating at high D.O. concentrations (greater than 3-4 mg/l) does not improve nitrification. It is essential that a D.O. profile be performed prior to an aeration time change to insure that adequate supply of air is available during peak organic loading conditions.

It is recommended that the operator perform D.O. profiles in each AquaNereda basin on a weekly basis. By performing D.O. profiles throughout the React phase, it can be verified that an appropriate D.O. residual is maintained. If the D.O. levels are not at the desired level, adjustments to the aeration counters may be necessary to increase or decrease the D.O. concentration.

1.4 pH and Alkalinity

Optimum rates of nitrification occur in the pH range of 7.5-9.0. It is possible to nitrify when the pH is outside of this range, but the nitrification reaction will not occur as quickly. To maintain the optimal pH, it is essential that the wastewater have sufficient alkalinity resist changes in the pH. This is due to the fact that for every 1 mg/l of ammonia nitrogen nitrified, approximately 7 mg/l of alkalinity (as $CaCO_3$) is destroyed, potentially leading to a decrease in basin pH. A minimum of 50 mg/l of alkalinity (as $CaCO_3$) in the effluent should be targeted. If there is not sufficient alkalinity present in the wastewater, the nitrification process will lower the overall pH in the basin, possibly to the point where it inhibits the nitrification and carbonaceous oxidation process. Therefore, pH and alkalinity should be monitored regularly. If the effluent pH drops below 6.5, or effluent alkalinity is less than 50 mg/l, then the nitrification rate may decrease severely. In this case, lime, caustic or bicarbonate addition to the reactor to raise the alkalinity and pH of the wastewater may be necessary. It should be noted that performing denitrification restores half of the alkalinity that is destroyed in the nitrification reaction. This can be taken into account in the calculation of required alkalinity.

1.5 Inhibitory Substances

Inhibitory substances in the influent wastewater can interfere with the metabolism of nitrifying bacteria. Some inhibitors of concern are metals and inorganic compounds such as: zinc, copper, nickel, fluoride, lead, hexavalent chromium, magnesium, sulfate, and sodium cyanide. Other inhibitors that may be present in industrial wastewater are acetone, chloroform, and ethanol. Before the inhibitory substance list is examined during troubleshooting of the nitrification process, it is recommended to check the more "typical" controlling factors for nitrification, such as temperature, D.O., pH and alkalinity. If the factors listed above such as temperature, D.O., pH/Alkalinity and sludge age are shown to not be the cause for a loss of nitrification, then analyses should be performed to determine if the inhibitory substances listed in this section are present at inhibitory levels.

Per the 1977 reference "Wastewater Treatment Plant Design, WPCF Manual of Practice No. 8" (p. 227), the threshold concentrations for inhibition of the nitrification process are as follows:

Parameter	Concentration, mg/l
Hexavalent Chromium	0.25
Cyanide	0.34
Lead	0.5
Magnesium	50
Nickel	0.25

Sulfate	500
Zinc	0.08 to 0.5
Copper	0.005 to 0.5

The concentration level at which inhibition of nitrification occurs in your AquaNereda system may vary from the values listed above, and will be affected by the basin concentration of the inhibitory substance as well as the influent concentration.

1.6 BOD5/TKN Ratio

The ratio of BOD_5 to TKN in the influent to the system is an important factor in determining the fraction of nitrifiers that will be present in the system. As the BOD_5/TKN ratio increases, the fraction of nitrifiers in the reactor decreases. Conversely, as the BOD_5/TKN ratio decreases, the fraction of nitrifiers in the reactor increases. This is usually the result of the yield of heterotrophic and autotrophic organisms in response to the respective organic and nitrogenous loads to the system.

6 Denitrification

Denitrification is defined as the conversion of nitrate to nitrogen gas. Denitrification is performed under anoxic conditions by many of the same heterotrophic bacteria that perform carbonaceous and phosphorus removal in an aerobic granular sludge system. Anoxic conditions are defined as conditions where oxidized nitrogen is present but there is little or no dissolved oxygen present. These conditions can be found in the inside layers of the granules. Facultative bacteria use nitrate as an oxygen source (their terminal electron acceptor). Denitrification generally occurs at the beginning of Fill/Draw and during the React phase, inside of the granule.

While this section is more applicable to plants that are designed to meet a total nitrogen or nitrate effluent limit, denitrification in a granular sludge system will occur simply due to the structure of the granule, with the anoxic layers. One of the advantages of denitrification is the oxygen and alkalinity recovery. Note that plants that are nutrient deficient for nitrogen, which is the case with some industrial wastes, do not need to denitrify as the plant will not be nitrifying in the first place.

The rate of denitrification is a function of the dissolved oxygen concentration, temperature, MLVSS concentration, pH/alkalinity, and the availability of a carbon source. In the case of granular sludge, the main source of carbon is the slow biodegradable carbon stored during the Fill/Draw phase. If denitrification is to occur, then it must occur after nitrification has taken place. Therefore, the oxygen supply system during the React phase is provided to achieve full nitrification.

6.1 Dissolved Oxygen (DO) Concentration

In order for denitrification to occur inside the granule, anoxic conditions with D.O. < 0.5 mg/l are required, along with the availability of soluble carbon. Therefore, if the D.O. in the bulk liquid is too high, the granule anoxic layer will be smaller. It is recommended to maintain DO levels in the bulk liquid between 0.5 and 1.5 mg/l in order to improve the denitrification occurring in the system. Additional “off” time may be necessary during the React phase to facilitate improved denitrification.

6.2 Temperature

Temperature is a very important factor in determining the rate of denitrification, but as with nitrification, it is a factor with which the operator has little control. The heterotrophic bacteria that perform denitrificaton and organic reduction function more slowly as wastewater temperatures decrease. Nitrifiers are more sensitive to cold temperatures than heterotrophic bacteria, and temperature could become a limiting factor in a plant's ability to meet an effluent ammonia limit in cold weather.

The rate of denitrification in an AquaNereda® would be expected to decrease with decreasing temperature. It is important to maintain a stable operation and avoid over-wasting sludge or shocking the biomass during cold weather operation. It is generally recommended to increase the operating MLSS concentration (and thereby the denitrifier population) and sludge age during cold weather operations to help offset the lower denitrification reaction rate at lower temperatures. For warm weather operation, the heterotrophic bacteria prefer temperatures less than 35°C. Temperatures greater than 35°C may have an adverse effect on denitrification, as well as BOD_5 removal and settling. Temperature should be measured in the basin and recorded on a daily basis when the basin temperature is expected to fall outside the range of 10-35°C.

6.3 pH and Alkalinity

The rate of denitrification is also pH dependent. Denitrification occurs most rapidly at a pH of 7.0-7.5, and is slowed greatly when the pH is outside of the range 6.0-8.0. The alkalinity that is consumed during the nitrification process is partially restored during the denitrification process. For every 1 mg of nitrate converted to nitrogen gas, 3.6 mg alkalinity (as $CaCO_3$) is produced. If the pH is depressed as a result of nitrification, then it will be partially restored if denitrification takes place. If the denitrification process is not sufficient to maintain the pH of the wastewater in the desired pH range of approximately 6.5-8.0, then the addition of caustic, bicarbonate or lime to the wastewater may be necessary. pH and alkalinity in the basin should be measured three times per week.

6.4 Availability of a Carbon Source

In order for denitrification to occur in an AquaNereda, a readily available source of soluble carbon must be present. This carbon source comes from the influent BOD_5, TOC, or COD) that enters the reactor during the Fill/Draw phase. The readily available carbon is then converted into slow degradable carbon in the granule and utilized later for denitrification. Another source of carbon is that generated through cell lysis caused by endogenous decay in the reactor. The hydrogen in the carbon source serves as an electron donor during the conversion of nitrates to nitrogen gas. The carbon also serves to provide the organic substrate necessary for the heterotrophic bacteria to create new cell mass. In systems that are lacking a sufficient source of carbon to perform the denitrification reaction, a carbon source such as methanol or sugar may be added to the reactor, preferably in a soluble form. For plants with supplemental carbon feed systems designed to enhance denitrification, the supplemental carbon feed would be introduced during the Fill/Draw phase.

6.5 Nitrogen Removal Summary

As a general principle, systems that require nitrification without denitrification are designed to operate with the aeration system operating continuously to maintain aerobic conditions and achieve a minimum D.O. residual of 2.0 mg/l. In an aerobic granular sludge, due to the layered structure of the granule, while the aeration is "on", simultaneous denitrification is occurring inside the granule. The correct D.O. concentration can be targeted to achieve this, and for systems which require very low nitrates in the effluent, the aeration system can be operated in a specific "on/off" cycle to promote improved anoxic conditions in the granule.

7 Phosphorus Removal

The AquaNereda process is ideal for biological phosphorus removal. AquaNereda® systems can be designed to remove phosphorus biologically and in some cases chemical is required to achieve really low levels. Biological phosphorus removal is achieved by controlling the feed phase, the aeration system, sludge age, effluent solids, and available organic supply. Chemical phosphorus removal is achieved through the addition of chemicals to precipitate the phosphorus.

Total phosphorus is defined as the sum of the various fractions of phosphorus in the wastewater. Total phosphorus includes fractions of orthophosphate, poly-phosphorus, and organic phosphorus compounds. Orthophosphate, also known as soluble phosphorus, is generally considered the fraction of the total phosphorus that is most readily available to the biomass as a nutrient. Orthophosphate is also the only form of phosphorus that is readily reactive with chemicals, such as aluminum or iron salts.

7.1 Biological Phosphorus Removal

The basic principle in biological phosphorus removal in an AquaNereda® system is to expose bacteria to alternating anaerobic to aerobic and anoxic conditions. The organic matter in the anaerobic conditions of Fill/Draw are fermented to create a source of volatile fatty acids (VFAs). These VFAs serve as a source of food for the phosphorus accumulating organisms (PAOs). Under anoxic to anaerobic conditions such as those found in the Fill/Draw phase, the PAOs (especially *Acinetobacter and Rhodocyclus*) have the ability to take in organic substrate, such as readily degradable COD and BOD_5. The volatile fatty acids are the carbon source that is then stored as polyhydroxybutyrate (PHB). In order to obtain the energy to incorporate BOD_5 into the microbial cell under anaerobic conditions, the bacteria convert ATP in their cell mass to ADP, and in the process they release phosphorus into the wastewater. When aerobic conditions are restored at the beginning of the React phase, the organic substrate (PHB) that has been taken in is converted to energy and cell mass. This allows the PAOs to take in phosphorus, and after being exposed to anaerobic conditions, the bacteria can take in more phosphorus than they need to fulfill their nutrient needs. This will lead to an excess of phosphorus in bacteria exposed to anoxic to near anaerobic followed by aerobic conditions. The biomass in an AquaNereda® may contain 4-6% (maybe higher) phosphorus in a system designed to perform biological phosphorus removal. This is compared to approximately 1-3% phosphorus in the biomass of a system not designed for enhanced biological phosphorus removal. When the bacteria are removed from the basin in the form of waste sludge during the Waste Sludge phase, the sludge has been enriched in phosphorus, and the supernatant has been depleted of phosphorus. This overall sequence of events is referred to as "enhanced biological phosphorus removal".

The amount of phosphorus taken in by the bacteria present in the reactor can be affected by many factors which the operator has control over. The main factors in biological phosphorus removal are listed and discussed below.

1. Nitrate and Dissolved Oxygen Concentrations in the Fill/Draw phase
2. Effluent Suspended Solids
3. Availability of Organic Substrate

4. Sludge Age

Nitrate and Dissolved Oxygen Concentrations in the Fill/Draw phase

In order to achieve efficient biological phosphorus removal, anoxic to near anaerobic conditions must exist in the reactor during the Fill/Draw phase. Anoxic conditions would be defined as the lack of dissolved oxygen in the wastewater, though nitrates may be present. Anaerobic conditions would be defined as the lack of dissolved oxygen or nitrate in the wastewater. In order to achieve anaerobic conditions in the reactor, effective denitrification of the wastewaster must occur in the previous cycle. For systems designed to perform enhanced biological phosphorus removal, the nitrate concentration of the wastewater in the reactor as the Fill/Draw phase begins should not exceed 2.0 mg/l. As wastewater enters the reactor in the Fill/Draw phase, the D.O. concentration should drop quickly to less than 0.5 mg/l in the settled layer of granules. If nitrates are present in this layer, they will be reduced as the Fill/Draw phase takes place. If the nitrate concentration is greater than approximately 2.0 mg/l or the D.O. concentration is greater than 0.5 mg/l during the Fill/Draw phase, in order to optimize the phosphorus release during Fill/Draw, the treatment cycle may need to be adjusted to promote complete nitrification and denitrification.

Effluent Suspended Solids

Another important aspect in achieving low effluent phosphorus concentrations is to maintain low effluent suspended solids concentrations because the solids will contain phosphorus. Therefore, increased effluent solids concentrations will lead to an increase in effluent total phosphorus concentrations.

Availability of an Organic Substrate

In order for enhanced biological phosphorus removal to occur in an AquaNereda® system, anaerobic conditions must occur in the reactor during the Fill/Draw phase. The influent wastewater acts as a food source for the bacteria in the reactor, leading to consumption of the oxygen and nitrate in the reactor, and eventually to the release of phosphorus by the bacteria. If low flow conditions exist in the system, and little flow is received during a Fill/Draw phase, then consideration shall be given to ensure the reactor is adequately achieving anoxic to anaerobic conditions. If anoxic to anaerobic conditions are not achieved, enhanced biological phosphorus removal may not occur. It is generally recommended that the minimum system organic loading for attaining the specified biological phosphorus removal shall be within 15% of the design loading values. Operators should monitor the influent organic loading three times per week to determine if the system is operating at or near design load.

Sludge Age

In general, systems that are designed to perform biological phosphorus removal must perform both nitrification and denitrification since very low nitrate concentrations are required in the granule layer as the Fill/Draw phase begins. This requires operating at a longer sludge age than would be required for systems that only perform BOD and TSS removal because the growth rate of nitrifying bacteria compared to those that perform organic removal is slower. To maximize biological phosphorus removal, systems should not be operated at a sludge age in excess of that required for overall treatment needs. It is recommended that the operator calculate the sludge age on a weekly basis, and adjust the sludge age as necessary to control nitrification and denitrification in the system.

7.2 Chemical Phosphorus Removal

If the phosphorus concentration required is lower than the system can achieve biologically, the AquaNereda system will be designed with the capability of adding chemicals to precipitate the phosphate present in the wastewater. The primary chemicals used for phosphorus removal include ferric chloride, ferric sulfate, aluminum sulfate (alum), sodium aluminate and polyaluminum chloride. The primary mechanism for chemical phosphorus removal is interaction of the metal ion with orthophosphate to form an insoluble precipitate that is filtered or settled out of the wastewater stream. Adjustment of pH through addition of alkaline materials may be necessary if the alkalinity of the wastewater is low. If a high degree of phosphorus removal is required and the system contains a digester, then removal of the phosphorus from the digester supernatant prior to reintroduction into the reactors may be required to prevent recycling the phosphorus back to the system.

Phosphorus removal through chemical addition requires complete mixing and good flocculation to achieve the best removal efficiencies. Therefore, if chemical addition is required in an AquaNereda system, it is generally recommended that the chemical addition occur directly into the reactor in the React phase. In the React phase, the reactor is completely mixed due to operation of the aeration systems. Also, the React phase directly precedes the Settle phase. Therefore the chemicals added to the reactor will be allowed to completely mix, and will then be settled and removed during the Settle and Waste Sludge phases.

If the effluent phosphorus required is considered ultra-low, for AquaNereda systems which have tertiary filtration, a separate rapid mix tank or post equalization basin for chemical addition after the reactor and prior to the filter is recommended. This allows for complete mixing of the wastewater with the chemical added, and allows for contact time prior to the wastewater reaching the filter.

If chemicals are added to the reactor, pH monitoring of the reactor is required, because aluminum sulfate, ferric sulfate and ferric chloride will lower the pH in the reactor by neutralizing alkalinity and precipitating metal hydroxides, while lime or sodium aluminate will raise the pH in the reactor. Polyaluminum chloride (PAC) does not add or consume alkalinity. If chemical addition takes place in the reactor, the pH must be monitored to prevent harming the biomass. The desired pH range for the biomass is pH 6-9, though the optimal pH for minimizing chemical requirements would be in the range of 7-8. The pH should be monitored on a continuous basis as chemical addition occurs. It is recommended that the operator perform jar tests or contact a chemical sales representative to determine the proper dosage required to achieve the desired effluent phosphorus concentration. Dosages can be expected to vary from plant to plant, and even from day to day, depending on choice of chemical, wastewater characteristics, degree of mixing, opportunity for flocculation, and desired effluent phosphorus concentration.

8 Oxygen Uptake Rate Determination

In order to calculate the Oxygen Uptake Rate (OUR) in mg/l/hr in an AquaNereda system, the following equipment is required:

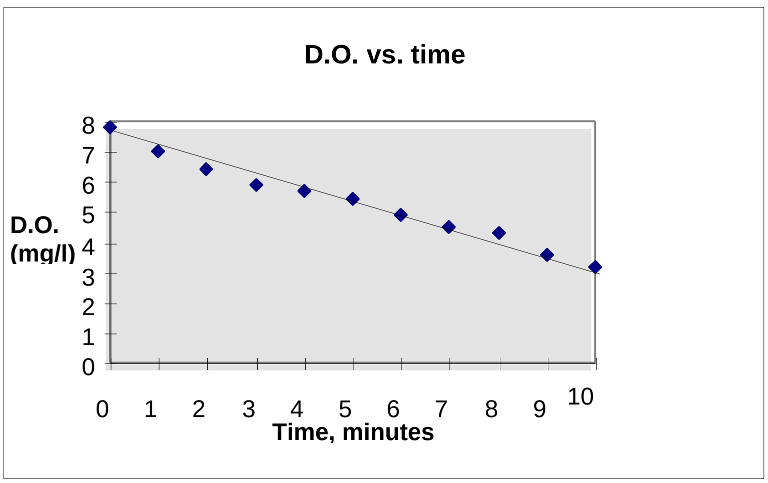
1. Two (2) 300 ml BOD Bottles (Standard)
2. One (1) BOD Bottle Probe

3. One (1) Magnetic Stir Plate with Stir Bar or Integral stirrer on BOD Bottle Probe.
4. One (1) Stopwatch or Timer

The following procedure is recommended:

- Calibrate the BOD Bottle Probe per the equipment suppliers' recommendation.
- Collect a sample of MLSS from the system.
- Fill each of the two (2) BOD bottles to over half-full, leaving air in each bottle.
- Cap each bottle and shake each bottle vigorously for several minutes. This will bring the D.O. level in the samples up to near saturation.
- Combine the two samples into one BOD bottle, making sure that the entire bottle is filled (until the bottle overflows).
- Insert the stir bar if necessary.
- Place the BOD bottle probe in the sample bottle and begin mixing the sample. Be sure NO air bubbles are in the sample bottle neck.
- After a short period of time, the D.O. reading on the meter will stabilize and begin to drop.
- Begin recording D.O. values from the D.O. meter as soon as the D.O. reading on the meter begins to drop.
- Record the D.O. concentration off the meter at equal time increments of 15, 30 or 60 seconds until 10 minutes has passed or the D.O. reading is less than 1.0 mg/l.

The OUR value can be determined either graphically or mathematically. To determine the OUR graphically, plot the time vs. D.O. concentration on a piece of graph paper. The OUR is equal to the slope of the best fit line passing through the data points. See the graph below.



The graph was drawn from the following data:

Time (Minutes)	D.O. Concentration (mg/l)
0	7.8
1	7.0
2	6.4

3	5.9
4	5.7
5	5.4
6	4.9
7	4.5
8	4.3
9	3.6
10	3.2

From the graph shown above the OUR on a mg/l/min basis is estimated at 0.5 mg/l/min. To convert this to a mg/l/hr basis, multiply the slope of the line by 60. Then the OUR value determined from the chart is 0.5 x 60 = 30 mg/l/hr. Disregard readings for the first one or two minutes of the test if the D.O. concentration in the bottle rises, or remains the same.

To determine the OUR on a mathematical basis, take the difference between each D.O. reading, sum the differences, and divide by the total number of readings. Then multiply this value by 60 to convert the value to a mg/l/hr basis. Calculating the OUR mathematically for the example shown above would lead to an OUR value of

(0.8 + 0.6 + 0.5 + 0.2 + 0.3 + 0.5 + 0.4 + 0.2 + 0.7 + 0.4)/10 = 0.46 mg/l/min

= 27.6 mg/l/hr

The OUR test shows how active organisms are in the process. The activity of the organisms is related to the amount of oxygen the organisms consume. The OUR test measures how much oxygen a sample of sludge consumes over a specific time period. It is expected for the OUR values to be higher at the beginning of the React phase and decrease as the cycles moves to the end of the phase.

After a series of samples throughout the React phase an average OUR can be determined. Low OUR values (< 15 mg/l/hr) on average can show an fairly inactive biomass, which may be caused by lack of organic substrate at the time of sampling (no BOD_5 or COD available to be degraded) or it could show a biomass that has undergone a toxic shock. Higher OUR values on average (> 45 mg/l/hr) show a very active biomass, which may be caused by a high concentration of organic substrate, or a plant that is nearing it's design organic load. It is recommended that the operator initially perform a series of OUR tests on samples obtained at various times in the React phase. Routine OUR tests may then be based upon a rotating sample time or on a selected sample time for an OUR determination on a weekly basis.

AquaNereda® Aerobic Granular Sludge Technology Sampling Protocol

Introduction

The purpose of process monitoring is to assess the performance of the process over time in order to make informed operational decisions and to ensure effluent compliance is always maintained. Furthermore, process monitoring can enable optimization. Process monitoring requires a sampling and testing protocol along with consistent process monitoring of the operations and performance trends.

The AquaNereda system has been designed to operate on an automatic basis with respect to the reactor progressing through a programmed mode of operation during each treatment cycle; i.e., to initiate a Feed/Decant phase or activate a specific pattern of aeration in the routine day-to-day operation of the wastewater treatment system. Adjustments to the individual timer values may be necessary as the influent loading conditions change.

To determine the efficiency of the treatment system and to maintain specific loading criteria to the reactor, it is necessary to analyze the raw waste influent to the reactor, the mixed liquor characteristics, the waste sludge characteristics, and the quality of the effluent discharged from the reactor. The influent and effluent measurements will provide the necessary data to determine system efficiency. The observations and measurements of the mixed liquor and waste sludge components of the system will provide the operator with important “operational” information. This information is essential for the initiation of control measures that may be utilized to maintain the treatment system at maximum efficiency levels.

The latest edition of Standard Methods[1] should be available and consulted for proper procedures, reagents, and equipment required to run each specific test. Most of the equipment necessary for routine analyses is standard assorted lab equipment such as glassware, beakers, etc. If there is any question as to what equipment is required, contact Aqua-Aerobic Systems Customer Service for more assistance and guidance in selecting analytical equipment.

Analytical Methods

Reliable analytical data is critical for operational success and performance compliance. Laboratory analyses should be executed by trained technicians using either Hach Lange cuvettes tests and/or conventional laboratory analytical procedures. Specific laboratory training regarding the sieving, SVI, and MLSS tests must be undertaken. A combination of accurate sampling procedures and reliable analytical data is critical for operational success and performance compliance.

The only departures from the above are the AquaNereda specific methods to be used for the sludge MLSS, SVI, and sludge grading analysis described in the AquaNereda Sludge Analysis Procedures section of the AquaNereda Process Manual.

[1] Eaton, A. D., Baird R. B., Rice E. W., American Public Health Association., American Water Works Association., & Water Environment Federation. (2017). *Standard Methods for the Examination of Water and Wastewater.* Washington, D.C.: American Public Health Association.

Influent/Effluent and Sludge Sampling

To determine the efficiency of the AquaNereda® Aerobic Granular Sludge system and provide proper process control, it is necessary to analyze the raw waste influent to the reactor, the mixed liquor characteristics, the waste sludge characteristics, and the quality of the effluent discharged from the reactor. Influent and effluent samples are to be collected from the 24-hour samplers upon completion of the sampling period.

The proposed measurements of the influent and effluent are presented in Table 1. The influent and effluent testing can be adjusted based on permit requirements. The frequency presented is recommended for start-up, pilot demonstration and process optimization purposes. Sampling should begin with the acclimation phase. The analyses required depend on the information that is needed with additional analyses providing an even better overview of the reactor's performance.

Permit requirements supersede the above recommendations if more frequent or additional testing is specified. The above aids in properly assessing process performance but can be reduced if operation and performance are stable.

Municipal plants should not need to run COD or TOC on a regular basis. Industrial systems with significant inorganic loading, such as septicity (sulfur compounds in the influent) and other parameters that can be oxidized, should consider running a TOC test in lieu of COD.

A DO profile should be reviewed for the entire React phase approximately once per week. In-basin DO sensors are provided in each basin.

Table 1. Recommended Sampling Schedule

Parameter	AGS Influent	AGS Effluent	Reactor
Flow	Daily	Daily	--
Temperature	Daily	Daily	Daily
DO	--	--	Daily
COD or TOC	2 / week	2 / week	--
Soluble COD	2 / week	2 / week	--
BOD or cBOD	2 / week	2 / week	--
Total Nitrogen*	--	2 / week	--
TKN	2 / week	--	--
Ammonia (NH_4)	2 / week	2 / week	--
Nitrite (NO_2)*	--	2 / week	--
Nitrate (NO_3)*	--	2 / week	--
Total Phosphorus	2 / week	1 / week	--
Soluble Phosphorus	1 / week	2 / week	--
Soluble Ortho-Phosphate	1 / week	1 / week	--
TSS	2 / week	2 / week	--
Alkalinity	1 / week	1 / week	
pH	Daily	Daily	Daily
OUR	1 / week	--	--
FOG	1 / month or as needed	--	

*Measure if anticipated

Sludge Sampling

The proposed measurements of the reactor sludge and sludge waste are presented in Table 2 and Table 3, respectively. The frequency can be reduced as the system reaches steady-state operation.

The sludge sample from the reactor should be taken after 20-30 minutes of aeration from the top and bottom sample locations, 3 ft. and 18 ft. depths. Because of the excellent settling characteristics of the sludge, it is measured at different heights to ensure an accurate representation of the reactor concentration.

The waste sludge sample can be taken as a grab sample or as a composite.

Table 2. Recommended Reactor Sludge Sampling

Measurement	Frequency
Sludge Flow	Daily
MLSS (Top & Bottom)	1 / week
Sieve (Bottom)	1 / week
SVI (Top & Bottom)	2 / week

Table 3. Recommended Sludge Waste Sampling

Measurement	Frequency
Waste Visual	2 / week
MLSS	1 / week
SVI	1 / week

Additional Cycle Measurements

The AquaNereda technology utilizes a batch process which *may* require additional sampling to ensure optimal operation. The cycle provides dynamic treatment to optimize effluent quality based on online instrumentation consistently monitoring Ammonia, Nitrate, Phosphorus, Redox, and DO conditions in the reactor. COD, however, cannot be measured automatically, and additional testing of this constituent may improve operation of the system. DO profiles may provide additional useful information.

For cycle measurements, the following samples must be taken:

- Effluent previous cycle
- Influent
- Sample after 5 minute aeration, 20 minute aeration, and 60 minute aeration
- Effluent next cycle

The frequency of cycle measurements is on an as-needed basis. Although cycle measurements are *not* required for monitoring of the process, they do give substantial additional information that is very useful in optimizing the process. Additional testing may also shorten the acclimation period.

Reporting

All analytical lab results should be recorded by the lab staff in datasheets either provided by Aqua-Aerobic Systems, Inc. (AASI) or developed by the client. These datasheets should be shared with AASI on a monthly basis (or more frequently during the initial period of operation) to aid in process optimization.

AquaNereda® Aerobic Granular Sludge Technology
Lab Equipment

Hach Equipment

- Spectrophotometer such as DR3900, or DR6000
- Digester with 16mm wells such as DRB200
  - Reactor Adapters – 16mm to 13mm for TNTplus kits (2895805)
  - 20mm Wells – for TN TNTplus (LR TNT826, HR TNT827, & UHR TNT828) and TKN (TNT880)

Hach Consumables

- Chemical Oxygen Demand – LR TNT821 & HR TNT822
- Ammonia – ULR TNT830 & HR TNT832
- Nitrite – TNT839
- Nitrate – TNT835
- Total Nitrogen – LR 2672245 & HR 2714100
- Total Phosphorus/Reactive – LR TNT843 & HR TNT844
- Alkalinity – TNT870
- TKN – TNT880

Additional Equipment

General

- 0.45 µm filters
- 1-5 mL pipette
- 0.1-1 mL pipette
- (2) 1000 mL short graduated cylinder
- 1L beaker
- 2L vacuum flask
- Stir plate and bar
- Balance (0-500 g)
- Oven (up to 200 °C)
- Muffle furnace (up to 550 °C)
- Dessicator
- Vacuum pump

BOD

- Incubator
- BOD bottle and cap (also for OUR)

TSS and VSS Testing

- 40-50 mm diameter Buchner funnel
- Whatman 40-50 mm diameter 1.5 µm filter paper

Sludge Sampling & Testing

- 1.2 L Bullet sampler
  - LaMotte Horizontal Water Sampler
  - Kemmerer Water Samplers
- 30 mL syringe with tip cut off
- Set of standard soil sieves
  - #10/14/30/40/70 = 2.0/1.4/0.6/0.425/0.212
- 110 mm diameter Buchner funnel with 9mm stopper, cut for funnels
- Coffer filters or Whatman 150 mm glass filter (1.5-1.6 µm)

Optional

- pH meter

AquaNereda® Aerobic Granular Sludge Technology
Sludge Testing Procedures

Introduction

The purpose of this section is to present the analytical procedures to perform the recommended sludge tests in an AquaNereda system as well as provide suggestions for the analysis process. A combination of accurate sampling procedures and reliable data is important for operational success and performance compliance.

Due to the characteristics of the granular sludge, care must be taken to collect the bulk samples from a high turbulence region within the reactor to ensure that it is homogenous and representative of the mixed liquor. It is preferred to obtain the sample approximately 5-10 minutes before the end of the React phase and prior to Settle.

Use submersible sampling equipment that:

- Allows the operator to identify the sample depth.
- Eliminates granule settling, draining, filtering, or modifying the contents in a way that could impact the MLSS concentration.
- Captures at least 1L volume that can be easily and completely transferred into the settling column.

The laboratory analyses should be executed by trained technicians using either Hach Lange cuvettes tests and/or conventional laboratory analytical procedures. Specific laboratory training will be provided by Aqua-Aerobic Systems regarding the sieve, SVI, and MLSS tests. With experience the anticipated time to complete all sludge analyses is approximately 1.5 hours.

The following text serves as a reference for this document:

- Eaton, A. D., Baird R. B., Rice E. W., American Public Health Association., American Water Works Association., & Water Environment Federation. (2017). *Standard Methods for the Examination of Water and Wastewater.* Washington, D.C.: American Public Health Association.

Settled Sludge Volume / Settleability

One of the main attributes of the aerobic granular sludge (AGS) present in the AquaNereda process is its superb settleability. The settling characteristics of the solids in the AquaNereda system are an important factor in determining whether effluent quality objectives are met.

Monitoring the settling in an AquaNereda reactor is done utilizing a Settleometer. The settleometer gives the operator a rough gauge as to how the basin is settling but should not be used as the sole basis of assessment. Due to wall and temperature effects in the settleometer, it is often the case that the sludge settles at a different rate than in the settleometer than it does in the reactor. Therefore, if there is a concern about settling rate then the operator should utilize the Sludge judge method during the Settle phase as the final determination of how the sludge is settling.

Note that rising sludge can be observed in a settleometer but rarely, if ever, in a reactor. Therefore, if the sludge rises in the settleometer there is typically no need for an operational change in the system, but the operator should visually inspect the reactor or use a sludge judge to confirm the sludge is not rising in the reactor.

Equipment

To perform this test, the following equipment is recommended:

- 1L homogeneous sample collected from AquaNereda reactor
- One (1) settling column – a 1L graduated cylinder, preferentially optically transparent plastic (such as styrene acrylonitrile resin) with an 80mm diameter and 280mm height
- One (1) stirring mechanism (<4 rpm, peripheral speed of approx. 1.3 m/s)
- Submersible water samplers (1.2L LaMotte Horizontal Water Sampler, or similar)
- One (1) stopwatch
- Results of MLSS analysis
- Settleability Worksheet

Methodology

This test should be performed on samples taken at 5 and 16.5 depths from the reactor water level. To perform the test on these sludge samples, follow the steps listed below:

1. Configure a stopwatch to alert every 5 minutes (e.g. 5, 10, 15 minutes…) for a 30-minute period.
2. Thoroughly mix the entire bulk sludge mixed liquor sample obtained from the AquaNereda reactor ensuring vertical and horizontal mixing.
3. Fill the graduated cylinder with the bulk sample making sure that the sample is well-stirred immediately before starting.
    a. If two or more samples are being analyzed simultaneously make sure that the contents are all stirred immediately before the start of the analysis.
4. Immediately start the timer. Measure and record the level of the top of the sludge blanket suspension at 5-minute intervals throughout the 30-minute analysis.
5. Make observations as to the following points:
    a. Clarity of the supernatant
    b. Rate of sludge settling

The aim is to have a final sludge blanket volume between 200 and 300 mL after 30 minutes. In this range the cylinder wall does not materially affect the analysis, and it provides results that are more representative of the settling regime inside the reactor.

- If the volume of the sludge blanket is less than 200 mL, the sludge sample must be concentrated as follows:
  - After the 30 minutes of the initial test, a certain (X) volume (usually between 200 and 500 mL, but it needs to be assessed by the analyst) of clear supernatant is removed from the cylinder. The discarded volume must be recorded.
  - The supernatant volume removed should be replaced by the same volume from the original bulk sample after it has been vigorously mixed.
  - A further test is then performed on the new, more concentrated 1000 mL sample.

- If the volume of the sludge blanket is more than 300 mL, the sludge sample must be diluted as follows:
  - After the 30 minutes of the initial test, the contents of the cylinder must be stirred again.
  - Remove a certain (Y) volume from the cylinder (usually between 200 to 500 mL, but it needs to be assessed by the analyst) and replaced by the same volume of tap water. The discarded volume must be recorded.
  - A further test is then preformed on the new, more dilute 1000 mL sample.
  - The analyst should decide on the degree of concentration/dilution on result of the first test (i.e. the volumes of (X) or (Y), respectively). To ensure that sufficient sludge is available for concentrating the sample if necessary, an original sample of at least 2000 mL should be extracted from the reactor.

<u>Results</u>

Generally, a properly settling granular sludge will settle to approximately 30-40% of its original volume after 5 minutes of quiescent settling. A settleometer test should be performed on a daily basis. The included Sludge Settling / SVI Worksheet can be used to track the test results.

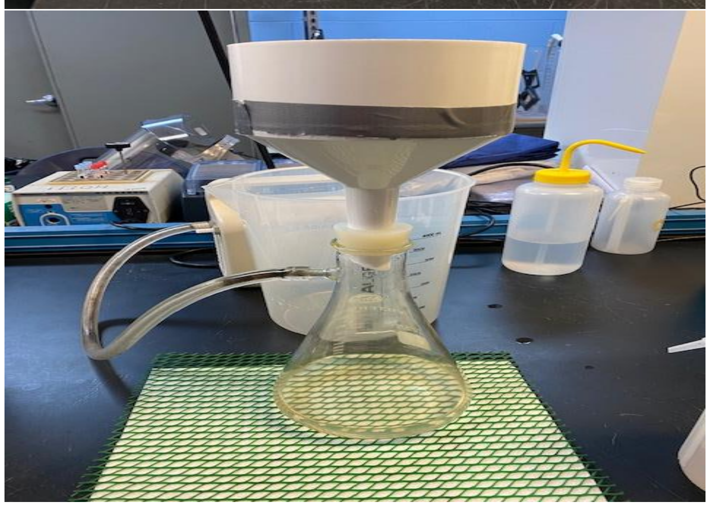
Mixed Liquor Suspended Solids

A mature AquaNereda system typically operates at mixed liquor concentrations of 8 g/L or greater, depending on influent conditions. The purpose of this analysis is to determine the MLSS concentration in the AquaNereda reactor(s) or sludge discharge stream.

Equipment

In order to perform an MLSS test with AGS in the AquaNereda system, the following equipment is necessary:

- The bulk sample liquid identified in the "Settled Sludge Volume / Settleability" analysis section.
- One (1) 1L beaker
- One (1) 100 mL beaker
- One (1) 30 mL plastic syringe, modified to provide a 6 mm diameter opening
- One (1) magnetic stir plate and bar
- Weighing/sample dish – such as aluminum cup or other inert material
- Coffee filters
- Forceps
- Analytical balance
- Vacuum filter equipment – 150 mm diameter Buchner Funnel, 2L Vacuum Flask, vacuum source
- Drying oven set to 105℃
- Desiccator with fresh drierite
- MLSS Worksheet



Methodology

This test should be performed on samples taken at 5 and 16.5 depths from the reactor water level. Typically, less than 100 mL of the 1L sample will be required for the MLSS test. The remaining volume will be used for the Sieve Analysis. It is imperative that starting, subtracted, and remaining volumes be recorded.

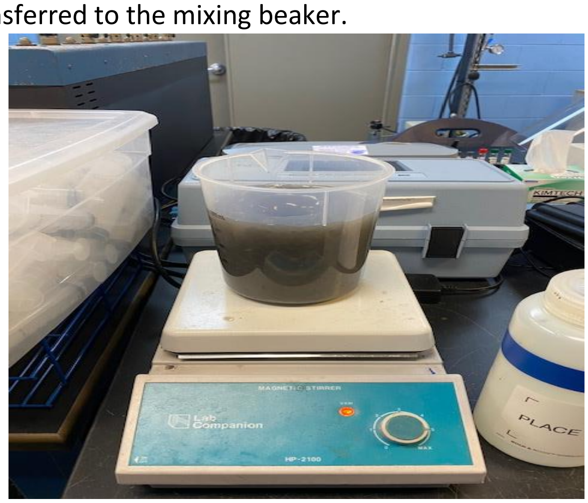
To perform the test on these sludge samples, follow the steps listed below:

1. *Sample Preparation:* Select a sample volume and a filter paper size to yield no more than 200 mg of dried residue and takes no more than 10 minutes to filter.
    a. For example, if the MLSS is expected to be 6,000 mg/L then the sample size should be less than 33 mL.

$$33\ mL = \frac{1000\,\frac{mL}{L}\ x\ 200\ mg}{6000\,\frac{mg}{L}}$$

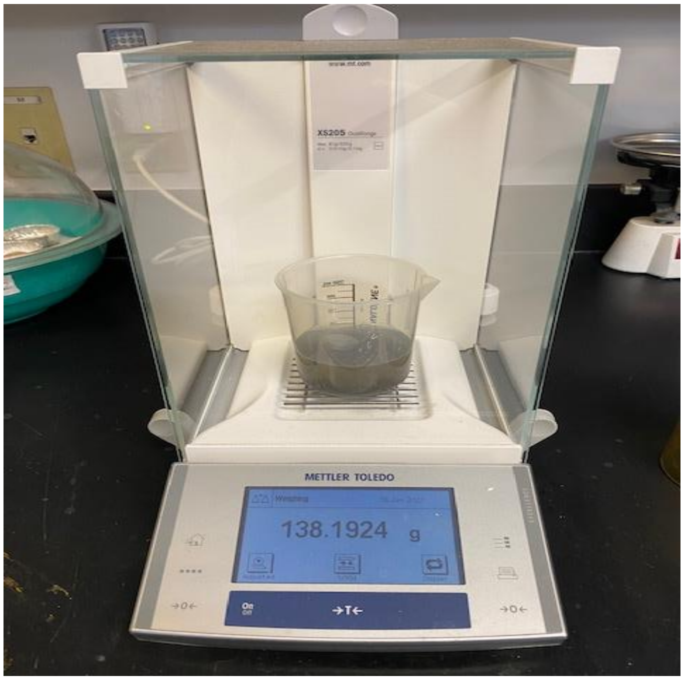
2. *Filter Paper Preparation:* Prepare the filter papers by inserting each one into the filtration apparatus, apply a vacuum, and wash with at least 20 mL of DI water three times. Remove and place on weighing dish then dry in the oven at 103-105℃ for an hour. Cool in desiccator for an hour, weigh, and record value. Store filters in desiccators or an oven at 103-105℃ until needed.
    a. Note that the filter papers for the sieve analysis could also be prepared at this time.

3. Either tare the empty 100 mL beaker on the balance and note its weight as 0, or weigh the empty beaker and note its empty weight.
4. Transfer the homogenous sample to a 1L graduated cylinder. This will aid in transferring all granules.
5. Pour half of sample into 1L beaker using the magnetic stir plate and bar to keep it completely mixed. Swirl the remaining liquid in the cylinder to ensure sure that all of the granules are dislodged then transferred to the mixing beaker.

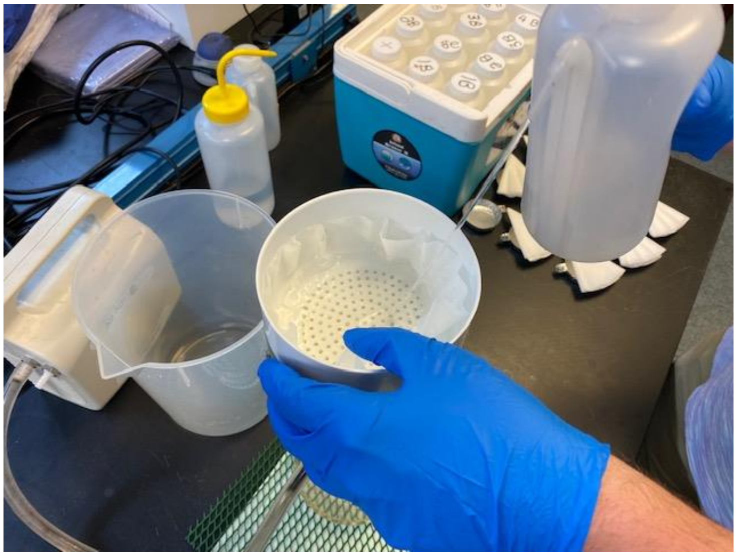


6. Rapidly withdraw an approximately 30 mL sample using the modified syringe and deposit the sample into the 100 mL beaker. A few syringe pulls may need to be drawn from the mixed beaker contents to deliver approximately a 100 mL volume sample. Record the actual volume in

this step as it may differ slightly from the original target. Also note the weight again.

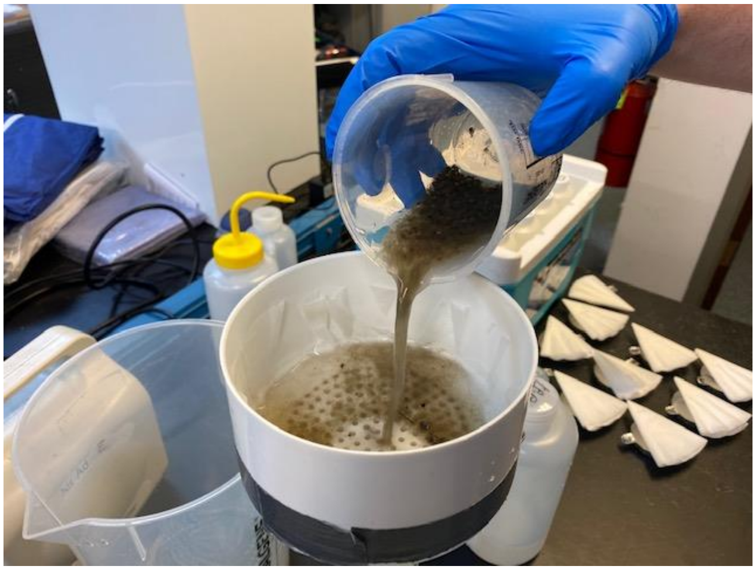


7. Place the washed, cooled, and weighed filter paper in the Buchner funnel and dampen with DI water.



8. Swirl the sample in the beaker and, using the vacuum filter equipment, filter the sample through the washed, cooled, and weighed filter paper to separate the sludge from the excess water.

Make sure all sample particles are removed from the beaker by rinsing it with DI water while applying a vacuum. The filtration step is necessary to remove interferences of dissolved salts in the final suspended solids concentration.



9. Once the filtration is complete, use forceps to carefully transfer the filtered cake and filter in a dumpling shape to the sample dish and dry at 103-105℃ for 24 hours in a thermostatically controlled oven.

10. After 24 hours allow the filtered sample to cool in the desiccator.
11. Use forceps to transfer the filtered sample to the analytical balance and record the final value.

Note: The same procedure should be used to measure the TSS in the influent, effluent, and sludge discharge streams; return liquors; or any other streamline on the site.

Results

The final solids determination is calculated as follows:

$$Solids\ concentration\ \left(\frac{mg}{L}\right) = \frac{[Dry\ Filter + Cup\ (mg)] - [Empty\ Filter + Cup\ (mg)]}{Volume\ (mL)}\ x\ 1000\ \left(\frac{mL}{L}\right)$$

Sludge Volume Index

Another operational parameter used to measure the quality of the settling characteristics is the sludge volume index (SVI). With AGS the SVI is the result of dividing the sludge blanket interface at a certain time interval into a settleometer test by the MLSS concentration.

Methodology

The SVI of a sample is calculated using settled sludge volume results with the following equation and should be calculated for both the 5 and 16.5 ft depth sludge samples at 5 minute intervals from 5 to 30 minutes:

$$SVI_x\left(\frac{mL}{g}\right) = \frac{X\ minute\ settled\ sludge\ volume\ (\frac{mL}{L})}{MLSS\ (\frac{g}{L})}$$

When the sample needs to be concentrated use the following:

$$SVI_x\left(\frac{mL}{g}\right) = \frac{X\ minute\ settled\ sludge\ volume\ (\frac{mL}{L})}{MLSS\ \left(\frac{g}{L}\right) x\ \frac{[1000\ (mL) + X\ (mL)]}{1000}}$$

When the sample needs to be diluted used the following:

$$SVI_x\left(\frac{mL}{g}\right) = \frac{X\ minute\ settled\ sludge\ volume\ (\frac{mL}{L})}{MLSS\ \left(\frac{g}{L}\right) x\ \frac{[1000\ (mL)\ - Y\ (mL)]}{1000}}$$

The same procedure is applied to measure the SVI of the excess waste sludge. The sample should be taken from the sludge buffer tank while it is being vigorously mixed (if practically possible) to ensure that it is homogenous and representative of the full body of wasted sludge.

Results

SVI values between 30 and 60 mL/g typically indicate high quality settling characteristics. A sludge settling at this rate will generally have well-formed granules. Sludge with SVI values greater than this range may indicated that a large fraction of the sludge is still flocculent. Therefore, higher SVI values can be expected during plant start-up. A good indication of granulation is the limited difference between SVI after 5, 10, and 30 minutes.

For AquaNereda sludge the SVI5/SVI30 ratio is an important indicator of the sludge settleability. Almost complete settling should occur within 5 minutes. The SVI10/SVI30 ratio should ideally be close to 1.25, though a range of 1.0 to 1.5 shows exceptional settling characteristics.

The settled volume can also be used to calculate the ‘sludge concentration’ after a certain time interval; i.e. the total mass of sludge is known (1000 mL x Concentration at start-up). For example, when the SV5 reading is 390 mL then the sludge concentration is 1000/390 times the starting concentration.

Sludge Sieve Analysis

The main goal of the sieve analysis (or granule size distribution) is to separate, measure, and grade the various granule sizes. This analysis tracks the growth trends of the total granule composition as well as establishes the percentage of each granule size and the total percentage of granules present in the mixed liquor relative to the total mass of sludge present in the mixed liquor.

Equipment

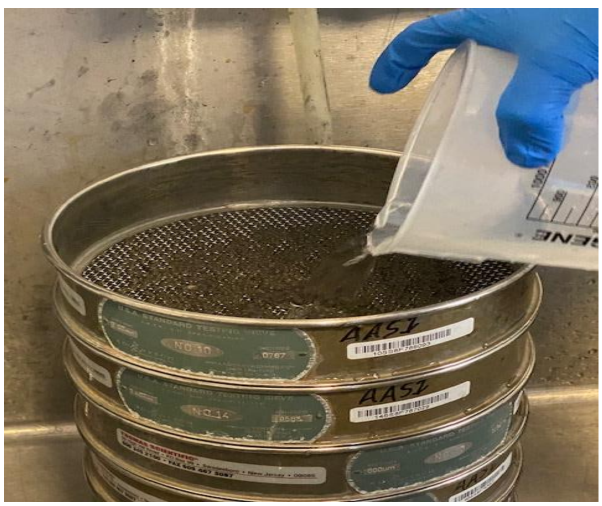
- The bulk sample liquid identified in the "Settled Sludge Volume / Settleability" analysis section, less the MLSS sample volume recorded for the "Mixed Liquor Suspended Solids" analysis.
- Apparatus identified in the "Mixed Liquor Suspended Solids" analysis section.
- 1000 mL Graduated cylinder or beaker
- Set of sieves with mesh sizes of 0.212 mm, 0.425 mm, 0.6 mm, 1.4 mm, 2.0 mm (ISO 565/3310-1)
    - ASTM E11: No 70, No 40, No 30, No 14, No 10
- A wash bottle and tap water
- Blender (homogenizer)
- Sieve Analysis Worksheet

Methodology

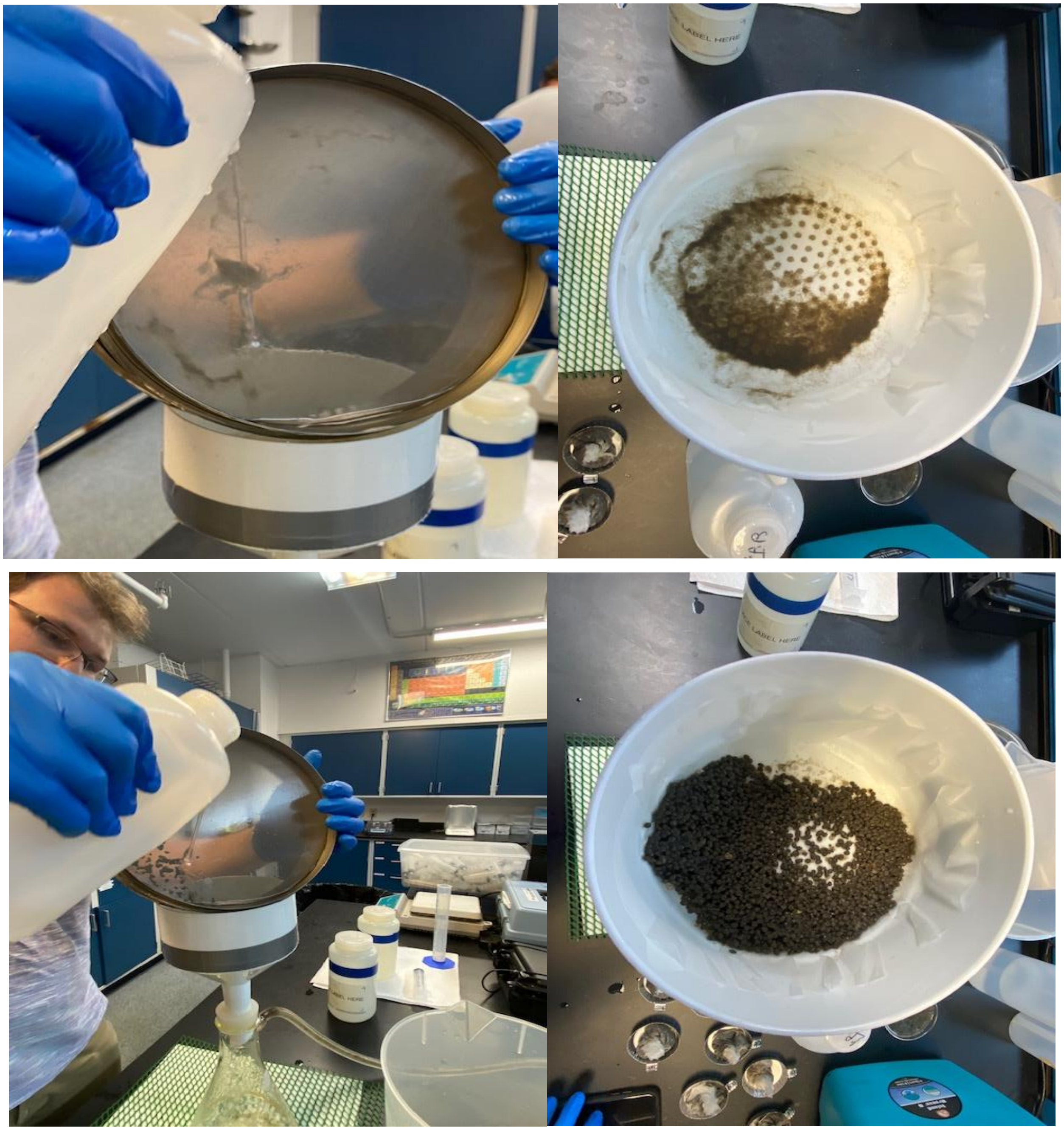
This test should be performed on only the bottom sample taken at a 16.5 depth from the reactor water level. To perform the test on these sludge samples, follow the steps listed below:

1. Do a MLSS analysis on the bulk sludge sample as described in the "Mixed Liquor Suspended Solids" section in order to establish the total mass of sludge in the reactor.
2. Prepare five (5) filter papers with aluminum cup (one per grading sieve) and record weight using the analytical balance.
3. Vigorously mix the full bulk sludge sample taken from the AquaNereda reactor.
4. Transfer a sludge sample to a 1000 mL graduated cylinder and record the actual volume in mL. Try to prevent solids from adhering to the original container by mixing as you pour but do not add rinse water at this point.
5. Place all five (5) sieves on top of each other in ascending order of mesh size (the largest on top and the smallest at the bottom). The sieves must be placed in a sink and underneath the faucet.
6. Using a faucet spray nozzle, turn on the water to apply gentle pressure and direct the water through the sieve to open all pores. The rate of water flow should be carefully controlled in order to make sure that smaller particles are washed through the sieves with larger mesh but must not be so vigorous as to flood the sieves or break up the granules.
7. To make sure that all granules and sludge particles from the sample are fed to the sieve stack, rinse the graduated cylinder with tap water and empty it into the top sieve.

8. Carefully wash the granules until the mass of granules in the top sieve is no longer decreasing as determined by a visual assessment.



9. For each sieve size, carefully wash then transfer the granules from the sieve to the filter in Buchner funnel. Use a wash bottle to more easily move the granules from the sieve to the filter. Be careful to avoid any granule losses.



a. For some sieve sizes (>400 mm) it may be necessary to flip the sieve upside down into the smallest sieve size and rise from behind as granules can get stuck in the openings.

10. Once the filtration is complete, use forceps to carefully transfer the filtered cake and filter in a dumpling shape to the sample dish and dry at 105℃ for 24 hours in a thermostatically controlled oven.

11. After 24 hours, cool the samples in a desiccator and weigh them taking note of the final value.
12. Determine the actual concentration of the MLSS in the sieve size as follows:

$$MLSS\ (\frac{mL}{g}) = \frac{Weight\ from\ Step\ 11\ (g)}{Actual\ Volume\ from\ Step\ 4\ (mL)}$$

Note that for granules greater than 2 mm the sample may need to be split into two separate filter and weighing dish sets.

Results

The Total Sludge Concentration of a sample is measured per the "Mixed Liquor Suspended Solids" analysis.

The Total Sludge Mass in the sieve analysis is calculated according to the following:

$$Total\ Sludge\ Mass = Sample\ Volume\ (L) x\ MLSS\ (\frac{g}{L})$$

The amount of sludge retained on each individual sieve size is determined using the below equations:

$$\% > 2\ mm = \frac{Mass\ Retained\ on\ 2\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$2\ mm > \% > 1.4\ mm\ = \frac{Mass\ Retained\ on\ 1.4\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$1.4\ mm > \% > 0.6\ mm = \frac{Mass\ Retained\ on\ 0.6\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$0.6\ mm > \% > 0.4\ mm = \frac{Mass\ Retained\ on\ 0.4\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$0.4\ mm > \% > 0.2\ mm = \frac{Mass\ Retained\ on\ 0.2\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$\% < 0.2\ mm = \frac{Total\ Sludge\ Mass\ (g) - Sum\ Mass\ Retained\ on\ All\ Sieves\ (g)}{Total\ Sludge\ Mass\ (g)}$$

AquaNereda® Aerobic Granular Sludge Technology
Sludge Analysis Worksheets

MLSS Worksheet

The final solids concentration is calculated as follows:

$$Solids\ concentration\ \left(\frac{g}{L}\right) = \frac{[Dry\ Filter + Cup\ (g)] - [Empty\ Filter + Cup\ (g)]}{Volume\ (mL)}\ x\ 1000\ (\frac{mL}{L})$$

MLSS TRACKER							
Basin # _____							
Date	**Sample Location**	**Empty/Tared Beaker** *(g)*	**Full Beaker** *(g)*	**Volume** *(mL)*	**Empty Cup + Filter** *(g)*	**Dried Cup + Filter** *(g)*	**Concentration** *(g/L)*
	Top						
	Bottom						
	Waste						
	Top						
	Bottom						
	Waste						
	Top						
	Bottom						
	Waste						
	Top						
	Bottom						
	Waste						

Sludge Settling / SVI Worksheet

Settleability and SVI Tracker

Use the table on the following page to record the settleability results. In addition to the top and bottom reactor samples, the waste (excess) discharge can also be analyzed.

Calculating the SVI

The SVI is calculated at a certain time interval into the settling period according to the following equation:

$$SVI_x\left(\frac{mL}{g}\right)=\frac{X\ minute\ settled\ sludge\ volume\ (\frac{mL}{L})}{MLSS\ (\frac{g}{L})}$$

For example, to calculate the SVI_5:

$$SVI_5\left(\frac{mL}{g}\right)=\frac{settled\ sludge\ volume\ @\ 5\ minutes\ (\frac{mL}{L})}{MLSS\ (\frac{g}{L})}$$

$$SVI_5=\frac{(\qquad\qquad)}{(\qquad\qquad)}\ x\ 1000=\_\_\_\_\_\_mL\ /g$$

SETTLEABILITY TRACKER

Basin # ____ MLSS (g/L) __________

Date	Sample Location	Sample Vol. (mL)	SV5 (mL)	SV10 (mL)	SV15 (mL)	SV20 (mL)	SV25 (mL)	SV30 (mL)	SVI5 (mL/g)	SVI10 (mL/g)	SVI30 (mL/g)	SVI5/ SVI30	SVI10/ SVI30
	Top	1000											
	Bottom	1000											
	Waste	1000											
	Top	1000											
	Bottom	1000											
	Waste	1000											
	Top	1000											
	Bottom	1000											
	Waste	1000											
	Top	1000											
	Bottom	1000											
	Waste	1000											

Sieve Analysis Worksheet

Use the table on the following page to aid in tracking particle size distribution.

The Total Sludge Concentration of a sample is measured per the "Mixed Liquor Suspended Solids" analysis.

The Total Sludge Mass in the sieve analysis is calculated according to the following:

$$Total\ Sludge\ Mass = Sample\ Volume\ (L) x\ MLSS\ (\frac{g}{L})$$

The amount of sludge retained on each individual sieve size is determined using the below equations:

$$\% > 2\ mm = \frac{Mass\ Retained\ on\ 2\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$2\ mm > \% > 1.4\ mm = \frac{Mass\ Retained\ on\ 1.4\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$1.4\ mm > \% > 0.6\ mm = \frac{Mass\ Retained\ on\ 0.6\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$0.6\ mm > \% > 0.4\ mm = \frac{Mass\ Retained\ on\ 0.4\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$0.4\ mm > \% > 0.2\ mm = \frac{Mass\ Retained\ on\ 0.2\ mm\ Sieve\ (g)}{Total\ Sludge\ Mass\ (g)}$$

$$\% < 0.2\ mm = \frac{Total\ Sludge\ Mass\ (g) - Sum\ Mass\ Retained\ on\ All\ Sieves\ (g)}{Total\ Sludge\ Mass\ (g)}$$

The total granulation percent of the MLSS sample is the summation of the individual percentages per sieve.

SIEVE TRACKER							
Basin # _____		**MLSS (g/L) __________**					
Date	**Particle Size** *(mm)*	**Cup** *(#)*	**Empty Cup** *(g)*	**Dried Cup** *(g)*	**Δ Mass** *(g)*	**Sample Concentration** *(g/L)*	**Fraction of Total Mass** *(%)*
	> 2.0						
	2.0-1.4						
	1.4-1.0						
	1.0-0.6						
	0.6-0.4						
	0.4-0.2						
	Volume (mL)			**Total Granule**		*g/L*	*%*
	> 2.0						
	2.0-1.4						
	1.4-1.0						
	1.0-0.6						
	0.6-0.4						
	0.4-0.2						
	Volume (mL)			**Total Granule**		*g/L*	*%*
	> 2.0						
	2.0-1.4						
	1.4-1.0						
	1.0-0.6						
	0.6-0.4						
	0.4-0.2						
	Volume (mL)			**Total Granule**		*g/L*	*%*
	> 2.0						
	2.0-1.4						
	1.4-1.0						
	1.0-0.6						
	0.6-0.4						
	0.4-0.2						
	Volume (mL)			**Total Granule**		*g/L*	*%*

AquaNereda® Aerobic Granular Sludge Technology Process Worksheets

1 F/M Worksheet

Measured MLSS, MLSS = _________________ mg/L

Average Influent Flow, Q_{AVG} = _________________ MGD

Influent BOD_5 = _________________ mg/L

Measured Depth @ Time of Sampling = _________________ ft

Total Volume per Basin @ PWL, V_{PWL} = _________________ MG

Number of Basins, #BASINS = _________________ basins

Collect a MLSS sample and calculate F/M using:

$$F/M = \frac{Q_{AVG} \times BOD_5}{MLSS \times V_{PWL} \times \#BASINS}$$

$$F/M = \frac{\qquad \times \qquad}{\qquad \times \qquad \times \qquad}$$

F/M = _________________ day^{-1}

2 Percent of Design Organic Load Worksheet

Design Average Influent flow, Q_{AVG} = ________________ MGD

Current Average influent Flow, Q_{AVG} = ________________ MGD

Design Influent BOD_5^{DES} = ________________ mg/L

Current Influent BOD_5^{CUR} = ________________ mg/L

Determine the Percent of Design Organic Load = $LOAD_{\%}$ as follows:

$$LOAD_{\%} = \frac{(Q_{AVG}^{CUR}) \quad x \quad (BOD_5^{CUR})}{(Q_{AVG}^{DES}) \quad x \quad (BOD_5^{DES})}$$

$$LOAD_{\%} = \frac{\quad x \quad}{\quad x \quad}$$

$LOAD_{\%}$ = ________________ % of Design Organic Load

6306 N. Alpine Rd. Loves Park, IL 61111-7655 **p** 815.654.2501 **f** 815.654.2508 **www.aqua-aerobic.com**

3 Percent of Design Nitrogen Load Worksheet

Design Average Influent Flow, Q_{AVG}^{DES} = ________________ MGD

Current Average Influent Flow, Q_{AVG}^{CUR} = ________________ MGD

Design Influent TKN^{DES} = ________________ mg/L

Current influent TKN^{CUR} = ________________ mg/L

Determine the Percent of Design Load = $LOAD_{\%}$ as follows:

$$LOAD_{\%} = \frac{(Q_{AVG}^{CUR}) \quad x \quad (TKN^{CUR})}{(Q_{AVG}^{DES}) \quad x \quad (TKN^{DES})}$$

$$LOAD_{\%} = \frac{\qquad x \qquad}{\qquad x \qquad}$$

$LOAD_{\%}$ = ________________ % of Design Nitrogen Load

4 Pounds of Influent Constituent per Day Worksheet

Design Average Influent flow, Q_{AVG}^{DES} = ________________ MGD

Influent Constituent concentration = ________________ mg/L

Use the following formula to convert influent BOD_5, TSS, TKN, or Total P concentrations to pounds of the constituent per day:

$BOD_{LBS.}$ = Q_{AVG} x BOD_5 x 8.34

$BOD_{LBS.}$ = ____________ x ____________ x 8.34

$BOD_{LBS.}$ = ____________________ lbs. BOD_5 day

6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

5 Sludge Age Worksheet

Take a sample of MLSS, Effluent TSS and Sludge Wasting concentration.

MLSS =	________________	mg/L
Total Volume per Basin @ PWL, VPWL =	________________	MG
Effluent TSS, TSSEFF =	________________	mg/L (avg)
Influent Flowrate, QAVG =	________________	MGD
Total Sludge Wasting Rate, QSLUDGE =	________________	gpm
Wasting Time/Cycle, SW =	________________	min/cycle
Cycles per day per basin, CPD =	________________	cycle/day
Numbers of Basins, #BASINS =	________________	basins
Waste sludge concentration, WSCONC =	________________	MGD

Calculate Sludge Age (T_S) using:

$$T_S = \frac{\text{Total Pounds of TSS}}{\text{(lbs. Effluent TSS/day) + (lbs. of Waste Sludge/day)}}$$

Where:

Total lbs. TSS = (V_{PWL}) x (#BASINS) x (MLSS) x 8.34

= ________ MG x ___ basins x ____________ mg/l x 8.34

= ________ lbs.

Lbs. Effluent TSS/d = (Q_{AVG}) x (TSS_{EFF}) x 8.34

= ________ MGD x ________ mg/l x 8.34

= ________ lbs./day

Lbs. W.S./day = (Q_{SLUDGE}) x (SW) x (CPD) x (#BASINS) x (WS_{CONC}) x 8.34 x 10^{-6}

= _____ gpm x ____ min/c x ____ cpd x ____ basins x _____ mg/l x 8.34 x 10^{-6}

= _______lbs./day

Therefore:

T_S = (lbs.) / (lbs./day) + (lbs./day)

T_S = _______ days

6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

AquaNereda® Aerobic Granular Sludge Technology Glossary

Introduction

This section provides a glossary of terms and definitions associated with the AquaNereda® Aerobic Granular Sludge Technology and serves as a reference for terminology that will be encountered in the Operation and Maintenance Manual.

Terms & Definitions

ADF – Average Design Flow. The ADF is calculated using an average (typically a monthly average) of daily flows.

Aeration capacity – Amount of air that can be supplied to the AquaNereda® reactor(s); usually refers to the opening percentage of the aeration valve or the capacity of the blowers.

Aeration grid – A network of aeration pipes and fine bubble diffusers to introduce air into the mixed liquor of the AquaNereda® reactor(s).

Aerobic (conditions) – Wastewater that contains molecular oxygen (dissolved free oxygen).

AGS – Aerobic Granular Sludge

Alkalinity – Measure of the capacity of water to neutralize acids without a change in pH. Typically reported in mg/L as $CaCO_3$.

Alpha – Oxygen mass transfer rate ratio of process water to clean water.

Anaerobic (conditions) – Wastewater that contains neither dissolved oxygen nor nitrates.

Analyzers – Instrumentation which automatically collects, filtrates, and analyzes parameters in real time; e.g., PHOSPHAX to measure phosphate, AMTAX to measure ammonia, etc.

Anoxic (conditions) – Wastewater that contains nitrates but no molecular oxygen.

AOR – Actual Oxygen Requirement. Used to determine the amount of oxygen needed by microorganisms to oxidize BOD, COD, and nitrogen.

Automatic control – When the Nereda® Controller is operated in automatic mode; i.e., the operator cannot manually start or stop a recipe. The reactor(s) (and sludge buffer(s), if applicable) are controlled automatically and their cycle time varies between the nominal and minimal cycle time.

Autotrophs – Any organism capable of self-nourishment by using inorganic materials as a source of nutrients and using photosynthesis or chemosynthesis as a source of energy. In the AquaNereda® environment, the most important of these are the nitrifier bacteria that oxidize ammonia to NOx.

BHP – Brake Horse Power. Measure of a unit's gross horse power prior to losses.

BOD – Biochemical Oxygen Demand. Measure of the amount of oxygen needed by microorganisms to breakdown organic (carbonaceous) materials under aerobic conditions in a 5 day test.

BODult – Ultimate Biochemical Oxygen Demand. Measure of the amount of oxygen needed by microorganisms over a 20 day test as opposed to the typical 5 day test.

Centerline of Discharge – Line formed using the center of the discharge pipe.

cBOD – Carbonaceous Biochemical Oxygen Demand. Measure of the amount of oxygen needed by microorganisms to breakdown organic (carbonaceous) and inorganic materials (such as ferrous iron and sulfide) under aerobic conditions. BOD from nitrification is not included in this measurement.

COD – Chemical Oxygen Demand. The measure of the amount of oxygen needed to chemically oxidize material in wastewater. It does not include the oxidation of ammonia to nitrites and nitrates.

Composite sample – Technique whereby multiple periodic or spatially discrete samples are combined, thoroughly homogenized, and treated as a single sample (typically over a 24-hour period) to form a daily composite sample.

Cycle – The sum of the individual phases of the AquaNereda® process (Fill/Draw, React, and Settle/Sludge wasting)

Cycle structure – Time period of each phase of the AquaNereda® process

Denitrification – Biological process under anoxic conditions in which the removal of nitrogen through the conversion of nitrites and nitrates to nitrogen gas via anaerobic microbial degradation occurs.

Digester – Basin used for the digestion (biological oxidation) of organic sludge.

Diffuser – The air supply mechanism; typically fine bubble. These are installed across the bottom of the basin.

DO – Dissolved Oxygen

Effluent – Treated supernatant that flows out of a basin.

Effluent decanter(s) – Channel(s) to collect the clear effluent at the top of the AquaNereda® reactor(s); also called effluent gutter(s) or effluent launder(s). The tops of the gutters are V-notch weirs to ensure even flow collection over the whole surface of the reactor(s).

Endogenous decay – Biomass decrease caused when cells obtain energy by oxidizing their own internal storage products.

Exchange ratio – Ratio between the batch volume fed to each reactor per cycle and the reactor process volume. Normally it is expressed as a percentage.

F/M – Food-to-Microorganism ratio. Measured as the ratio between the mass of food (usually COD or BOD) fed to the AquaNereda reactor per day and the mass of microorganisms (MLSS) in the reactor. $F/M_{biological}$ is corrected to the biological cycle time; i.e., it only refers to the mass of sludge that is in the aerobic and anoxic phases. F/M_{total} refers to the total cycle time including all operation time phases.

Fill/Draw – The first phase of the AquaNereda® cycle during which the reactor is fed from the basin floor while displacing the clear supernatant at the top.

FOG – Fats, Oils, and Greases

Freeboard – Distance from the top of the basin wall to the process water level.

FTF – Field Transfer Factor. Used to adjust the AOR from clean water to field conditions (dirty water).

FTR – Field Transfer Rate. Same as FTF.

GAO – Glycogen Accumulating Organisms

GPD – Gallons per day

GPM – Gallons per minute

Grab sample – Discrete sample collected at a specific time.

Granulation – Biological process resulting in the development of granules.

Granule – Particle of activated biomass bigger than 0.2 mm.

Heterotrophs – Organisms that cannot manufacture their own food and instead obtain food and energy by taking in and breaking down organic substances, usually plant or animal matter. All animals, protozoans, fungi, and most bacteria are heterotrophs; for example, denitrifiers and phosphate accumulating organisms are heterotrophs: they can use either oxygen or NOx as electron acceptors for energy transfer and so can grow under both aerobic and anoxic conditions but not under anaerobic conditions.

HP – Horsepower

HP/MG – Horsepower per Million Gallons. Usually this ratio is used to determine the required mixing energy.

HRT – Hydraulic Retention Time. Average time that a water molecule remains in a basin.

Influent – Raw, untreated waste that flows into a basin.

Influent distribution grid – Influent distribution pipes installed at the bottom of the AquaNereda® reactor(s). They are perforated to allow the influent to be evenly distributed through the sludge blanket in a plug-flow regime; also known as feed pipes.

Influent feed pump(s) – Pump(s) feeding influent to the AquaNereda® reactors.

Loop – A sequence of repeating phases running during a particular time period.

Lysis – The dissolution or destruction of cells.

Manual control – When the Nereda® Controller is operated in manual mode; i.e., the operator can select to manually start a recipe in any of the three operations. Cycle time is fixed.

MCRT – Mean Cell Residence Time. Average time that a bacterial cell remains in the reactor. Total pounds of sludge in the reactor divided by the sum of the pounds of sludge in the effluent and pounds of sludge wasted.

MDF – Maximum Design Flow. Maximum 24-hour flow reported at the location. Typically the basis of the system's hydraulic design.

MGD – Million Gallons per day

Mg/L – Milligrams per liter

mL/g – Milliliters per gram

MLSS – Mixed Liquor Suspended Solids. The suspended solids in the wastewater. A portion of these solids is active biological solids involved in the treatment of wastewater.

MLVSS – Mixed Liquor Volatile Suspended Solids. The volatile fraction of the MLSS. Normally assumed to be more representative of the active biological solids than MLSS.

MSL – Mean Sea Level

Nereda® Controller – Software which controls the AquaNereda® system operation.

NH_3 – Ammonia

Nitrification – Biological process under aerobic conditions in which the conversion of nitrogen containing matter to nitrites and nitrates occurs. Process performed by nitrosomonas and nitrobacter bacteria.

NPHP – Nameplate horsepower

NO_3 – Nitrate

NOx-N – All oxidized forms of nitrogen, namely nitrate (NO_3), nitrite (NO_2), and nitric oxide (NO).

Nutrient Deficient – Essential nutrients for microorganism respiration or growth are either absent or present in insufficient quantities. Typically this is nitrogen or phosphorus. Typical required ratio is 100:5:1 (Degradable Organic : Nitrogen : Phosphorus).

O&G – Oil and Grease

Organic Nitrogen – Proteins, amines, and amino acids

OUR – Oxygen Uptake Rate. Rate of decrease in oxygen concentration caused by microorganisms. Measured mg/L/hr.

O_2 – Oxygen

PAO – Phosphorus Accumulating Organism. These are bacteria that consume volatile fatty acids (VFAs) in a reaction that releases phosphorus into the wastewater.

pH – Measure of the acidity or basicity of a solution.

Phase – A time period during which progressive batch treatment of the influent occurs. Phases make up a full cycle.

PLC – Programmable Logic Controller

PPM – Parts per million

PO_4 – Phosphate

Post-equalization / Effluent buffer – Basin downstream of the AquaNereda® reactor(s) designed to provide a more uniform flow rate and liquid composition to treatment processes after the reactors.

Pre-equalization / Influent buffer – Basin upstream of the AquaNereda® reactor(s) designed to moderate the flow and concentration of the influent and store influent wastewater when none of the reactors are in the feed phase of their operating cycle. It also prevents flow from entering the system during React and Settle phases.

Pressure Transducer – Converts transducer pressure caused by water above the transducer into a water depth measurement.

Probes – Instrumentation that provides direct on-line measurement of parameter concentrations; e.g., dissolved oxygen, redox, dry solids, etc.

PWL – Process Water Level

Q – Flow

React – AquaNereda® phase where no further influent is entering the basin and aeration (and mixing) is occurring. Air is either continuously added to provide aerobic conditions or periodically added to provide both aerobic and anoxic conditions.

Reactor(s) – Biological reactor(s) where the sequential biological AquaNereda® process takes place including pollutant removal (carbon, nitrogen, and phosphorus) as well as the separation between biomass and clear effluent.

Recipe – Sequence of operations and phases controlled by the Nereda® Controller according to the defined set points.

Sample depth – Sample collected inside the AquaNereda® reactor(s) at a specified depth below the top of the water surface and, typically, taken during the aeration phase while running at maximum capacity, after at least 5 minutes of aeration.

SCADA – Control software connected to the plant PLC. The SCADA shows the interpretation made by the PLC which receives instructions from the Nereda® Controller to execute actions. The SCADA allows, for example, starting and stopping blowers and pumps, opening and closing valves, etc. Usually it reports trends, alarms, and allows manual and automatic equipment operation.

SCFM – Standard Cubic Feet per Minute. Air flow rate that has been standardized for pressure, temperature, and relative humidity.

Septicity – The degree to which the raw wastewater or basin MLSS has gone septic, in which anaerobic microorganisms consume the organics in the wastewater in the absence of oxygen and nitrate. Indicators of this condition are the presence of hydrogen sulfide, methane gas, and *Spirillium* bacteria in the wastewater.

Set-point – Target value that the Nereda® Controller attempts to achieve.

Settle – AquaNereda® phase where there is no influent entering the basin and there is no aeration occurring. Solids separate from the supernatant and settle toward the basin floor.

Settleability – The degree to which the MLSS settles in the basin during the Settle phase. This parameter is measured by sludge judge or settleometer testing.

Settleometer – A small container used to measure the settleability of the MLSS.

Settling velocity – Biomass sedimentation velocity measured in m/hr.

Shared aeration – The same blower is used to aerate two or more basins.

Sludge – Particles of activated biomass smaller than 0.2 mm; also called flocs.

Sludge age – Same as MCRT. The average time a solids particle remains in the system.

Sludge buffer – Tank to which the AquaNereda® excess sludge is discharged.

Sludge judge – A device used to collect a sample of the MLSS in the basin at specific water depths. The sample is then used to determine the settleability of the solids.

Sludge selection pressure – Defined by the settling velocity of the sludge and granules; it is defined as the ratio between the distance from the top water surface to the sludge pipes and the settling time before the discharge is initiated (m/hr). This determines the amount of sludge/granules that will have settled past the sludge discharge pipe(s) before the sludge discharge is initiated. The aim is to allow the granules to settle past the level of the sludge pipe(s) so that they remain in the reactor whereas the slower settling sludge is removed.

Sludge waste – Excess sludge which is removed from the reactor from the top of the granule layer.

Sludge yield – Ratio of the amount of sludge formed to the amount of food (BOD) consumed.

SOR – Standard Oxygen Requirement. Oxygen transferred rate (lbs/hr) of AOR at field conditions (dirty water).

Storm flow – Flow in excess of the MDF.

Supplemental carbon – Additional carbon source added to encourage microbial growth and food (BOD) consumption or denitrification. This is typically accomplished through adding methanol, ethanol, corn syrup, etc.

Supernatant – The liquid layer between the water surface and the top of the sludge blanket.

SVI – Sludge Volume Index. The volume (in mL) occupied by one gram of mixed liquor after settling for X minutes in a one liter graduate cylinder (mL/gm). Calculated by: SVI = Settled Sludge Vol. (mL/L) x 1000 / MLSS (mg/L).

SVI_5 – The sludge volume index after 5 minutes is the measure of the biomass settleability after 5 minutes of settling; measured in mL/g.

SVI_{30} – The sludge volume index after 30 minutes is the measure of the biomass settleability after 30 minutes of settling; measured in mL/g.

SWD – Side Water Depth. Depth of water in a tank as measured from the bottom of the tank to the water surface.

TDH – Total Dynamic Head. Elevation difference, following pumping, between the pump inlet elevation and the new water level elevation.

Timers – Inform the PLC when the blowers or aerators should be on/off during the React phase of the AquaNereda.

TIN – Total Inorganic Nitrogen. Sum of NOx-N and ammonia nitrogen.

TKN – Total Kjeldahl Nitrogen. The organic nitrogen plus ammonia nitrogen.

TN – Total Nitrogen. Sum of TKN and NOx-N.

TOC – Total Organic Carbon

TP – Total Phosphorus. Typically made up of orthophosphate, polyphosphate, and organic phosphate. Orthophosphate (PO_4^{-3}, HPO_4^{-2}, $H_2PO_4^{-}$, and H_3PO_4) is immediately available for biological use.

TSS – Total Suspended Solids. Solids that are suspended in a basin but retained on a filter (not dissolved).

Upflow velocity – Hydraulic upflow velocity of the influent feed into the reactor measured in m/hr.

V – Volume

VFA – Volatile Fatty Acid. A product of the breakdown (fermentation) of organic matter under oxygen-free (anaerobic) conditions. The VFAs are consumed by the biomass in a reaction that releases phosphorus into the wastewater.

VSS – Volatile Suspended Solids. Concentration of solids (mg/L) that will volatilize at 550° C.

Water level correction buffer – Tank which receives the clear effluent discharged from the AquaNereda® reactor(s) during the Lower Level Phase. If this stream is discharged to the sludge buffer tank or to the final effluent network, the water level correction buffer tank is unnecessary.

Zooglea – An aggregate of bacteria forming a jellylike mass with cell walls swollen by the absorption of water. These tend to settle slowly and can, therefore, cause higher effluent solids.

6306 N. Alpine Rd. Loves Park, IL 61111-7655 **p** 815.654.2501 **f** 815.654.2508 **www.aqua-aerobic.com**

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

MECHANICAL AND FIELD INSTRUMENT COMPONENT INFORMATION

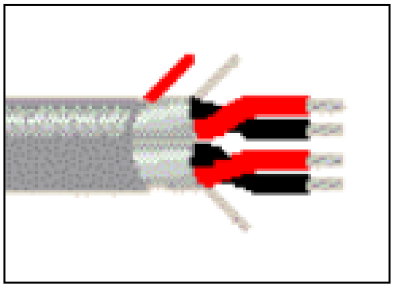
ACTUATOR

CORD SET

Electrical Cable

Part # 2702210

Shielded, 2 Twisted Pair

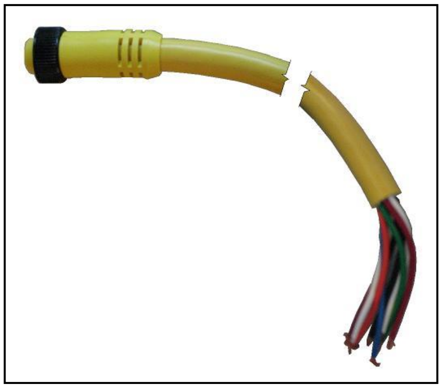


- Belden # 9368 or Omni Cable # L21802
- 18 AWG 2-Pair stranded tinned copper conductors
- Individually shielded w/ PVC insulation and jacket
- Suitability: Indoor, Outdoor, Burial, Sunlight Resistance
- Certifications: UL Approved

Cordset

Part # 2612931-12

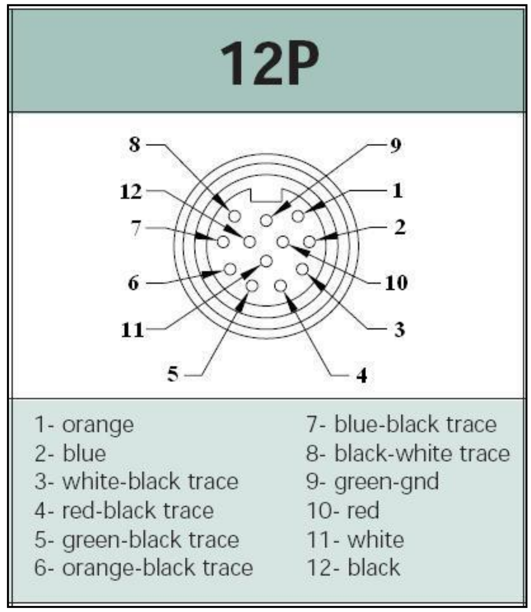
12P Single Female, 12' Cord

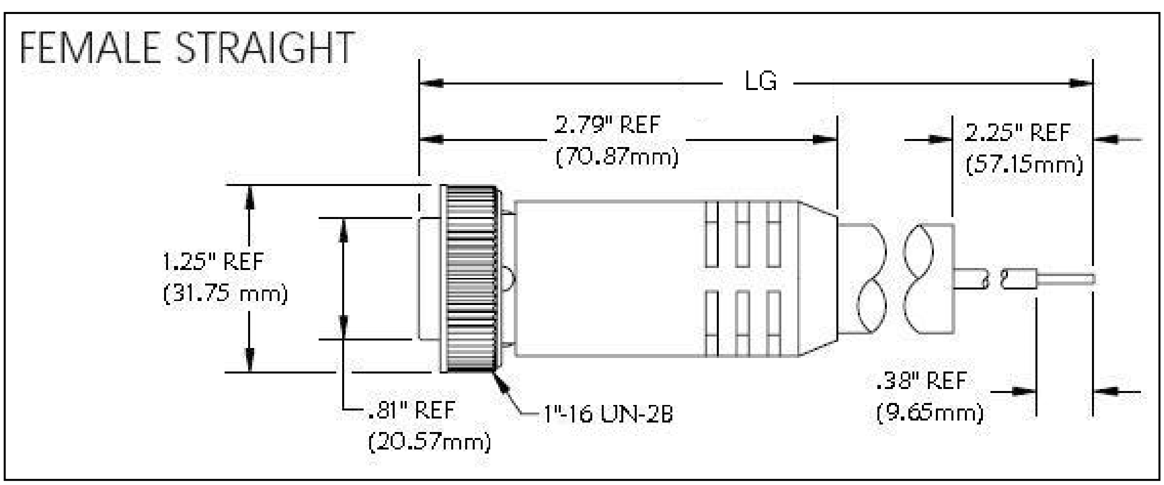


- #16 AWG Yellow STOOW Cable – U.S. Color Code
- Oil-resistant PVC Jacket
- Low-resistance contact design with gold/palladium nickel plating

Connector Data:

- Conn. face: PVC – UL STD 94 – VO
- Molded body: PVC – UL STD 94 – VO
- Coupling nut: Zinc diecast with black epoxy coat.
- Cable: Yellow #16 AWG, PVC jacket and PVC conductor insulation over 65 x #34 copper stranding, 600V, UL STOOW CSA ST.
- Outside diameter: .71” (18.0mm)
- Voltage rating: 600V AC/DC
- Amperage: 5A
- Protection: IP68, NEMA 6P
- Ambient operating temperature: -4º to 221º F (-20º to 105º C)
- Certifications: UL recognized, file #E46237, CSA certified, file #LR6837





AUMA

115V/1ph/60Hz

Actuator Assembly **Part # 9704419A30136**

Auma SQEx07.2/AMExC01.1, 115V, C1D1, w/LC, CSA

Mechanical Data

- Auma Explosion-proof (C1D1)
- Mechanical dial position indication
- Tripping torque (both directions): 75-220 lb-ft (100-300 Nm)
- Machined splined coupling
- Ambient temperature: -22°F to +158°F (-30°C to 70°C)
- Insulation class: F, tropicalized
- Finish coating / color: two component iron-mica combination / silver grey
- Hand wheel diameter: 6.3 in. (160 mm)
- Weight: 51 lbs. (23 kg)
- Over-Ride manual hand wheel (w/instructions) does not rotate during electric operation.
- CSA Nameplated

Electrical Data

- Motor voltage: 115VAC/1PH/60Hz
- Motor Speed: 1680 RPM
- NEMA 4X/6 enclosure: submersible, 6 feet for 30 minutes
- Rated for Class 1/Division 1, Groups C & D : Class 2-3/Division 1, Groups E, F, & G
- 2 Gear train limit switch: minimum 4 contacts
- Open and close torque Switches
- 120V space heater in limit switch compartment
- Motor Controls – Selector Switch (L/O/R) with Auxiliary Contact, Control Push Buttons (O/S/C), 2 Indicating Lights (O/C)
- Operating time for 90°: 12 seconds
- Motor power (at shortest time): 0.04 HP (0.03 kW)
- Nominal current: 2.6 amps
- Current at maximum torque and shortest operating time (approx.): 3.1 amps
- Starting current: 5.4 amps
- Ref. AASI wiring diagram 2702997

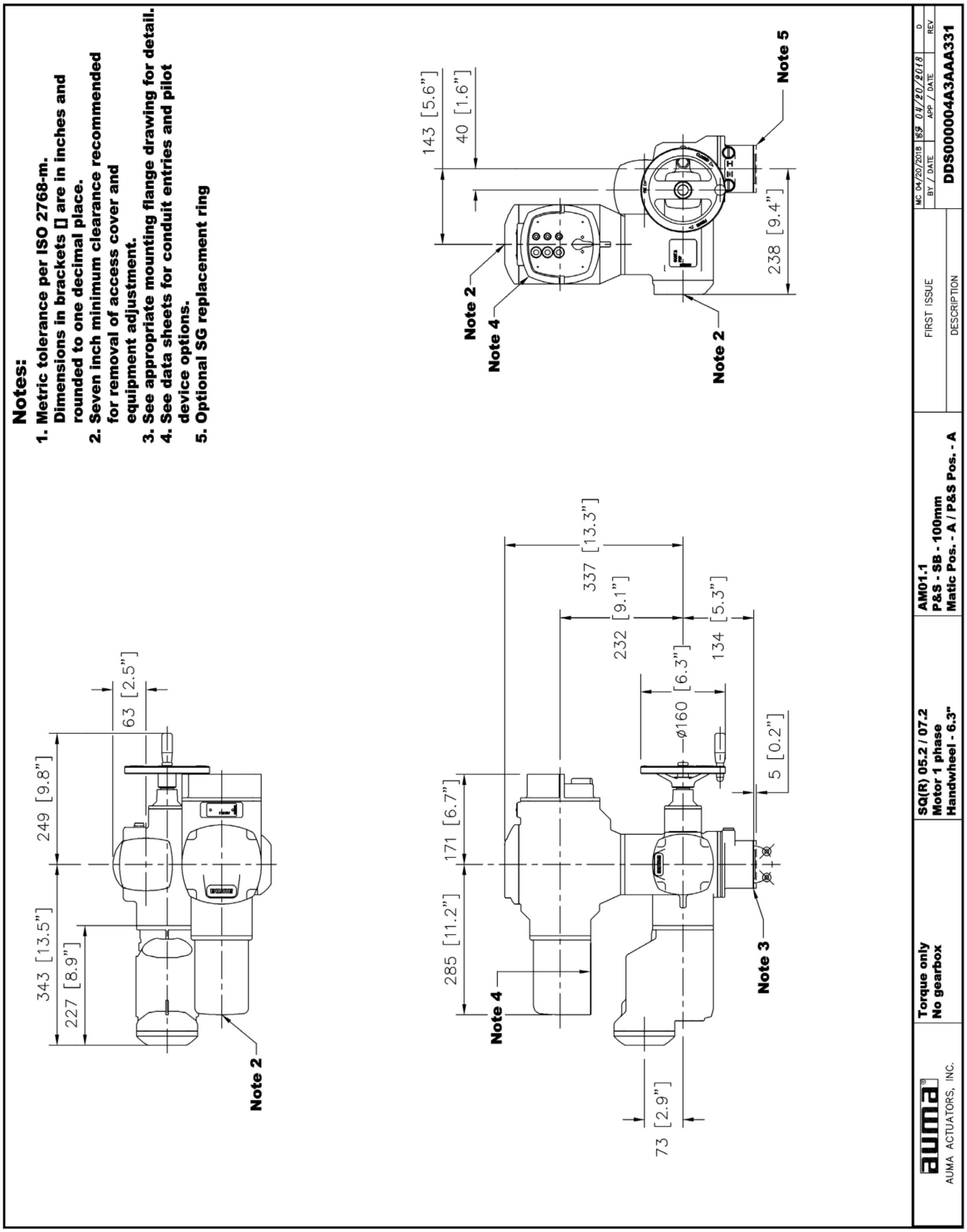
NOTICE

AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

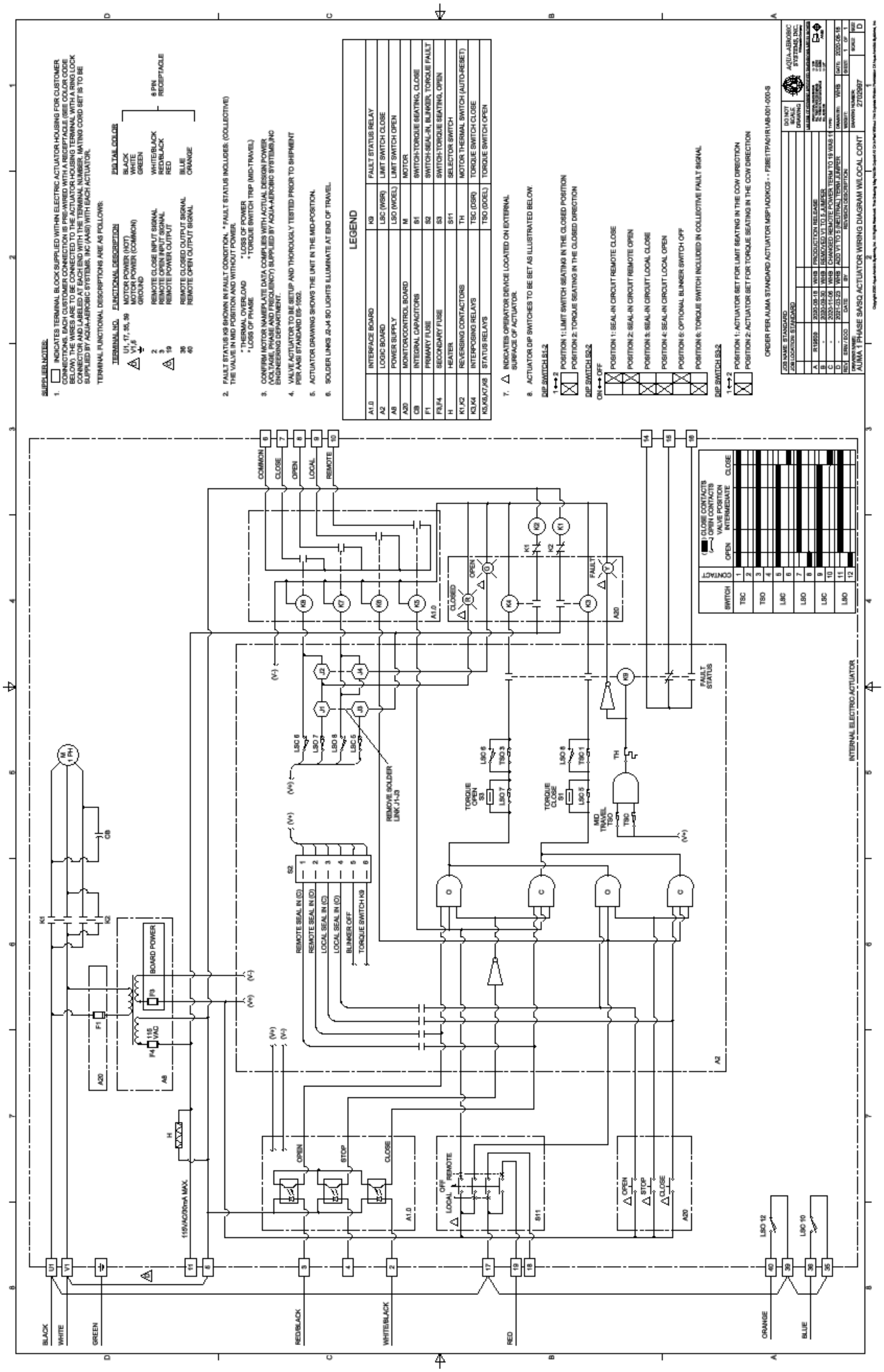
Actuator Assembly

Part # 9704419A30136

Auma SQEx07.2/AMExC01.1, 115V, C1D1, w/LC, CSA



Auma SQEx07.2/AMExC01.1, 115V, C1D1, w/LC, CSA



575V/3ph/60Hz

Actuator Assembly   Part # 9704419A30135

Auma SQR07.2-AC01.2, 575V, Modulating, LC, CSA

Mechanical Data

- Mechanical dial position indication
- Tripping torque (both directions): 221 lb-ft (300 N-m) Max
- Machined splined coupling
- Ambient temperature: -22°F to +158°F (-30°C to 70°C)
- Insulation class: F, tropicalized
- Finish coating / color: two component iron-mica combination / silver grey
- Hand wheel diameter: 6.3 in. (160 mm)
- Weight (SQR+AC): 61.7 lbs. (28 kg)
- Override manual hand wheel (w/instructions) does not rotate during electric operation.
- Reference EP-50349-001
- CSA Nameplated

Electrical Data

- Motor voltage: 575VAC (±10%) / 3 Phase / 60 Hertz (±5%)
- With local controls, push buttons & display
- Analog Input / Output Signal
- NEMA 4X/6 enclosure: submersible, 6 feet for 30 minutes
- MWG magnetic limit/torque sensor (non-intrusive setting)
- 115V space heater in limit switch compartment
- Operating time for 90°: 12 seconds
- Motor power (at shortest time): 0.04 HP (0.03 kW)
- Nominal current: 0.30 amps
- Current at maximum torque and shortest operating time (approx.): 0.40 amps
- Starting Current: 0.80 amps

NOTICE

AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

Actuator Assembly **Part # 9704419A30135**

Auma SQR07.2-AC01.2, 575V, Modulating, LC, CSA

<u>AUMA AC01.2 CONTROL STATION</u>

<u>Mechanical Data</u>

- Enclosure protection: IP68
- Ambient temperature: -13°F to 158°F (-25°C to 70°C)
- Corrosion protection: KS
- Finish coating / color: two component iron-mica / silver grey (RAL 7037)
- Weight: 15.4 lbs. (7 kg)

<u>Electrical Data</u>

- Motor voltage: 575VAC (±10%) / 3 Phase / 60 Hertz (±5%)
- Electrical connection: plug/socket connector with screw type connection
- Output signals: 5 output relays with gold plated contacts
- Switchgear: Reversing contactors
- Control: 115 VAC (±10%) Open-Stop-Close
- Voltage output: Auxiliary voltage 115 VAC max, 30mA to supply the control inputs.
- LCD display for status indication and programming support.

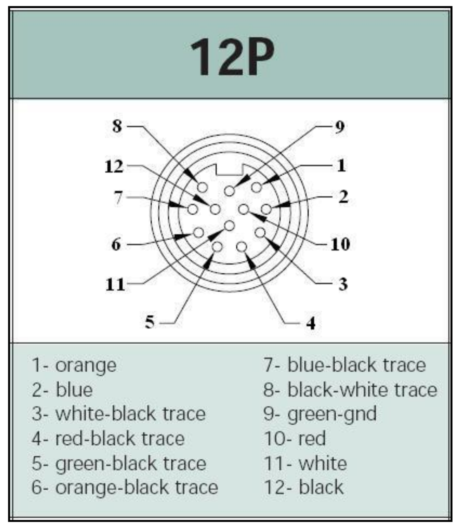
Actuator Assembly Part # 9704419A30135

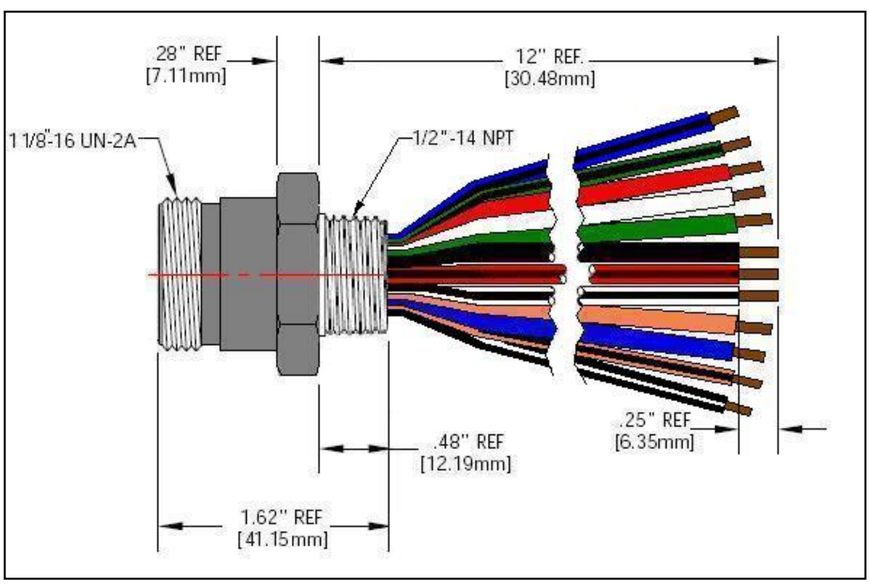
Auma SQR07.2-AC01.2, 575V, Modulating, LC, CSA

- Brad Harrison #3R2006A20A120
- #16 AWG PVC 12” Leads – US Color Code, epoxy potted
- Black epoxy coat zinc die cast shell design.

<u>Receptacle Data:</u>

- Shell: Zinc diecast w/black epoxy coat.
- Insert: PVC – UL Std 94 – VO
- Conductors: #16 AWG PVC insulation over 26 X #30 copper stranding, 600V, UL style 1015 CSA TEW
- Voltage rating: 600V AC/DC
- Amperage: 7A
- Protection: IP 68, Nema 6P
- Operating temp: -4 to 221 F (-20 to 105 C)
- Certifications: UL recognized, File # E46237
  CSA certified, File # LR6837

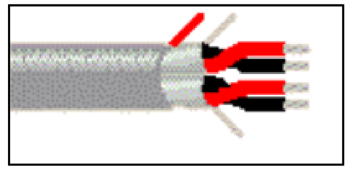




Auma SQR07.2-AC01.2, 575V, Modulating, LC, CSA

Cord Grip with Shielded Twisted Pair Cable (Modulating Service):

Cable Data:

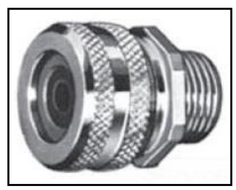


- Belden #9368 A.A.S.I. # 2702210
- 18 AWG pairs stranded (19x30) tinned copper conductors
- Twisted pairs
- PVC insulation and jacket
- Individually shielded
- #16 AWG PVC 12" Leads – US Color Code, epoxy potted
- Voltage rating: 300V AC/DC
- Amperage: 6.4A per conductor
- Suitability: Indoor, Outdoor, Burial, Sunlight Resistance
- Operating temperature: -22° to 221° F (-30° to 105° C)
- Certifications: UL recognized, File # E46237
  CSA certified, File # LR6837

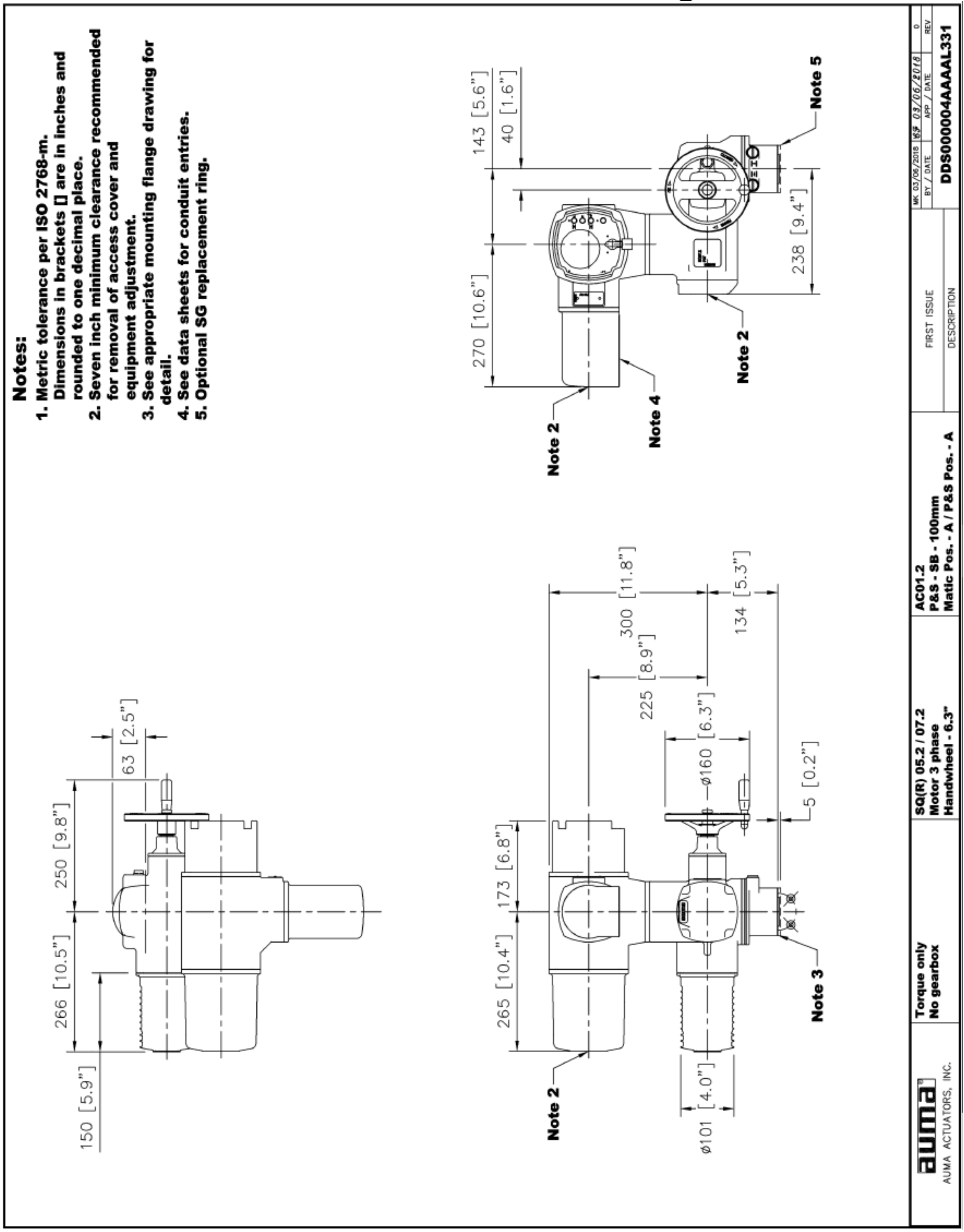
Number	Color
1	Black & Red #1
2	Black & Red #2

Cord Grip Data:

- Appleton #CG-2575
- A.A.S.I. # 2614928
- Straight, 3/4" NPT
- Aluminum body, copper free aluminum cap, neoprene grommet, steel/Teflon washer
- Cord size: 0.25" to 0.375"
- 1-1/4" diameter
- Certifications: UL Approved

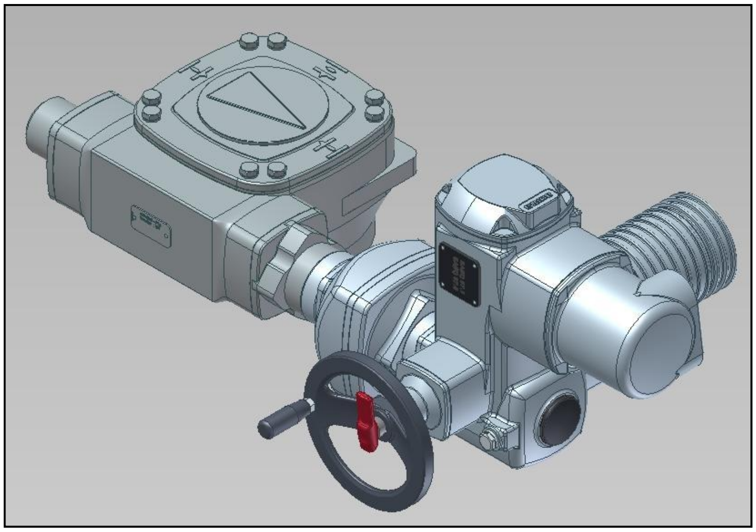


Auma SQR07.2-AC01.2, 575V, Modulating, LC, CSA



Actuator Assembly   Part # 9704419A30134

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA



The SAExC07.6 Actuator is combined with a GS100.3 gearbox, and VZ4.3 Gear Reducer.

The multi-turn actuator SAExC07.6 is designed for intermittent duty S4-25%.

Design Features:

Maximum number of starts = 1,200 c/h
Limit and torque seating.
Hand wheel for manual operation.

Total Weight: 161 lbs. (73 kg)

AUMA worm gearboxes have intermittent duty S4-25%. Clockwise rotation at the input shaft results in clockwise rotation at the output drive.

NOTICE
AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

Actuator Assembly

Part # 9704419A30134

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

AUMA SAExC07.6 ACTUATOR DATA

Mechanical Data

- Auma Explosion-proof
- Mechanical dial position indication
- Tripping torque (both directions): 14.74 lb-ft (20 Nm) min., 44.25 (60 Nm) max.
- Machined splined coupling
- 304 stainless steel hardware
- Ambient temperature: -20°F to 175°F (-25°C to 80°C)
- Insulation class: F, tropicalized
- Enclosure Protection: IP67
- Corrosion Protection: KN
- Finish coating / color: two component iron-mica combination / grey (DB 702, similar to RAL 9007)
- Hand wheel diameter: 6.3 in. (160 mm)
- Weight: 46.3 lbs. (21 kg)
- Over-Ride manual hand wheel (w/instructions) does not rotate during electric operation.
- Reference EP-50026
- CSA Nameplated

Electrical Data

- Motor voltage: 575VAC (±10%) / 3-Phase / 60 Hertz (±5%)
- Motor Speed: 3360 RPM
- Output Speed: 108 RPM
- NEMA 4x/6 enclosure: submersible, 6 feet for 30 minutes
- Rated for Class 1/Div 1, Group C&D- Class 2-3/Div1, Groups E, F, &G
- 2 Gear train limit switch: minimum 4 contacts
- Open and close torque Switches
- 110V space heater in limit switch compartment
- With push buttons, selector switches and pilot lights
- Operating time for 90°: ~30 seconds
- Motor power (at shortest time): 0.536 hp (.40 kW)
- Nominal current: 1.90 amps
- Current at maximum torque and shortest operating time (approx.): 2.10 amps
- Starting current: 7.50 amps

Actuator Assembly **Part # 9704419A30134**

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

AUMA MATIC CONTROL STATION DATA

Mechanical Data

- Mechanical dial position indication
- Enclosure protection: IP67
- 304 stainless steel hardware
- Ambient temperature: -13°F to 158°F (-25°C to 70°C)
- Corrosion protection: KS
- Finish coating / color: two component iron-mica / silver-grey (RAL 7037)
- Weight: 15.4 lbs. (7 kg)

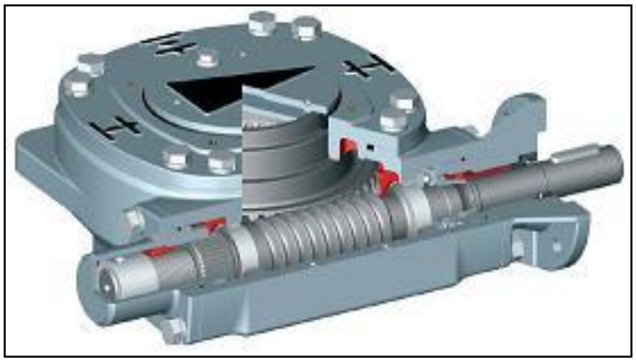
Electrical Data

- Motor voltage: 575V (±10%) / 3-Phase /60 Hz (±5%)
- Electrical connection: 0.75" NPT
- Output signals: 5 output relays with gold plated contacts
- Switchgear: Reversing contactors
- Control: 115 VAC Open-Stop-Close
- Voltage output: Auxiliary voltage 115 VAC (±10%) max, 30mA to supply the control inputs.

Actuator Assembly **Part # 9704419A30134**

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

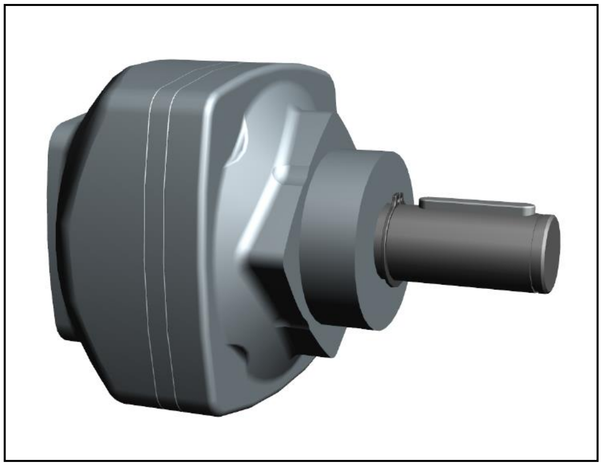
GS100.3 GEARBOX DATA



Mechanical Data

- Pointer cover position indication
- Housing material: Cast iron
- Machined splined coupling
- Maximum output torque: 2,950 ft-lb (4,000 Nm)
- Maximum input torque: 42 ft-lb (57 Nm)
- Fixed swing angle: 10º-100º
- Reduction Ratio: 208:1
- Turns for 90°: 52
- Enclosure protection: IP68-3
- Corrosion protection: KN
- Ambient temperature: -20°F to 175°F
- (-25°C to 80°C)
- Finish coating / color: two component iron-mica combination / Grey (DB702 / RAL9007)
- Weight: 86 lbs. (39 kg)

VZ4.3 PRIMARY REDUCTION GEARING



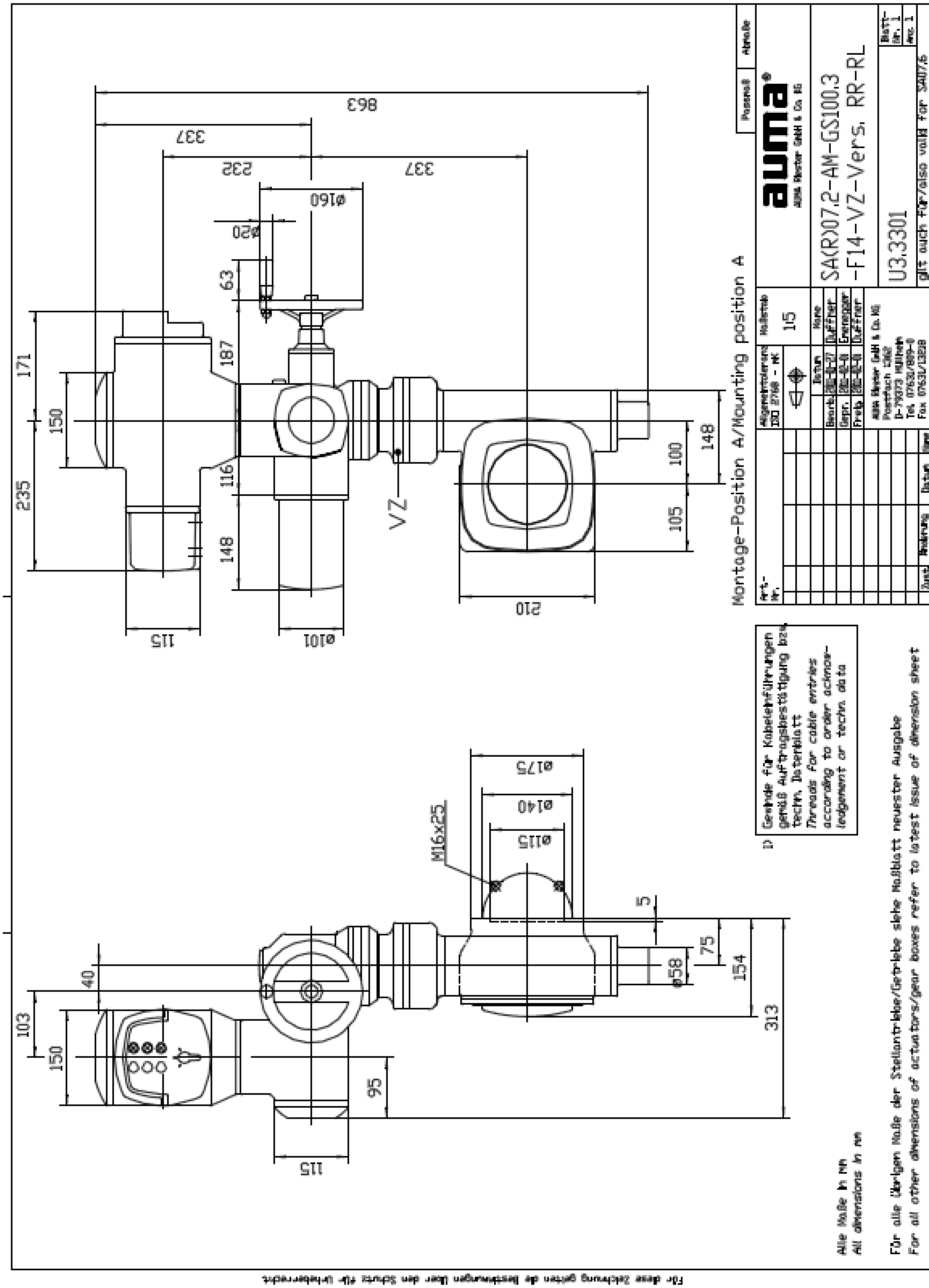
A primary reduction gear expands considerably the number of combinations of multi-turn actuator and part-turn gearbox. The additional reduction increases the operating time of the actuator / gearbox combination.

- Reduction Ratio: 4:1
- Input Torque: 19.18 ft.lb.(26Nm)
- Weight: 13 lbs. (6 kg)

Actuator Assembly

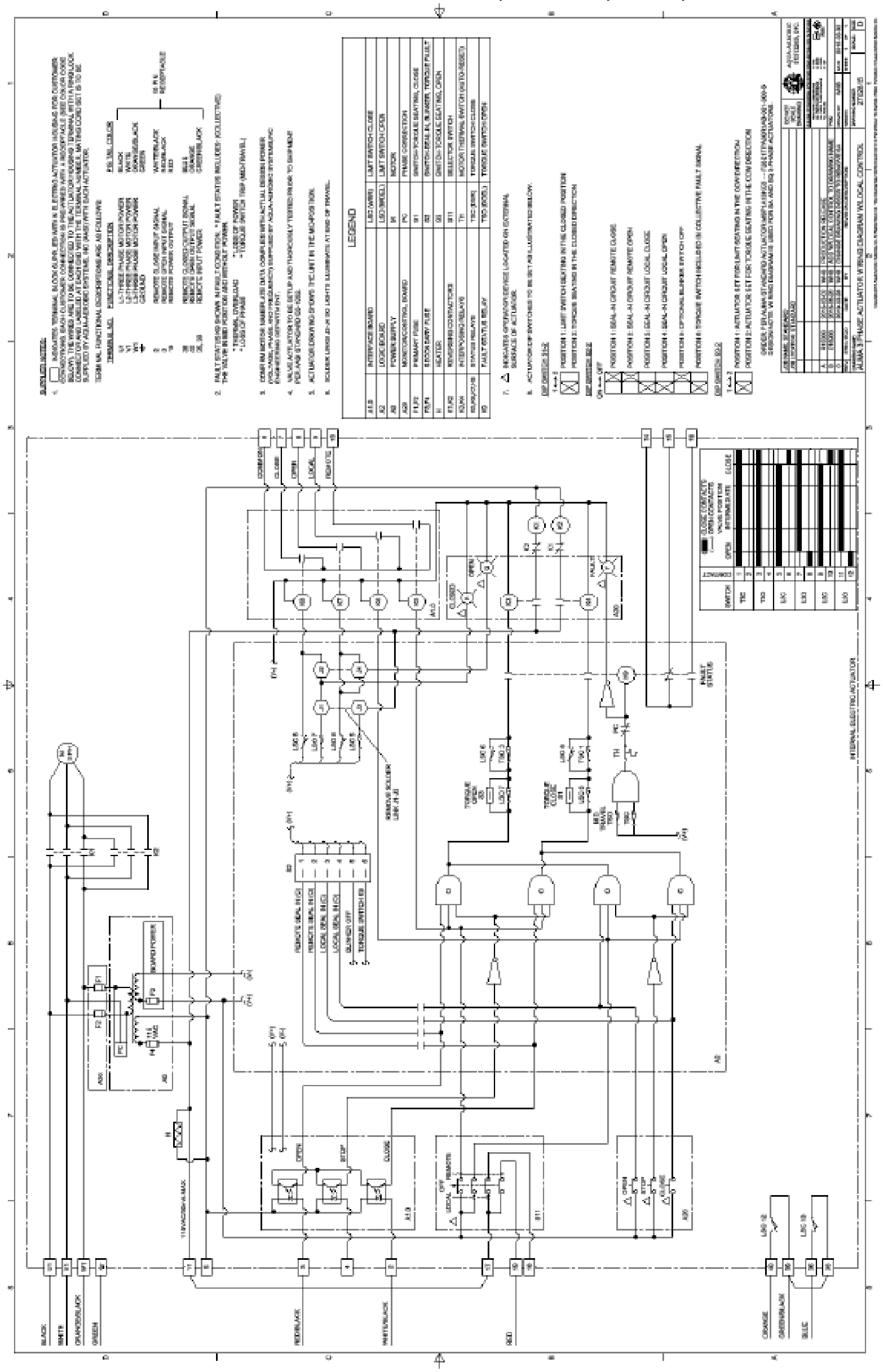
Part # 9704419A30134

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA



Actuator Assembly **Part # 9704419A30134**

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA



Actuator Assembly Part # 9704419A30137

Auma SAEx14.6/ACEX01.2, 575V, CSA

The multi-turn actuator SAEx14.6 is designed for short-time duty S2-15%.

Design Features:

Maximum number of starts = 1,200 c/h
Limit and torque seating.
Hand wheel for manual operation.

Total Weight: 169 lbs. (77 kg)

NOTICE
AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

Auma SAEx14.6/ACEX01.2, 575V, CSA

AUMA SAEx14.6 ACTUATOR DATA

Mechanical Data

- Auma Explosion-proof
- Mechanical dial position indication
- Tripping torque (both directions): 147.5 lb-ft (200 Nm) min., 368.8 (500 Nm) max.
- Machined splined coupling
- 304 stainless steel hardware
- Ambient temperature: -22°F to 104°F (-30°C to 40°C)
- Insulation class: F, tropicalized
- Enclosure Protection: NEMA 6
- Corrosion Protection: KS
- Finish coating / color: two component iron-mica combination / grey (DB 702, similar to RAL 9007)
- Hand wheel diameter: 15.7 in. (400 mm)
- Weight: 116 lbs. (53 kg)
- Over-Ride manual hand wheel (w/instructions) does not rotate during electric operation.
- Reference EP-50026
- CSA Nameplated

Electrical Data

- Motor voltage: 575VAC (±10%) / 3-Phase / 60 Hertz (±5%)
- Motor Speed: 1,680 RPM
- Output Speed: 54 RPM
- NEMA 4x/6 enclosure: submersible, 6 feet for 30 minutes
- Rated for Class 1/Div 1, Group C&D- Class 2-3/Div1, Groups E, F, &G
- 2 Gear train limit switch: minimum 4 contacts
- Open and close torque Switches
- 115V space heater in limit switch compartment
- With push buttons, selector switches and pilot lights
- Operating time: 71 seconds
- Turns per stroke: 64.00
- Motor power (at shortest time): 2 HP (1.60 kW)
- Nominal current: 4.4 amps
- Current at maximum torque and shortest operating time (approx.): 7.5 amps
- Starting current: 32.0 amps

Actuator Assembly **Part # 9704419A30137**

Auma SAEx14.6/ACEX01.2, 575V, CSA

AUMATIC CONTROL STATION DATA

Mechanical Data

- Mechanical dial position indication
- Enclosure protection: IP67
- 304 stainless steel hardware
- Ambient temperature: -13°F to 158°F (-25°C to 70°C)
- Corrosion protection: KS
- Finish coating / color: two component iron-mica / silver-grey (RAL 7037)
- Weight: 26 lbs. (12 kg)

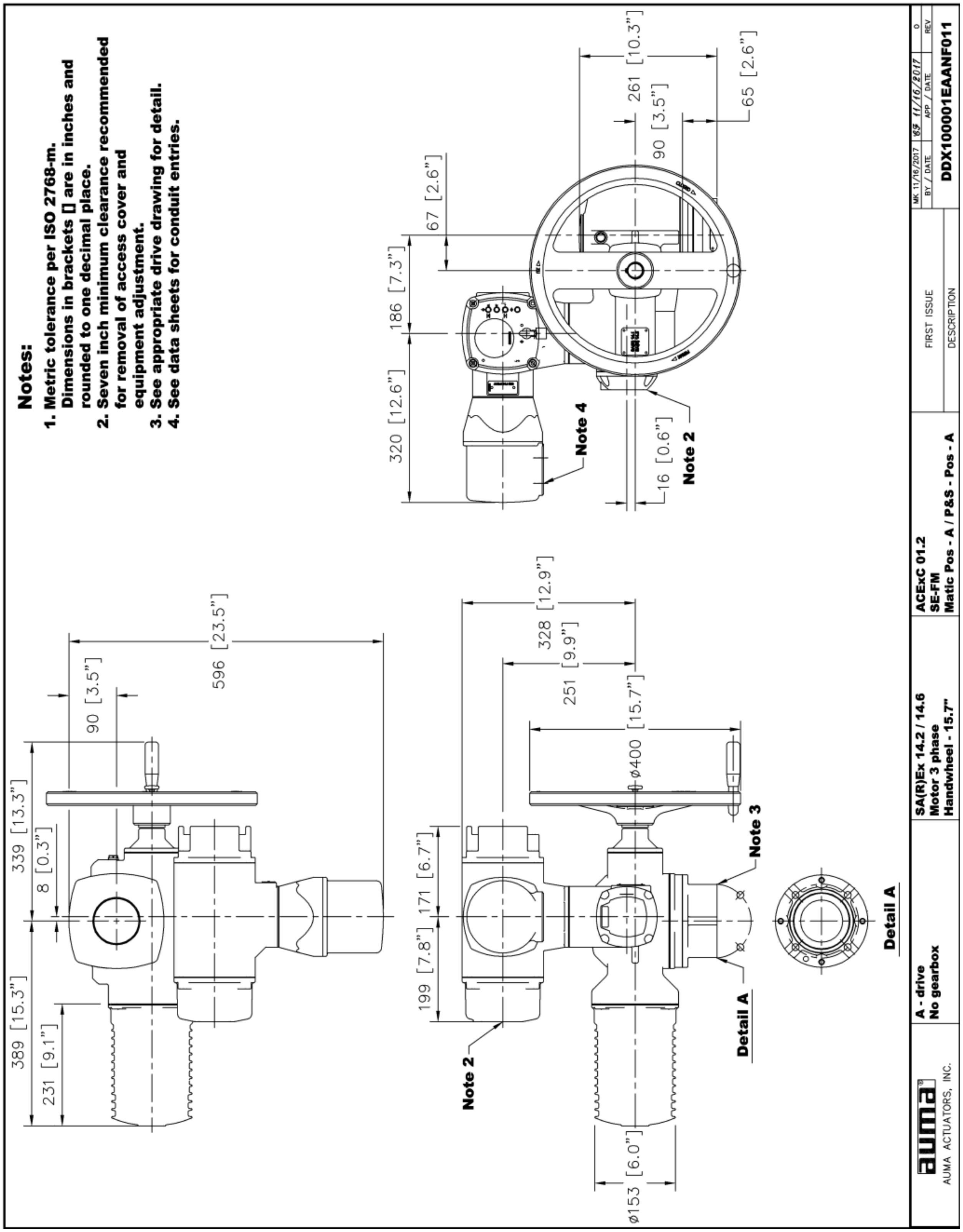
Electrical Data

- Motor voltage: 575V (±10%) / 3-Phase /60 Hz (±5%)
- Electrical connection: (2) 1” NPT, (1) 1 1/4” NPT
- Output signals: 5 output relays with gold plated contacts
- Switchgear: Reversing contactors
- Control: 115 VAC Open-Stop-Close
- Voltage output: Auxiliary voltage 115 VAC (±10%) max, 30mA to supply the control inputs.

Actuator Assembly

Part # 9704419A30137

Auma SAEx14.6/ACEX01.2, 575V, CSA



Actuator Assembly

Part # 9704419A30133

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

The multi-turn actuator SAEx14.6 is designed for short-time duty S2-15%.

Design Features:

Maximum number of starts = 1,200 c/h
Limit and torque seating.
Hand wheel for manual operation.

Total Weight: 169 lbs. (77 kg)

NOTICE

AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

Actuator Assembly Part # 9704419A30133

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

AUMA SAEx14.6 ACTUATOR DATA

Mechanical Data

- Auma Explosion-proof
- Mechanical dial position indication
- Tripping torque (both directions): 147.5 lb-ft (200 Nm) min., 368.8 (500 Nm) max.
- Machined splined coupling
- 304 stainless steel hardware
- Ambient temperature: -22°F to 104°F (-30°C to 40°C)
- Insulation class: F, tropicalized
- Enclosure Protection: NEMA 6
- Corrosion Protection: KS
- Finish coating / color: two component iron-mica combination / grey (DB 702, similar to RAL 9007)
- Hand wheel diameter: 15.7 in. (400 mm)
- Weight: 116 lbs. (53 kg)
- Over-Ride manual hand wheel (w/instructions) does not rotate during electric operation.
- Reference EP-50026
- CSA Nameplated

Electrical Data

- Motor voltage: 575VAC (±10%) / 3-Phase / 60 Hertz (±5%)
- Motor Speed: 1,680 RPM
- Output Speed: 54 RPM
- NEMA 4x/6 enclosure: submersible, 6 feet for 30 minutes
- Rated for Class 1/Div 1, Group C&D- Class 2-3/Div1, Groups E, F, &G
- 2 Gear train limit switch: minimum 4 contacts
- Open and close torque Switches
- 115V space heater in limit switch compartment
- With push buttons, selector switches and pilot lights
- Operating time: 80 seconds
- Turns per stroke: 72.00
- Motor power (at shortest time): 2 HP (1.60 kW)
- Nominal current: 4.4 amps
- Current at maximum torque and shortest operating time (approx.): 7.5 amps
- Starting current: 32.0 amps

Actuator Assembly Part # 9704419A30133

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA

AUMATIC CONTROL STATION DATA

Mechanical Data

- Mechanical dial position indication
- Enclosure protection: IP67
- 304 stainless steel hardware
- Ambient temperature: -13°F to 158°F (-25°C to 70°C)
- Corrosion protection: KS
- Finish coating / color: two component iron-mica / silver-grey (RAL 7037)
- Weight: 26 lbs. (12 kg)

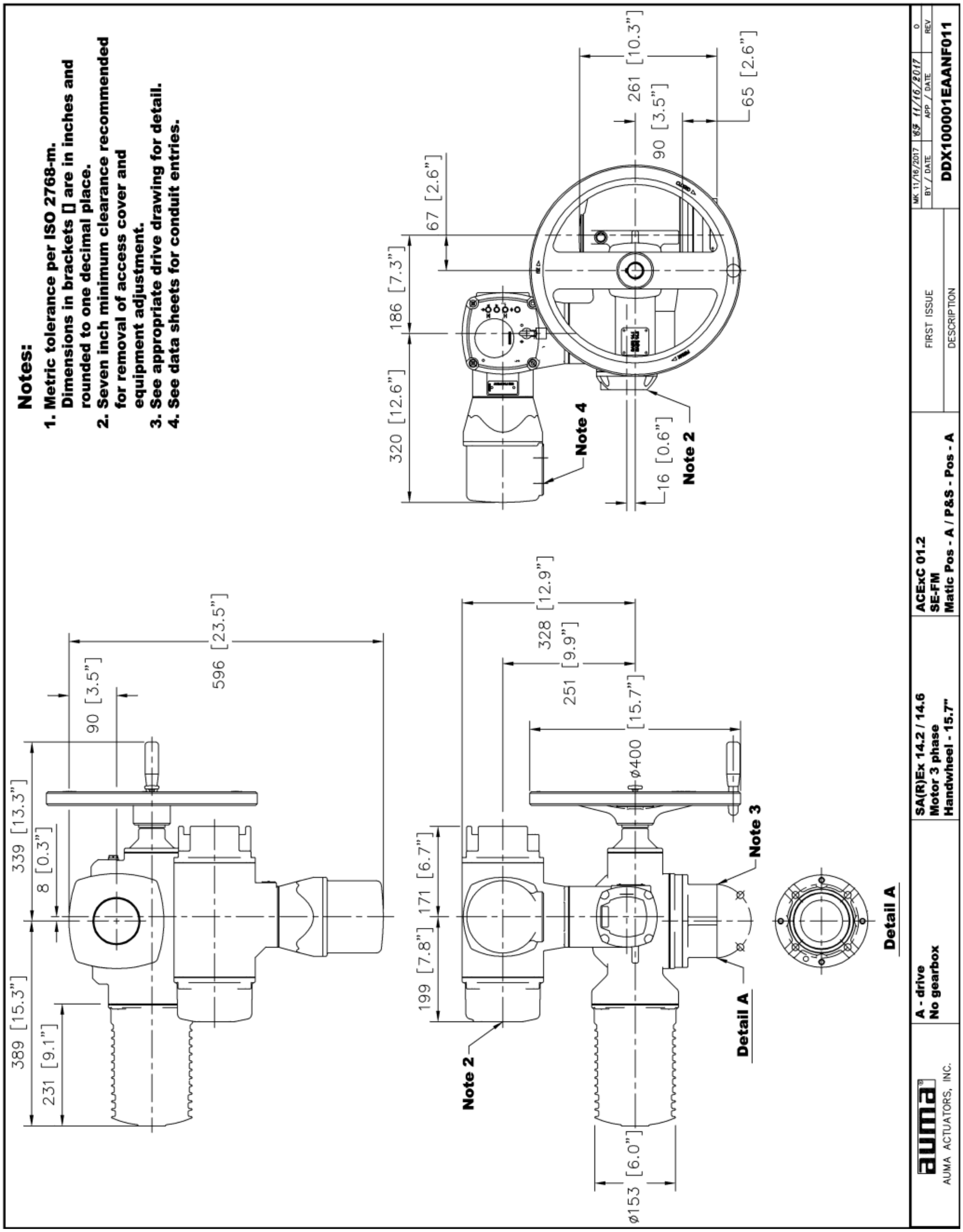
Electrical Data

- Motor voltage: 575V (±10%) / 3-Phase /60 Hz (±5%)
- Electrical connection: (2) 1” NPT, (1) 1 1/4” NPT
- Output signals: 5 output relays with gold plated contacts
- Switchgear: Reversing contactors
- Control: 115 VAC Open-Stop-Close
- Voltage output: Auxiliary voltage 115 VAC (±10%) max, 30mA to supply the control inputs.

Actuator Assembly

Part # 9704419A30133

Auma SAExC07.6/GS100.3/VZ4.3, 575V, LC, CSA



Actuator Assembly

Part # 9704419A30132

Auma SAExC16.2/ACEXC01.2, 575V, CSA

The multi-turn actuator SAEx16.2 is designed for short-time duty S2-15%.

Design Features:

Maximum number of starts = 1,200 c/h
Limit and torque seating.
Hand wheel for manual operation.

Total Weight: 239 lbs. (108 kg)

NOTICE

AUMA motors are provided with thermo switches to protect the windings. AUMA warranty for the motor will lapse if those thermo switches are not connected in the control circuit. Motor data is approximate. Due to usual manufacturing tolerances there may be deviations from the values given.

Actuator Assembly **Part # 9704419A30132**

Auma SAExC16.2/ACEXC01.2, 575V, CSA

AUMA SAExC16.2 ACTUATOR DATA

Mechanical Data

- Auma Explosion-proof
- Mechanical dial position indication
- Tripping torque (both directions): 295 lb-ft (400 Nm) min., 738 lb-ft (1,000 Nm) max.
- Machined splined coupling
- 304 stainless steel hardware
- Ambient temperature: -22°F to 104°F (-30°C to 40°C)
- Insulation class: F, tropicalized
- Enclosure Protection: NEMA 6
- Corrosion Protection: KS
- Finish coating / color: two component iron-mica combination / grey (DB 702, similar to RAL 9007)
- Hand wheel diameter: 19.6 in. (500 mm)
- Weight: 174 lbs. (79 kg)
- Over-Ride manual hand wheel (w/instructions) does not rotate during electric operation.
- Reference EP-50026
- CSA Nameplated

Electrical Data

- Motor voltage: 575VAC (±10%) / 3-Phase / 60 Hertz (±5%)
- Motor Speed: 1,680 RPM
- Output Speed: 54 RPM
- NEMA 4x/6 enclosure: submersible, 6 feet for 30 minutes
- Rated for Class 1/Div 1, Group C&D- Class 2-3/Div1, Groups E, F, &G
- 2 Gear train limit switch: minimum 4 contacts
- Open and close torque Switches
- 115V space heater in limit switch compartment
- With push buttons, selector switches and pilot lights
- Operating time: 107 seconds
- Turns per stroke: 96.00
- Motor power (at shortest time): 4 HP (2.98 kW)
- Nominal current: 7.1 amps
- Current at maximum torque and shortest operating time (approx.): 14.0 amps
- Starting current: 50.0 amps

Actuator Assembly **Part # 9704419A30132**

Auma SAExC16.2/ACEXC01.2, 575V, CSA

AUMATIC CONTROL STATION DATA

Mechanical Data

- Mechanical dial position indication
- Enclosure protection: IP67
- 304 stainless steel hardware
- Ambient temperature: -13°F to 158°F (-25°C to 70°C)
- Corrosion protection: KS
- Finish coating / color: two component iron-mica / silver-grey (RAL 7037)
- Weight: 26 lbs. (12 kg)

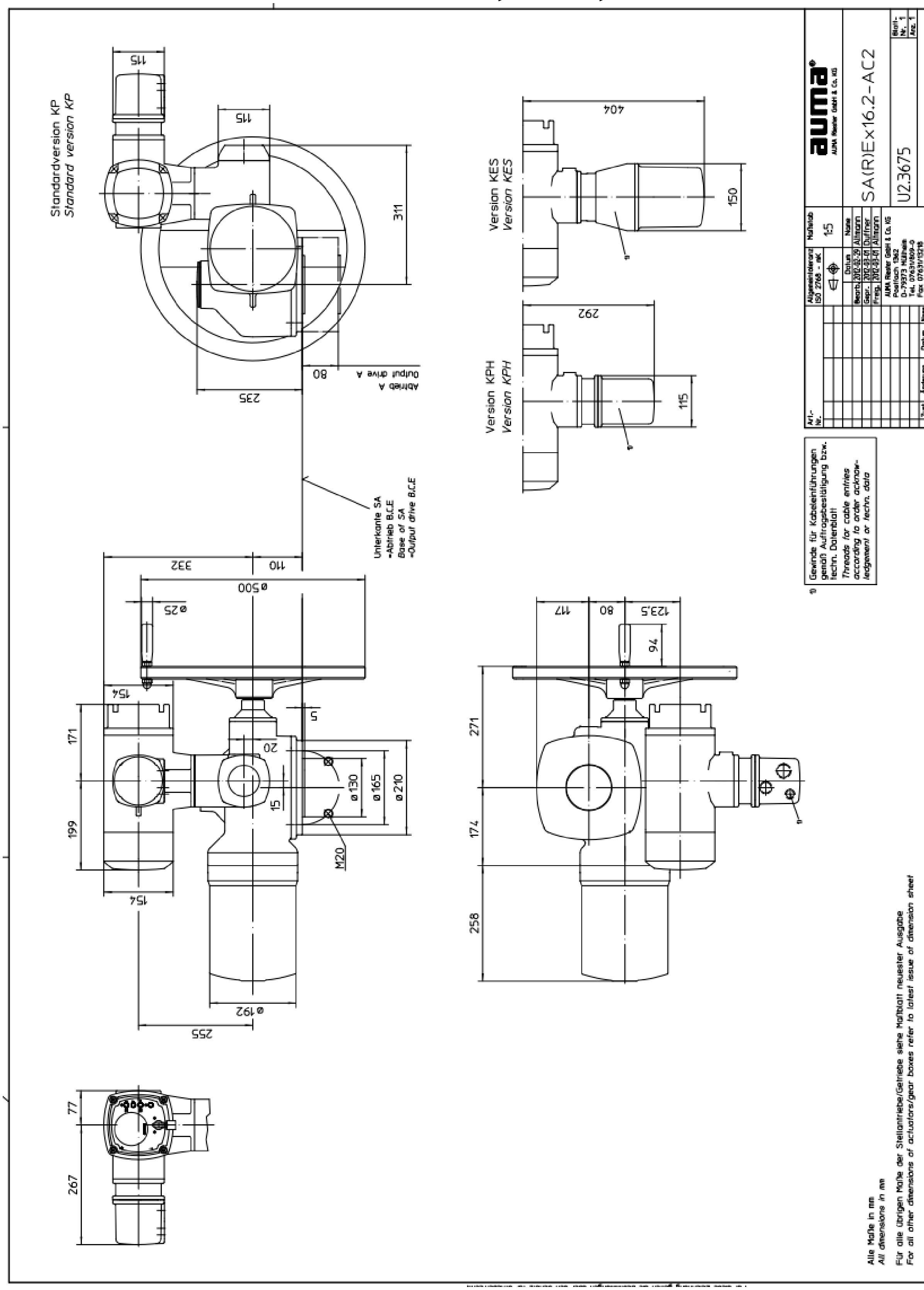
Electrical Data

- Motor voltage: 575V (±10%) / 3-Phase /60 Hz (±5%)
- Electrical connection: (2) 1" NPT, (1) 1 1/4" NPT
- Output signals: 5 output relays with gold plated contacts
- Switchgear: Reversing contactors
- Control: 115 VAC Open-Stop-Close
- Voltage output: Auxiliary voltage 115 VAC (±10%) max, 30mA to supply the control inputs.

Actuator Assembly

Part # 9704419A30132

Auma SAExC16.2/ACEXC01.2, 575V, CSA



ANCHORS

ADHESIVE ANCHOR

See Drawing Section 7 for Details

MANUAL GUN

Adhesive Dispensing Gun Part # **2608020**

Hilti HDM 500, Manual, HIT-CB 500 Black Cartridge

The HDM 500 manual dispenser will provide fast, trouble free injections with a minimum of effort. AASI is supplying one (1) HDM 500 manual dispenser gun as a special tool for the installation of all size adhesive anchors. The dispenser gun comes with one (1) HIT-CB 500 black adhesive cartridge. This dispenser gun has been designed and built to last and may be used for many projects.

The Hilti manual adhesive dispensing gun has been provided by AASI for ease in installation of the adhesive anchors, and should be used exclusively with Hilti HIT-HY 150 MAX-SD, HIT-HY 150 MAX, HIT-RE 500, HIT-RE 500-SD, HIT-RE 500-V3 and HIT-HY 70 foil refill packs. The manual dispenser gun has a dual piston system to ensure the accurate dispensing of the dual refill foil packs containing the separate resin and hardener. A release lever with plastic grip is provided for releasing and control of adhesive material. Impact-resistant, metal reinforced plastic cradle is included for the holder in which the Hilti HIT refill foil packs are inserted. The dispenser gun has a grip and trigger for piston advance, and an opening in the front portion for removing holder. Check the expiry date on the front of each refill foil pack junction piece prior to inserting within plastic cradle holder.

It is important that the Installing Contractor review and read the complete operating instructions provided for the dispensing gun before using this product. These instructions should be provided within the shipping box with the dispensing gun and within the data sheets provided within the operation and maintenance manuals.

The adhesive dispensed with the first two (2) trigger pulls after opening the foil refill packs (initial flow) is not suitable for making fastenings and must be discarded. Likewise, after changing a static mixing nozzle, the initial flow must be discarded. The mixed adhesive is injected directly into the hole drilled in the solid concrete base material.

GENERAL SAFETY

Always observe good safety precautions and wear gloves when using the dispenser. Observe the information in the instructions applicable to each type of refill foil pack before use. Read the safety precautions and conditions for use given in the instructions enclosed with the refill foil pack.

CARE AND MAINTENANCE: The piston advance rods should be oiled at regular intervals. Deposits of adhesive mortar on the holder (inside and outside) and in the working section of the dispenser should be removed immediately. Free movement of the pistons in the holder must be ensured!

REFILL PACK

Adhesive Anchor Refill Pack Part # **2613400**

Hilti HIT-RE 500 V3

The Hilti adhesive mortar system HIT-RE 500 V3 is Seismic qualified per ICC-ES AC308 / ICC-ESR 3814 and is certified for potable water applications per NSF ANSI 61. It is provided in cartridges with a net content of 11.1 fl oz (330 ml). It is critical that the installing contractor review and read the complete installation instructions and (SDS) safety data sheets in the back of the operation & maintenance manuals before using this product.

⚠ **CAUTION**

The limited Shelf Life and Storage requirements of this material are critical for the installation of anchors on this project and the Installing Contractor must completely review all data sheets submitted. Avoid prolonged or repeated contact with the eyes, skin or clothing, and prolonged or repeated inhalation of vapors. Use with adequate ventilation.

The Hilti adhesive mortar system is virtually odor free and has high bond strength suitable for making fastenings in all types of solid base concrete materials. The resin and hardener are dispensed through a mixing tube, which provides proper mixing and eliminates any possibility of measuring errors. An appropriate Hilti dispenser gun with a dual piston system is required to ensure the accurate dispensing of the dual pack resin and hardener. The mixed adhesive is injected directly into the hole drilled in the solid concrete base material.

Material Properties

Compressive Strength ASTM D-695-10	82.7 MPa	12,000 PSI
Tensile Strength ASTM D-638-14	49.3 MPa	7,150 PSI
Bond Strength ASTM C882-13A (14 day)	11.7 MPa	1690 PSI
Compressive Modulus ASTM D-695-10	2600 MPa	0.38×10^{6} PSI
Absorption ASTM D570-98	0.18%	0.18%
Elongation at Break ASTM D638-14	1.10%	1.10%
Heat Deflection Temp. ASTM D648-07	50°C	122°F

TECHNICAL DATA SPECIFICATION TABLE

Anchor Diameter Inches [mm]	**Drill Bit Diameter** Inches [mm]	**Embedment Depth (min)** Inches [mm]	**Embedment Depth (max)** Inches [mm]	**Max. Tightening Torque** ft-lb [Nm]	**Minimum Base Matl. Thickness** Inches [mm]	**Qty. Anchors Per Pack (Approx.)**
3/8” [9.5]	7/16” [11]	2-3/8” [60]	7-1/2” [191]	15 [20]	4 5/8” [117]	49
1/2” [12.7]	9/16” [14]	2-3/4” [70]	10” [254]	30 [41]	5 3/4” [146]	27
5/8” [15.9]	3/4” 19.1]	3-1/8” [79]	12-1/2” [318]	60 [81]	7 1/8” [181]	11
3/4” [19.1]	7/8” [22.2]	3-1/2” [89]	15” [381]	100 [136]	8 1/2” [216]	7

Adhesive Anchor Refill Pack — Part # **2613400**

Hilti HIT-RE 500 V3

CURING TIME TABLE			
BASE MATERIAL TEMPERATURES		**APPROX. CURING TIME**	**APPROX. GEL TIME**
°F	**°C**		
40	4	24 hours	2.0 hours
50	10	16 hours	1.5 hours
60	16	16 hours	1.0 hours
72	22	6.5 hours	25 minutes
85	29	5 hours	15 minutes
105	41	4 hours	10 minutes

Note: Product temperature shall be between 41°F (5°C) and 104°F (40°C) prior to and during installation.

⚠ CAUTION

LIMITED SHELF LIFE:
All adhesive cartridges are manufactured with a maximum shelf life of nine months from date of manufacture, with Aqua-Aerobic Systems, Inc. usually providing this material with a shelf life of 4-5 months before the expiration date. Once this material has been shipped to the jobsite, it is the Installing Contractors responsibility to plan and use this material within the expiration date listed on the material. AASI can only guarantee a maximum shelf life of four (4) months for this material upon receipt at the jobsite, and if this is not acceptable the Contractor must call and make special arrangements for the shipment of this material. If it is found necessary to make a complaint, please quote the product designation lot number printed on the front of each refill foil pack junction piece.

STORAGE REQUIREMENTS:
Storage for this material is critical and it is recommended to be stored in a temperature controlled environment in a cool, dry, and dark place between the temperatures of 41° and 77°F (5 to 25° C). When installing the anchor system, the cartridges must have a temperature of at least 41°F (5°C) and not higher than 104°F (40°C). **Refer to the installation instructions for details and complete cure times prior to use.**

MIXING NOZZLE

Mixing Nozzle **Part # 2616653**

Hilti RE-M

The Hilti static mixing nozzle is provided for use with the small HIT adhesive refill foil packs and must be threaded onto the end of each foil pack prior to use. The Hilti adhesive refill foil packs require the adhesive mortar system (resin and hardener) to be dispensed through this static mixing tube, which provides for proper mixing and eliminates any possibility of measuring errors. Once the refill foil pack has been placed inside the dispensing gun holder, the static mixer tube must be screwed onto the front of the refill pack.

NOTICE
The adhesive in the static mixing tube will become hard during a long pause, and the mixing tube must be changed before work can continue.

WEDGE ANCHOR

See Drawing Section 7 for Details

BLOWER PACKAGE

AERZEN BLOWER

Submittal

Napanee WWTP ON
Canada

Positive Displacement Blower

GM60S

Customer
Aqua-Aerobic Systems, Inc.
P.O. Box 16178
Loves Park, IL 61132
815-654-2501 (tel)

Manufacturer/Service/ Parts
Aerzen USA Corp.
108 Independence Way
Coatesville, PA 19320
800-444-1692 (tel)
610-380-0278 (fax)
www.aerzen.com/en-us

Aerzen USA Project:
SO-24-00272

Customer:
Aqua-Aerobic Systems, Inc.

Purchase Order No.
1076985

Project:
Napanee WWTP ON
Canada

SECTION 1

AERZEN	**Aerzen USA Corporation** 108 Independence Way, Coatesville, PA 19320 Tel: (610) 380-0244 Fax: (610) 380-0278 website www.USA-Inquiries@aerzen.com	**Job Specific Data Package**		
		DATE	**Aerzen Job #**	**Page**
		09.04.2024	SO-24-00272	1 of 3
		Revision Letter		-

CUSTOMER INFORMATION

CUSTOMER	Aqua-Aerobic Systems, Inc.
CUSTOMER PO #	1076985
PROJECT NAME	Napanee WWTP ON Canada

PACKAGE DESCRIPTION

EQUIPMENT IDENTIFICATION	AGS Blowers		**SERIAL NUMBERS**
BLOWER MODEL #	GM 060S-00	QTY. (4)	
PACKAGE DESCRIPTION	Pressure Unit w/ Enclosure		
DISCHARGE CONNECTION TYPE	150# ANSI Discharge Connection		
INLET CONNECTION TYPE	150# ANSI Inlet Connection		
MOTOR CONDUIT LOCATION	F3 Conduit Box		
TOTAL PACKAGE WEIGHT	4766 lbs		

DOCUMENTATION

GENERAL ARRANGEMENT DRAWING	GB-005477
MOTOR CABLE ROUTING	IA-004545
OPERATIONS & MAINTENANCE MANUAL	G4-006
WARRANTY TERMS & CONDITIONS	A2-001-USA

PERFORMANCE DATA

MEDIUM		Design	Min
INLET CAPACITY	*ICFM*	1563	410
INLET CAPACITY	*SCFM*	1434	376
INLET PRESSURE	*PSIA*	14.49	14.49
DISCHARGE PRESSURE	*PSI*	10.67	10.67
INLET TEMPERATURE	*°F*	90	90
DISCHARGE TEMPERATURE	*°F*	226	284
NOMINAL BLOWER SPEED	*RPM*	2407	898
POWER @ BLOWER SHAFT	*BHP*	94	33
MOTOR RATING	*HP*	125	125
MOTOR SPEED	*RPM*	1780	664
SOUND PRESSURE LEVEL *	*dB(A)*	80	80
MOTOR/VFD SPEED	*Hz*	60	22

* measured in free field at 3 foot distance from the outline of the unit (tol. +/- 2 dB(A))

Tolerance on Power & Flow is +/- 5%

CRITICAL INFORMATION / NOTES

1 PRIOR TO SHIPMENT - AERZEN DOES THE FOLLOWING
Removes V-Belts from the motor sheave and wraps them around the blower sheave
Locks the motor hinge plate
Always refer to the operations manual for determining the most suitable lubricant.
Operating and ambient conditions may impact which lubricant to use.

2 UPON ARRIVAL
Immediately remove stretch wrap from package when storred outdoors

3 LIFTING PACKAGE
Without Sound Enclosure: lifting eye holes in the corner of the base frame
With Sound Enclosure: lifting through slots in base with fork lift

4 READ OPERATION MANUAL FOR INSTALLATION INSTRUCTIONS
Call Aerzen After-Sales / Service if you have any questions

5 AT COMMISSIONING - CUSTOMER / CONTRACTOR IS TO
Check oil level (refer to operations manual) - and adjust if necessary
Anchor the base or sound enclosure
Make grounding connections
Connect motor cable per Aerzen Drawing IA-004545
Verify correct rotation of motor (counter-clockwise, looking at drive shaft)
Remove locking device from motor pivot plate
Reinstall V-belts
Apply the oil sight glass Sticker

6 **ALL CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED**

7 Recommended MINIMUM clearance at front and rear of package for "normal"
(i.e. inspect machine, change oil, replace belts, etc.) maintenance is 32 inches.

AERZEN	**Aerzen USA Corporation** 108 Independence Way, Coatesville, PA 19320 Tel: (610) 380-0244 Fax: (610) 380-0278 website www.USA-Inquiries@aerzen.com	**Job Specific Data Package**		
		Date	**Aerzen Job #**	**Page**
		09.04.2024	SO-24-00272	3 of 3
		Revision Letter		-

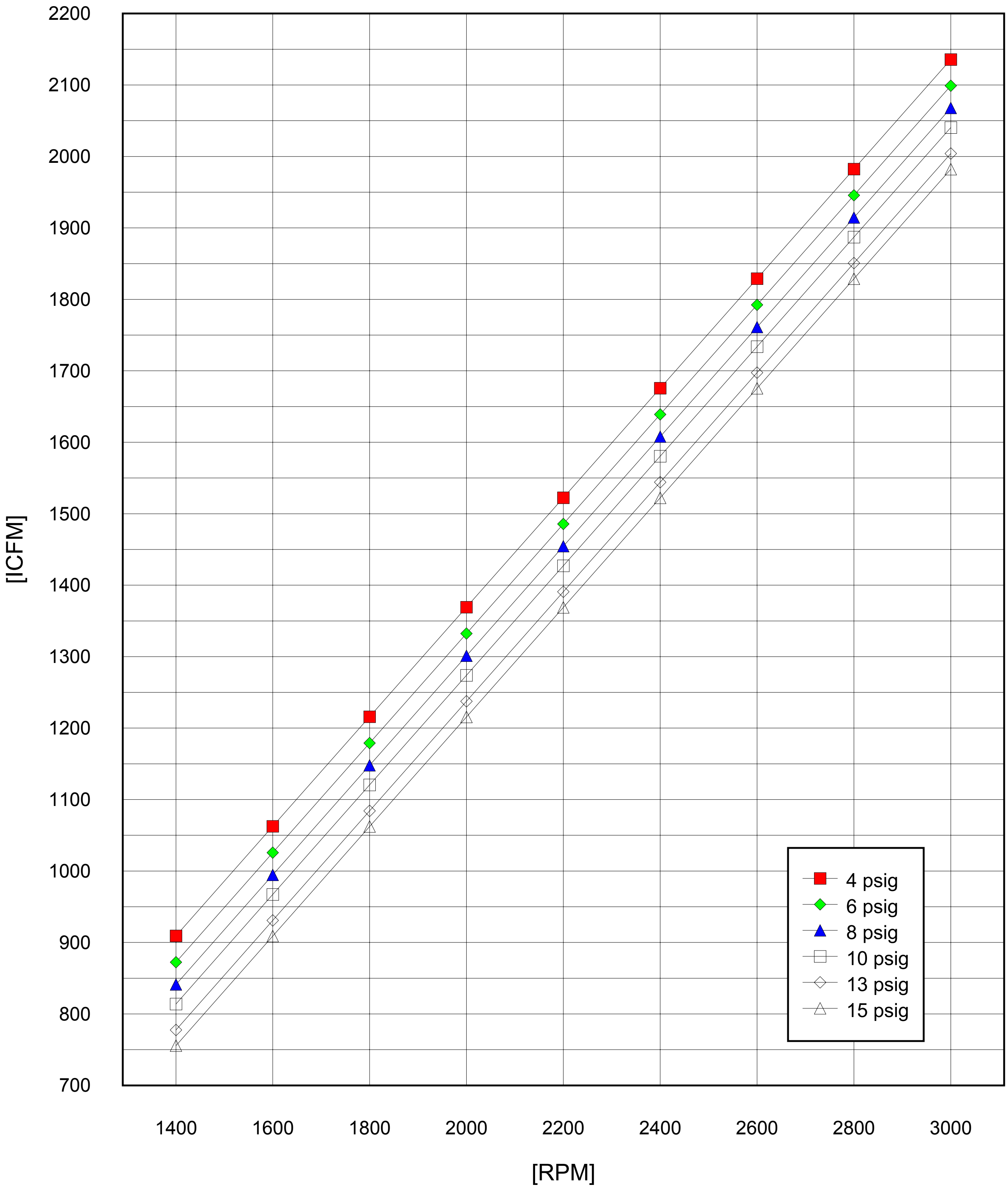
BILL OF MATERIAL

ITEM #	QTY	DESCRIPTION	PART #
1	1	Delta Blower Stage	GM 060S-00
2	1	Electric Motor WEG W22 NEMA Premium Efficiency 125 HP 4P 444/5T 3Ph 575 V 60 Hz IC411 - TEFC,T-stats, Aegis Ring, Insulated End Bracket	21-MTR-WG4-125ED357
3	1	Combination Base Frame / Silencer DN-200	2000012591
4	1	Sound Enclosure (S.E.) w/ Dial Gauges	180741
5	1	Inlet Filter / Silencer Assembly	182117
6	1	Discharge Connection Housing	178667
10	1	Filter Element	* 2000049288
20	3	Drive Belts	* 156321000
30	1	One-way Valve EPDM Flap	** 178655
50	4	Clamps for Discharge Connection for Sleeve	168658
52	1	Stub Pipe w/ ANSI Flange (Discharge) 8" 150# ANSI Flange	21-002827-14
60	1	Stub Pipe w/ ANSI Flange (Inlet) 8" 150# ANSI Flange	21-002827-08
70	1	Flexible Connector - Inlet for 8" sch. 40 pipe	** 159132
80	4	Clamps for Intake connection for Sleeve	168658
90	1	Safety Relief Valve DN-125, set @ 1050 mbar	** 167375
100	-	Instrumentation	21-G5-IM-PS07-4001
	1	Filter Maintenance Indicator	21-006757
	1	Discharge Pressure Gauge	21-010129
	1	Discharge Pressure Switch	21-000746-02
	1	Discharge Temperture Gauge/Switch	21-006756
140	-	Unloading Valve (optional)	Not Installed
150	1	S.E. - Ventilation Fan 650-3150 rpm	162578
170	1	Motor Sheave Bushing	165709000
180	1	Motor Sheave 450 mm	170198000
190	1	Blower Sheave Bushing	156250000
200	1	Blower Sheave 335 mm	166283000
250	4	Vibration Isolators	184821
260	1	Safety Relief Valve Hose	184096
270	3	Safety Relief Valve Hose Clamps	162923
	1	Oil Drain Valve	185388
	1	Seal Ring for Drain Valve	119086
	1	Oil Drain Hose	2000023662
		Spares / Shipped Loose Items	
	4	Air Filter Element	2000049288
	4	Set of v-belts (3 per set)	156321000
	4	External intake silencer 8" ANSI 3300 SCFM wire mesh element (ships loose, installed by others)	21-009955-P09-08-W
		Onsite Services	
		1 trip(s), 3 day(s) total installation, startup, & training	

RECOMMENDED SPARE PARTS
* on hand items
** 2-5 year recommended items

NOTE(S): Always reference the blower s/n & the Aerzen Job # (if known) when ordering spare parts

AERZEN GM 60S DELTA PACKAGE, PRESSURE
INLET FLOW

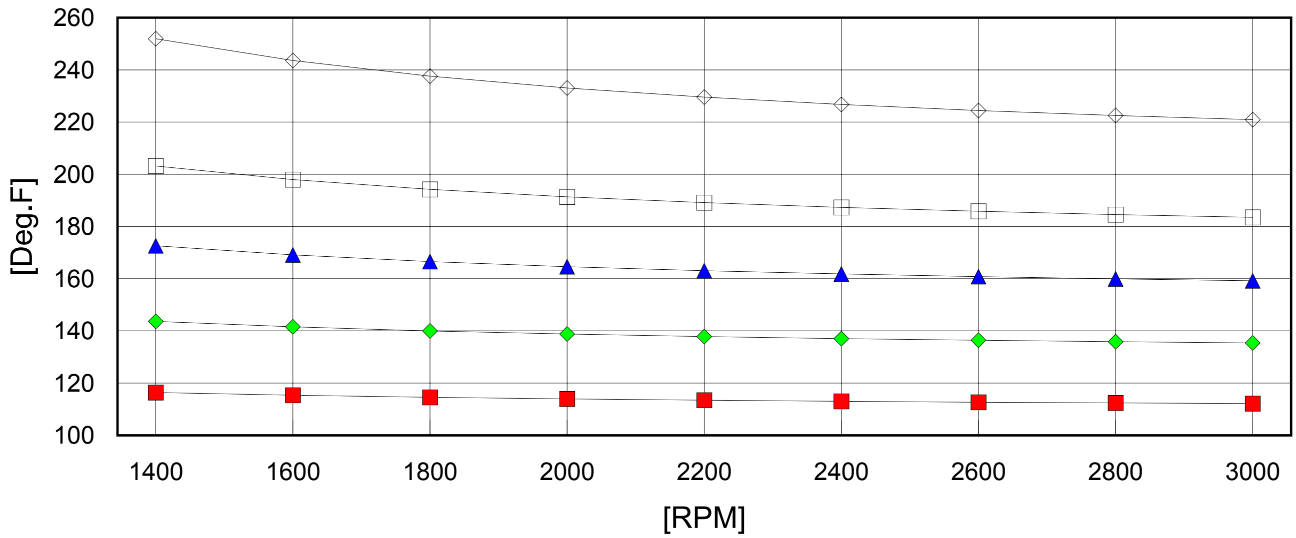


Performance data based on air @ 68 deg.F/ 14.7 psia inlet.

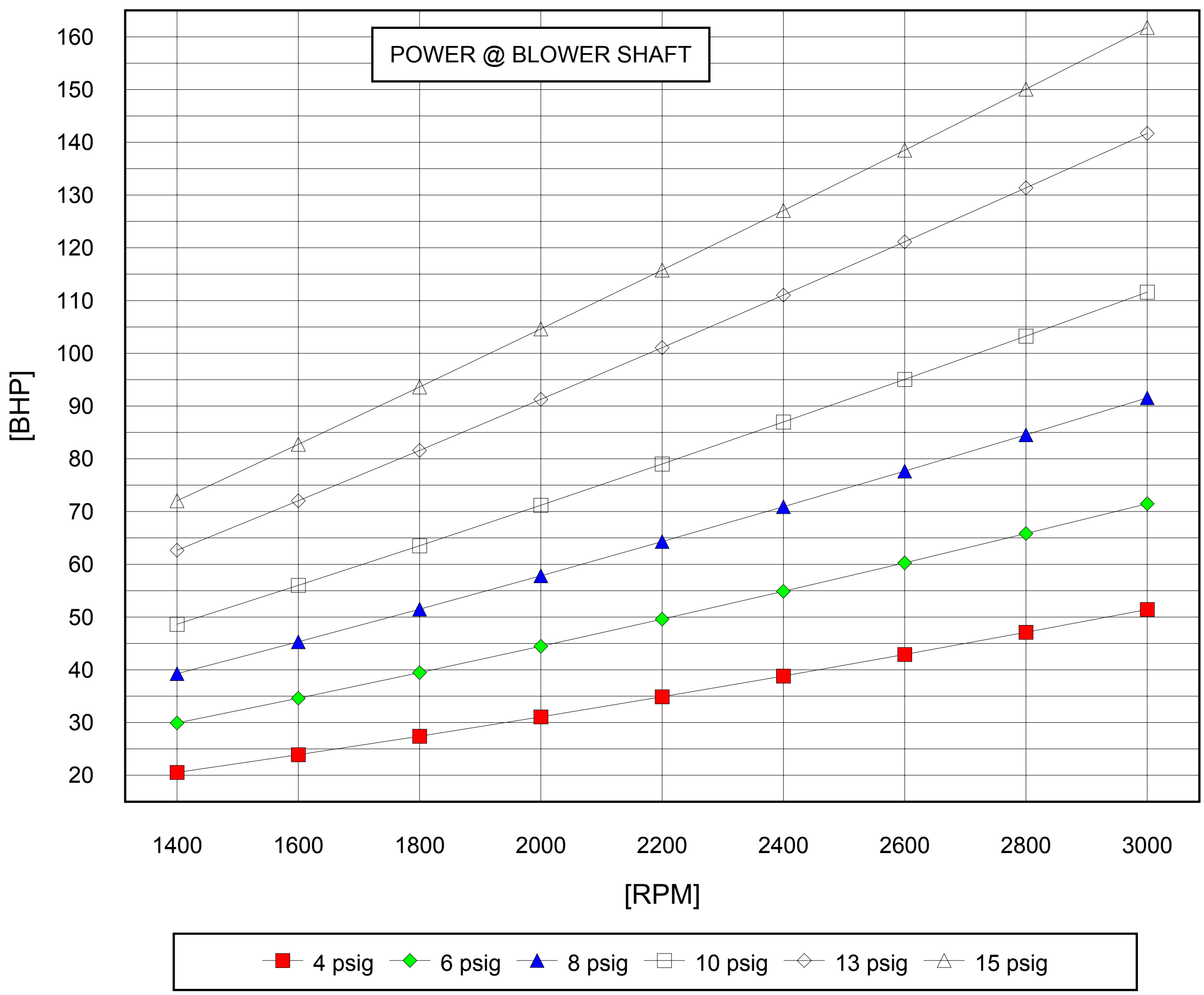
See temperature chart on second sheet for allowable operating range.

AERZEN GM 60S DELTA PACKAGE, PRESSURE

DISCHARGE TEMPERATURE



MAXIMUM ALLOWABLE DISCHARGE TEMPERATURE: 285 deg.F
Performance data based on air @ 68 deg.F/ 14.7 psia inlet.



SAMPLE – FOR REFERENCE ONLY

Aerzen USA Corporation

108 Independence Way
Coatesville, PA 19320
(610) 380-0244 ph
(610) 380-0244 fax

Aerzener Machinenfabrik GmbH
Since 1864
Reherweg 28 - D31855 Aerzen
Telefon: 0 51 54 / 810
Telefax: 0 51 54 / 811 91

Certified Test Report

evaluated date: **1-Aug-19**
evaluated by: Rzepka
certified by: Jarrow

Customer De Nora Water Technologies, Inc.
Customer PO# 23007-T019266

Aerzen reference # SO-18-01343

Performance & Order Data

Blower Model GM 90S **Serial #** 1619621

			Metric units	US units
1)	Inlet flow	Q_1	56.19 m³/min	1984.51 Icfm
2)	differential pressure	Δp	724 mbar	10.5 psig.
3)	Shaft Power	kW	85.15 kW	114.30 Bhp
4)	Blower Speed	rpm	1622 rpm	1622 rpm

Test Result			Metric units		US units	
5)	Volumetric Efficiency	$\eta_{vol, um}$	80%		80%	
6)	Actual Slip	$V_{verl, um}$	13.27	m³/min	468.49	cfm
7)	Theoretical Volume	$V_{0, UM}$	67.35	m³/min	2,378.28	cfm
8)	Actual Volume	$V_{1, UM}$	54.15	m³/min	1,912.39	cfm
9)	Flow Variance	$V_{t, UM}$	-3.62%		-3.62%	
10	Actual Power	$P_{KU, UM}$	85.09	kW	114.10	Bhp
11	Power Variance	$P_{KU, UM}$	-0.08%		-0.08%	

Explanation and Summary

Lines 1), 2), 3). 4) above show required performance data (what was ordered).
Lines 5) through 11) show data that resulted from the performance test on the actual blower.
Line 9) shows a variance of 3.62% in the flow capacity of this unit.
Line 11) shows a variance of 0.08% in the power consumption of this unit.

Standard accepted tolerance is +/- 5%. The unit would be acceptable if the flow was no more than 5% below the expected flow and the power was no more than 5% of expected power.

For this specific case the flow is -3.62% **less than expected.**
For this specific case the power is -0.08% **less than expected.**

Serial number 1619621 Model number GM 90S meets and exceeds the standard tolerance.

Blower Test Report will be provided in the project O&M Manual.

EC Declaration of Conformity

according to the Machinery Directive 2006/42/EC, Annex II, No.1 A

Company Name	:	Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany
Product Details	:	**The Declaration of Conformity for this piston engine is supplemented by the technical details in the chapter entitled "Performance Data". The details provided therein identify the product and must be applied together with this Declaration of Conformity.**
Appointed agent for the compilation of the technical documentation	:	Mr. Irtel, Managing Director Aerzener Maschinenfabrik GmbH Reherweg 28 31855 Aerzen Germany

We hereby declare that the aforementioned product complies with all relevant provisions of Machinery Directive 2006/42/EC for the conveyance and compression of gaseous media.

The aforementioned product also fulfils all provisions of the following relevant EC-directives:

- EMC / Electromagnetic Compatibility 2004/108/EC
- Pressure Equipment Directive 97/23/EC
- The protection targets of the Low Voltage Directive 2006/95/EC have been fulfilled in accordance with Annex I, No. 1.5.1 of the Machinery Directive.

The following harmonised standards were applied:

• DIN EN ISO 12100	03-2011	Safety of Machines - General Design Principles Risk Assessment and Risk Reduction
• DIN EN 1012-1	02-2011	Compressors and Vacuum Pumps - Safety Requirements - Part 1: Compressors

This Declaration of Conformity applies to the product in its original state as placed on the market by the manufacturer. Any retrospective changes and/or retrospective work undertaken shall void this Declaration of Conformity.

Aerzen, 09-01-2012
Place, Date of issue

Mr. Björn Irtel, Managing Director-
Details of the Undersigned

A3-050 G EN / 01-2012
Document No. / Compiled

SECTION 2

POSITIVE DISPLACEMENT BLOWERS

DELTA BLOWER GENERATION 5

Volume flows from 18 cfm to 8830 cfm

AERZEN

DELTA BLOWER. A TOUGH ENDURANCE RUNNER IN COUNTLESS COMPRESSION PROCESSES.

Delta Blower Generation 5

Positive displacement blowers of the Delta Blower Generation 5 act as the driving force behind many processes, and are the beating heart of a strong machine combination. This generation of assemblies from AERZEN compresses more than 150 years of experience as a world market leader in blower development. And it is more innovative than ever. AERZEN has introduced many innovations with this young series.

They provide a large volume-flow range from 18 cfm to 8830 cfm. With reduced life-cycle costs and quieter operation. But one thing remains the same: This blower class remains highly robust, thoroughly reliable and has an extremely long service life. No wonder customers choose it for continuous, long-term applications - over years and decades.


AERZEN
Delta Blower

Applications
- Water and
  Waste water treatment
- Aeration
- Backwash of filters
- Pneumatic conveying
  of bulk materials
- Gas conveying
- Degassing
- Dedusting
- Generation of negative pressure
- Biogas treatment
- Vehicle operation
- Ship unloading
- Tunnel boring

and much more

Industries
- Wastewater treatment plants
- Chemistry and process engineering
- Power plant
- Cement and lime
- Foodstuff technology
- Paper industry
- Pharmacy and many more

Goods conveyed
- Granules
- Sugar
- Cement
- Cereals
- Carbon

and much more

VERSATILE FOR EACH APPLICATION.

The versatile compact power packages of the Delta Blower series can be used in all climate zones of the world. Just as safe under the most difficult environmental conditions as in indoor installation. They work stand-alone or in a machine combination.

Versatility in figures.
Delta Blowers are strong all-rounders: The smallest assemblies are mounted on silo trucks. The largest machines operate in lifting systems. They unload transport vessels. With an hourly performance of up to 1,000 tons.

Control range between 25 % and 100 %

Volume flows from approx. 18 cfm to 8830 cfm

Pressures up to 14.5 Psi
Negative pressures down to -7.25 Psi

Nominal diameters DN 50 to DN 400

Indispensable for power plant technology

Conveying of powdery goods

Powerful for ship loading and unloading

MACHINES AND SERVICES FROM AERZEN. IN USE WORLDWIDE AND HIGHLY AVAILABLE.

The extremely high load capacity of Delta Blower packages is legendary. Just like their proverbial reliability, their durability or their intelligent operating and maintenance concept. Why are the services of AERZEN an issue at all? Because service is a must. And because our worldwide wellpositioned service teams are an important decision criterion for plant operators: for blowers made by AERZEN.

It's the inner values that matter: the AERZEN blower stage

Made in Germany

High availability.
The best blower packages are those that you do not notice. Because they are steadfast in their work. For years and decades. The Delta Blowers from AERZEN are such assemblies. AERZEN manufactures all core components itself. From the assembly to the control system. From the idea to engineering and configuration. And thus ensures the high productivity of its machines. Our value contribution to the quality standard made in Germany.

On site worldwide.
Typical for AERZEN: The reliable availability of its solutions. This refers to our machines. And to our services. The fact that our service teams look after your systems over their entire life cycle protects the value of your investment. The fact that we have a dense network of 50 subsidiaries and agencies in more than 100 countries around the globe guarantees short distances. So we are quickly there for you - in case we are needed.

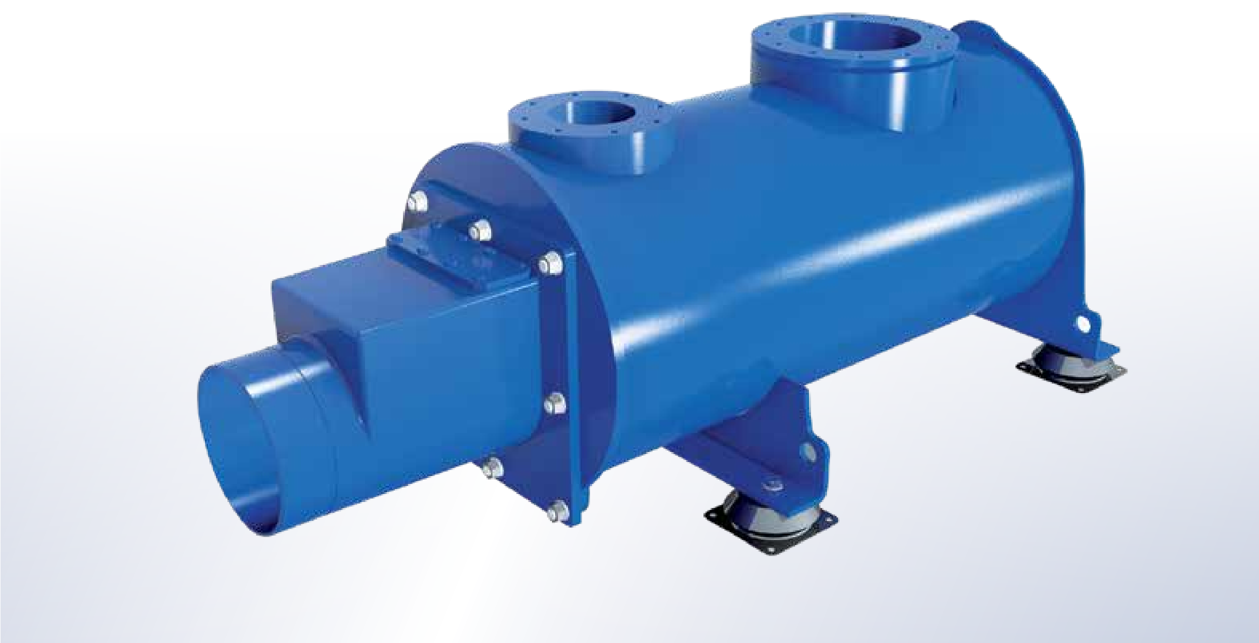
Safely AERZEN.

- Commissioning by qualified personnel
- Individual training of your specialist personnel
- Customer-specific service and maintenance contracts
- Machine repair also directly on site

Intelligently designed.
What does compact, easy handling or ease of maintenance mean? The value of these promises only becomes apparent in everyday practice. Just like these tangible benefits:

- Small footprint
- Flexible machinery mountings
- Easy to transport with forklift/lift truck
- Space-saving side-by-side installation
- Plug&play installation and commissioning
- Easy access to all wearing parts
- Oil level check from the outside while the machine is running
- Maintenance work such as oil and filter change from the front
- Low sound pressure level
- Belt drive for optimum volume flow design, subsequent power adjustment is quick and easy

Intelligent silencing: the AERZEN discharge silencer without absorption material



100 % clean.
How do we offer food suitability, avoid expensive cleaning or even production restrictions? We do not use absorption material for sound absorption. “Therefore, AERZEN made the base support a discharge silencer and reduces the noise exclusively by means of air deflections.

100 % free of absorption material, because this could wear out and contaminate the downstream system. By the way, the AERZEN base support is patented and certified as spark arrester for ATEX applications.

ROBUST BLOWER PACKAGE
READY TO PERFORM.

AERZEN belongs to the most innovative companies worldwide in the field of compressor technology. In 1868, we started manufacturing positive displacement blowers. By the way, we were the company that manufactured the first positive displacement blower in Europe. Since then, we have taken the performance features of this technology to the peak with every generation. Let yourself be surprised. Discover these special blowers: Delta Blower Generation 5.

Extremely robust blower package
- For a wide range of applications within a high control range from 25 to 100%
- Various modifications are possible

Compact design
- Space-saving side-by-side installation
- Small dimensioning of machine rooms

Easy operation and low-maintenance design
- Highly available at continuous operation even under toughest environmental conditions
- The front side is used for operation and maintenance

Plug&play Solution
- Completely configured, parameterized and ready for connection
- Integrated service kit with first oil fill

Oil-free as per class 0
- According to ISO 8573-1, certified by the TÜV (German technical inspection association)

Free from absorption material
- Suitability for use with foodstuffs in the pneumatic conveying of bulk materials (no impurities)
- Safety for energy-efficient productivity in the Water treatment (no sedimentation of absorption material in the aeration plates, no clogging of the aeration plugs, no pressure loss)

Integrated power supply panel (optional)
- Frequency converter, star-delta, direct, softstarter
- Intelligent AERZEN AERtronic control system

Smart oil system
- Oil level check while machine is running
- It can be read from the outside
- Oil instead of grease: Oil-lubricated bearings increase the service life

Advantages for the life cycle assessment

- Standard use of premium efficiency motors
- Suction on the cold side of the assembly
- Belt drive for optimal volume flow design
- Subsequent power adaptations are easily and quickly possible

Belt tensioning hinged motor mounting plate

- Fully automatic and maintenance-free belt tension
- Inspection of V-belt tension no longer necessary
- Easy assembly or replacement of V-belts

Multifunctional hoist for hinged motor mounting plate

- Transport safety lock
- Easy and safe installation of V-belts
- Mobile installation of assemblies (e.g. ship installation/earthquake design)
- Hinged motor mounting plate support for heavy motors

Low noise level

- Safe control of the sound values, close to building areas and production areas
- Lowest sound values by optimised acoustic hood
- Integrated method for reducing pulsation (Patented AERZEN blower stage)

PED pressure-vessel guidelines approval (pressure safety valve)

- for overpressure operation

ATEX-compliant

- AERZEN base supports certified as spark suppressor for ATEX applications

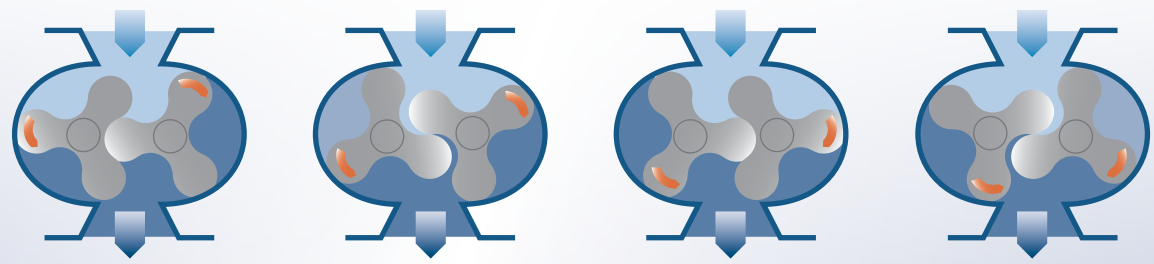
TÜV-certified zone separation filter (optional)

INTERESTED IN THE INNER VALUES? CONSTRUCTION AND DESIGN.

It is good to know what is in the assemblies of the Delta Blower line from AERZEN: The wealth of experience of the world market leader. The quality standard of the traditional German family business. The innovation goal "Best solution provider for our customers". In addition first-class material selection. And a principle that has proven itself in tens of thousands of applications: Roots.

Innovation pulsation reduction.

Especially for its Delta Blower stages AERZEN has developed a unique process and integrated it into all sizes: the pulsation reduction. The patented AERZEN process prevents pulsations and noise already at the origin within the blower stage. For this purpose the AERZEN blowers equipped with 3-lobe pistons have two special channels cast in the cylinder. These control the backflow of the medium into the conveying chamber in such a way that the typical backstroke and squeezing pulses (typical for 2-lobe blowers) are eliminated. The end for pulsations due to patented interference method.



Conveying process in the AERZEN blower

Intelligent technical details ensure that the Delta Blower packages retain their value. One example of many: the patented pulsation reduction, an AERZEN innovation for longer bearing life.

Blower stage
- AERZEN Blowers with 3-lobe pistons and integrated pulsation reduction
- Housing consisting of: Cylinder (with two cylinder with cast-in pre-inlet channels at discharge side to minimise the sound by pulsation reduction), wheel housing, housing cover and side plates
- Material EN-GJL-200
- Ribbed surfaces

Pistons

Sizes GM 3 S to GM 130 L:
- Pistons and shafts in one piece

Sizes GM 150 S to GM 240 S:
- Pistons made of nodular cast iron, shafts made of tempered steel

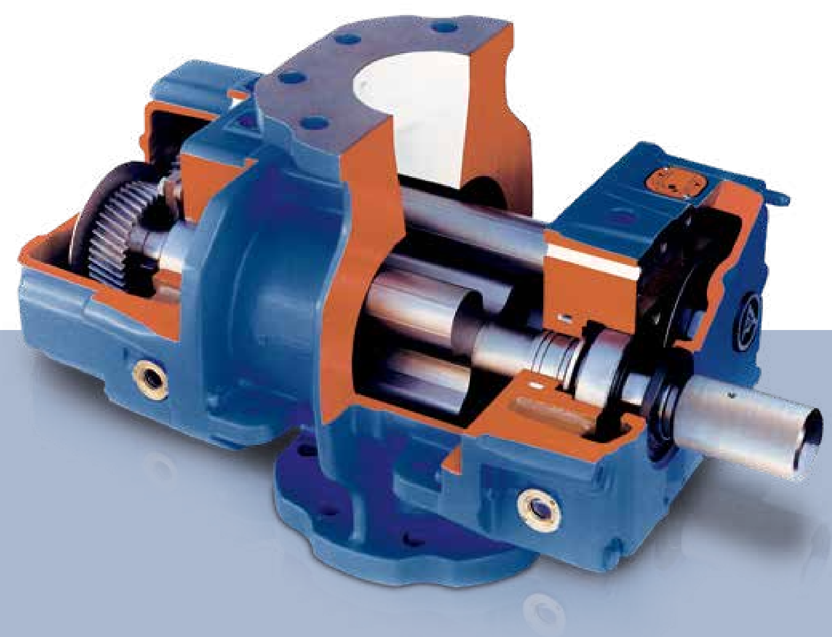
Drive type
- Overhung via narrow V-belt
- Direct drive

Cooling
- Convection cooling

Lubrication
- Oil splash lubrication for bearings and timing gears

Oil-free conveying
- The oil-free design according to ISO 8573-1 class 0 is guaranteed by the piston ring labyrinth seal, which has proven itself over decades, in combination with neutral chambers (open to the atmosphere)

Timing gears
- Hardened and ground, helically geared and made of case-hardened steel
- They are fitted to the shafts by taper interference fit
- maximum running smoothness and service life

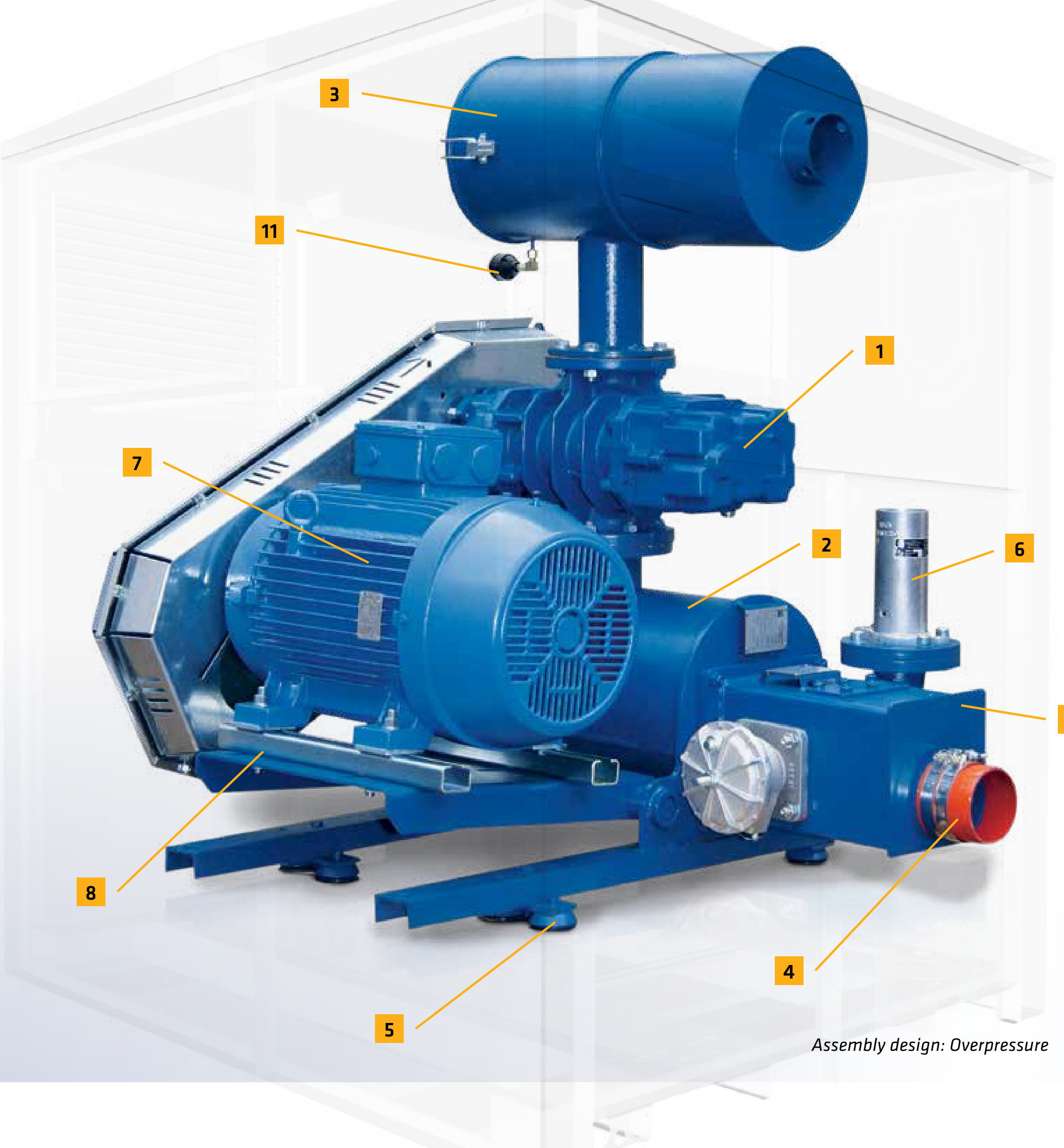


It's the inner values that matter: the AERZEN blower stage

ALREADY IN THE STANDARD VERSION EXTRAORDINARY.
THE DELIVERY CONCEPT OF AERZEN.

Some call it comfortable. The others efficient. We call it all-in: the delivery concept of AERZEN. When the Delta Blower package comes to you, it is already completely configured, parameterized and mounted ready for connection at the factory. Naturally, this is tailored to your processes. Including all standardised accessory components for trouble-free operation at the touch of a button.

All in: The scope of supply in the normal version.



Assembly design: Overpressure

1 **3-lobe blower stage**

- With integrated pulsation reduction (see page 10/11)

2 **Base supports with integrated discharge silencer**

- Certified as spark arrester
- Absorbent-free silencing through patented discharge silencer

3 **Intake silencer with integrated air filter or strainer**

- Standard suction from the atmosphere (overpressure)
- Suction via piping optional

(standard for negative pressure)

- Suction via filter element for negative pressure optional

Overpressure

Negative pressure

4 **Flexible rubber sleeve**

- with clamps

5 **Flexible machinery mountings**

- For the decoupling of structure-borne noise

6 **Pressure valve or suction valve**

- For machine protection

7 **Drive**

- Via high-performance narrow V-belt drive by means of three-phase motor
- Standard use of premium efficiency motors (up to motor size 447/9T)

8 **Hinged motor mounting plate**

- Automatic tensioning device for the belt drive
- Multifunctional hoist for hinged motor mounting plate

9 **Connecting housing**

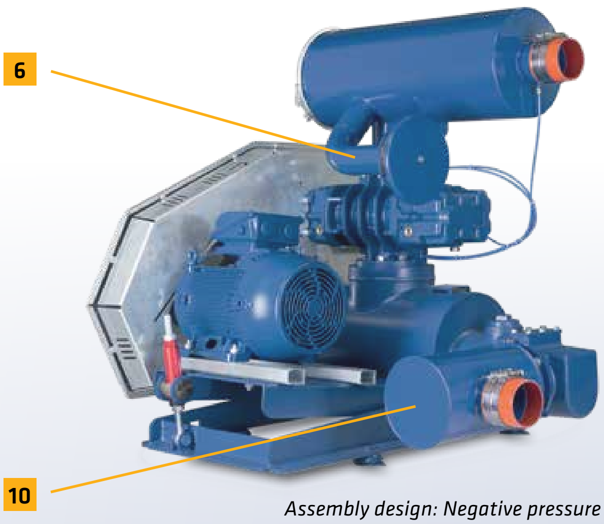
- integrated check valve

10 **Integrated blow-off silencer**

- Horizontal version (up to DN 125)

11 **Standard instrumentation**

- Pressure gauge for indication of the conveying pressure (overpressure)
- Maintenance indicator for monitoring the intake filter (overpressure)
- Vacuum meter for indication of the conveying pressure (negative pressure)



Assembly design: Negative pressure

MODIFICATIONS AND ACCESSORIES.
THE BEST FOR EVERY APPLICATION.

Added value: The accessory components.

- Acoustic hood for indoor and outdoor installation, forced ventilation via mechanical fan
- Start unloading device, required for star-delta starting of the motor (overpressure),
- Vertical blow-off silencer with base plate (negative pressure)
- discharge side expansion joint instead of flexible rubber sleeve
- Power cabinet Star-delta, frequency converter, soft starter
- AERZEN AERtronic blower control
- AERZEN original spare parts
- Other accessories on request

AERZEN Start unloading device

Modifications.

- Special motors
- Special varnish
- ATEX compliant design
- Acoustic hood for desert installation with special sand collector
- Acoustic hood for low temperatures down to negative 104°F with heating and gravity louvers
- Acoustic hood for earthquake resistance and increased wind loads
- Ship installation and vehicle deployment
- Use for special gases through the use of special materials
- Customised documentation
- Compliance with legal requirements for delivery e.g. in Eurasian customs union

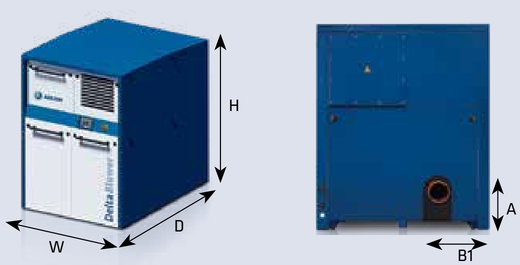
Always the safe choice: ATEX compliant design from AERZEN

The new AERtronic - the way into the digital future.
The new edition of the AERtronic control system offers a user-friendly and clear possibility for the analysis and processing of relevant process parameters and thus provides more transparency, safety and efficiency. All measured values converge in the new control system and can be transferred to the production control system via common interfaces in order to always operate the plant at the optimum operating point. The AERtronic is available in three versions:

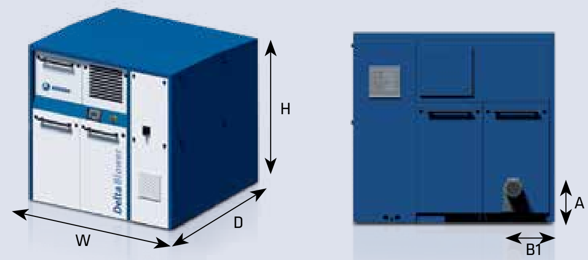
Basic: As a fully digital display instrument
Advanced: For active process control
Premium: As an intelligent interface with cloud compatibility.

COMPACT DESIGN. CAN BE SET UP SIDE-BY-SIDE, OF COURSE.

Dimensions and weights (subject to technical changes - product is subject to technical change).



Delta Blower



Delta Blower with integrated power supply panel.

Delta Blower.

Type	W in.	mm	D in.	mm	H in.	mm	A in.	mm	B1 in.	mm	Nominal diameter DN	Weight without acoustic hood lbs.	kg	Weight with acoustic hood lbs.	kg
GM 3 S	31	800	31	800	41	1,055	8	228	9	245	50	326	148	467	212
GM 4 S	36	925	44	1,135	50	1,280	10	258	10	258	80	456	207	659	299
GM 7 L	36	925	44	1,135	50	1,280	10	258	10	258	80	467	212	670	304
GM 10 S / DN 80	36	925	44	1,135	50	1,280	10	258	10	258	80	520	236	723	328
GM 10 S / DN 100	49	1,250	53	1,350	59	1,500	11	294	14	375	100	740	336	1093	496
GM 15 L	49	1,250	53	1,350	59	1,500	11	294	14	375	100	773	351	1126	511
GM 25 S	49	1,250	53	1,350	59	1,500	11	294	14	375	125	897	407	1250	567
GM 30 L	59	1,500	70	1,800	74	1,900	14	356	17	435	150	1521	690	2248	1020
GM 35 S	59	1,500	70	1,800	74	1,900	14	356	17	435	150	1719	780	2447	1110
GM 50 L	66	1,700	80	2,055	83	2,111	14	357	20	525	200	1995	905	3251	1475
GM 60 S	66	1,700	80	2,055	83	2,111	14	357	20	525	200	2281	1,035	3,538	1,605
GM 80 L	74	1,900	80	2,200	90	2,308	17	456	23	600	250	3417	1,550	4,850	2,200
GM 90 S	74	1,900	80	2,200	90	2,308	17	456	23	600	250	3571	1,620	5,004	2,270
GM 100 S	74	1,900	80	2,200	90	2,308	17	456	23	600	250	4012	1,820	5,445	2,470
GM 130 L	82	2,100	112	2,850	92	2,345	16	410	25	635	300	5370	2,436	7,517	3,410
GM 150 S	82	2,100	112	2,850	92	2,345	16	410	25	635	300	6164	2,796	8,267	3,750
GM 220 L *	82	2,800	169	4,304	137	3,500	16	410	31	800	400	10981	4,981	18,166	8,240
GM 240 S *	82	2,800	169	4,304	137	3,500	16	410	31	800	400	11841	5,371	19,025	8,630

* Design in Compact IV

Weights without motor and belt drive

Delta Blower with integrated power supply panel.

Type	W in.	mm	D in.	mm	H in.	mm	A in.	mm	B1 in.	mm	Nominal diameter DN	Weight with acoustic hood lbs.	kg
GM 10 S	72	1,850	53	1,350	59	1,500	11	294	14	375	100	1364	619
GM 15 L	72	1,850	53	1,350	59	1,500	11	294	14	375	100	1457	661
GM 25 S	72	1,850	53	1,350	59	1,500	11	294	14	375	125	1580	717
GM 30 L	82	2,100	70	1,800	74	1,900	14	356	17	435	150	2914	1,322
GM 35 S	82	2,100	70	1,800	74	1,900	14	356	17	435	150	3112	1,412
GM 50 L	82	2,300	80	2,055	83	2,111	14	357	20	525	200	4023	1,825
GM 60 S	82	2,300	80	2,055	83	2,111	14	357	20	525	200	4310	1,955

Weights without motor, power electrics and belt drive

DELTA BLOWER IN FIGURES.
SIZES AND PRESSURE RANGES.

Type	Positive displacement blower
Design	Overpressure
Volume flow	17 to 8617 CFM
Overpressure	up to 14.5 Psi
Conveying medium	Air, Neutral gases
Handling	oil-free

Figure:
Delta Blower GM 25 S - Assembly without acoustic hood

Performance data - DELTA BLOWER - overpressure operation

Blower Size	Differential pressure		Volume flow		Motor rating		Sound pressure level
	max. Psi	max. mbar	max. CFM	max. m3/h *	max. hp	max. kW	max. dB(A) **
GM 3 S	14.5	1,000	141	240	15	11	70
GM 4 S	14.5	1,000	196	334	20	15	70
GM 7 L	10	700	287	488	20	15	70
GM 10 S / DN 80	14.5	1,000	353	600	40	30	72
GM 10 S / DN 100	14.5	1,000	402	684	40	30	72
GM 15 L	10	700	36	1,020	40	30	72
GM 25 S	14.5	1,000	851	1446	73	55	73
GM 30 L	10	700	1211	2,058	100	75	75
GM 35 S	14.5	1,000	1,405	2,388	120	90	75
GM 50 L	10	700	1935	3,288	120	90	76
GM 60 S	14.5	1,000	2,076	3,528	177	132	78
GM 80 L	10	700	2924	4,968	214	160	80
GM 90 S	14.5	1,000	3,150	5,352	268	200	81
GM 100 S	14.5	1,000	3,701	6,288	335	250	82
GM 130 L	10	700	4661	7,920	335	250	84
GM 150 S	14.5	1,000	5,297	9,000	476	355	84
GM 220 L	8.7	600	7398	12.570	422	315	84
GM 240 S	11.6	800	8617	14,640	670	500	86

* Volume flow (corresponds to the delivery volume flow measured according to ISO 1217 and converted to the reference suction conditions according to the (informative) Annex F of ISO 1217 [inlet pressure = 1.0 bar / inlet temperature = 20°C, RH = 0%])

** Machine noise at a distance of 1m with acoustic hood and connected, insulated pipe, tolerance ± 2 dB(A)

Further pressure ranges can be requested for the AERZEN spectrum. Extensive performance data charts can be found in our Customer Net.

Type	Positive displacement blower
Design	Negative pressure
Volume flow	17 to 8829 CFM
Overpressure	down to -7.5 Psi
Conveying medium	Air, Neutral gases
Handling	oil-free

Figure:
Delta Blower GM 15 L - Assembly without acoustic hood

Performance data - DELTA BLOWER - negative pressure operation

Blower Size	Differential pressure		Volume flow		Motor rating		Sound pressure level
	max. Psi	max. mbar	max. CFM	max. m3/h *	max. hp	max. kW	dB(A) **
GM 3 S	-7.5	-500	147	250	10	7.5	68
GM 4 S	-7.5	-500	200	340	10	7.5	70
GM 7 L	-7.5	-500	306	520	14 - 25	11 - 18.5	70
GM 10 S / DN 80	-7.5	-500	353	600	20 - 50	15 - 37	70
GM 10 S / DN 100	-7.5	-500	429	730	20 - 50	15 - 37	70
GM 15 L	-7.5	-500	635	1,080	29 - 50	22 - 37	73
GM 25 S	-7.5	-500	888	1,510	40 - 73	30 - 55	73
GM 30 L	-7.5	-500	1247	2,120	60 - 120	45 - 90	75
GM 35 S	-7.5	-500	1424	2,420	73 - 120	55 - 90	75
GM 50 L	-7.5	-500	2030	3,450	100 - 335	75 - 250	78
GM 60 S	-7.5	-500	2142	3,640	100 - 335	75 - 250	78
GM 80 L	-7.5	-500	3031	5.150	147 - 335	110 - 250	80
GM 90 S	-7.5	-500	3296	5,600	147 - 335	110 - 250	80
GM 100 S	-7.5	-500	3884	6,600	147 - 335	110 - 250	80
GM 130 L	-7.5	-500	4750	8,070	536	400	82
GM 150 S	-7.5	-500	5709	9,700	536	400	82
GM 220 L	-7.5	-500	7534	12,800	536	400	82
GM 240 S	-7.5	-500	8829	15,000	536	400	80

* Volume flow (corresponds to the delivery volume flow measured according to ISO 1217 and converted to the reference suction conditions according to the (informative) Annex F of ISO 1217 [inlet pressure = 1.0 bar / inlet temperature = 20°C, RH = 0%])

** Machine noise at a distance of 1m with acoustic hood and connected, insulated pipe, tolerance ± 2 dB(A)

Further pressure ranges can be requested for the AERZEN spectrum. Extensive performance data charts can be found in our Customer Net.

MATURED TO PERFECTION IN 150 YEARS: THE SERVICE WORLD OF AERZEN.

The best kind of service is the kind you don't need. But every technology involves wear and tear. Our machines are designed to do their job for as long and efficiently as possible. If necessary, for decades. The goal of AERZEN Services is to extend service life and availability – simple added value for your investment!

Benefit from AERZEN OEM competence - at any time and anywhere

With your OEM's best recommendations.
We have been manufacturing quality products for over 150 years. At the same time, we also developed a corresponding service world. With tailor-made offers for every phase of your machine's lifespan. With OEM original parts, reliable logistics and excellent service at its core. And with decentralised service centres in your vicinity, which guarantee fast provision of spare parts and competent service - worldwide.

AERZEN on-site service.
Our service teams work where our machines are. All over the world. Onshore or offshore. Often under extreme conditions. How do we do it? With short distances. AERZEN has a dense network of service centres and decentralised parts warehouses around the globe. More than 200 excellently trained service technicians can come to your aid from there. Any time and anywhere you need us.

Contact worldwide
2,500 employees work for AERZEN. On every continent. With six sales offices in Germany alone, we're there for you. And with 50 subsidiaries in over 100 countries around the world. Hence we're never far away – should you ever need us. Give us a call:
+49 5154 81 0

Service-Infoline
Our German Service Centre is available for customers and operators. We are happy to help you. We look forward to your call:
+49 700 49318551

Customer Net
Where you can learn more about the company and the leading compressor technologies from Aerzen? It's simple: In our Customer Net on our website, where we have stored everything that is worth knowing for you:
www.aerzen.com

AERZEN. Compression - the key to our success.

AERZEN was founded in 1864 as Aerzener Maschinenfabrik. In 1868, we built Europe's first positive displacement blower. The first turbo blowers followed in 1911, the first screw compressors in 1943, and in 2010 the world's first rotary lobe compressor package. Innovations "made by AERZEN" keep driving forward the development of compressor technology. Today, AERZEN is among the world's longest established and most significant manufacturers of positive displacement blowers, rotary lobe compressors, screw compressors and turbo blowers. AERZEN is among the undisputed market leaders in many areas of application.

At our 50 subsidiaries around the world, more than 2,500 experienced employees are working hard to shape the future of compressor technology. Their technological expertise, our international network of experts, and the constant feedback we get from our customers provide the basis for our success. AERZEN products and services set the standard in terms of reliability, stability of value and efficiency. Go ahead – challenge us!

FIND YOUR LOCAL CONTACT

www.aerzen.com/worldwide

Aerzen USA
108 Independence Way
Coatesville, PA 19320
Phone: 610-380-0244
Order-USA@aerzen.com
www.aerzen.com

AERZEN
EXPECT PERFORMANCE

Delta Blower (G1-068–10)_Aerzen USA
12|2022

AERZEN DELTA BLOWER GENERATION 5

North American Standard

Positive Pressure

Standard range

Blower sizes: .... GM 3S to GM 150S

Package nominal sizes: .... 2” (DN 50) to 12” (DN 300)

Medium: .... Air

Flow range: .... 35 to 5297 icfm (1.0 to 150 m^3/min)

Differential pressure: .... 15 psi (1000 mbar) for “S” and 10 psi (700 mbar) for “L” machines

Maximum operating temperature: 285ºF (140ºC)

Drive: .... V-belt drive with totally automatic belt tension adjustment

Introduction

The Aerzen Blower is renowned for its performance and its reliability. There is no secret: From the blower-stage through the accessories, Aerzen enhances key features of each component by applying sound engineering, precision machining, and superior workmanship.

The Delta Blower Generation 5 (G5 for short) is the synthesis of four previous Aerzen blower package generations combined with an array of new technical innovations to provide five key advantages to our customers:

- The machinery noise level has been lowered yet another 6-8dBa[1] on average compared to the previous Delta Blower
- The blower package is even more user friendly especially in transport, installation, operation, and maintenance
- The oil level is visible from the outside of the package, so the blower does not need to be shut down
- No absorption material is used in the discharge combination silencer; this eliminates the possibility of foreign objects contaminating the air or gas stream
- Use of a shaft mounted cooling fan, which reduces installation and operating costs by eliminating extra wiring, motor starters, and its interlocking with the main blower motor
- The compact footprint allows units equipped with sound enclosure to be mounted side-by-side since there is only one main maintenance access side

[1] Measured in 1m free-field conditions

Aerzen Delta Blower Generation 5 are pre-engineered modular compact packages, which offer a wide range of options from proven and standardized components at reasonable costs and short delivery times.

Shipped completely assembled, the Aerzen Delta Blower Generation 5 is indoor and outdoor rated. There is no extensive installation work - neither grouting nor special anchoring is required, just simply level it and bolt it to any standard industrial flooring or surface.

Scope of supply: basic configuration

- Aerzen Rotary Lobe Blower stage
- Combination Base Frame / Silencer combined with hinged motor plate for automatic belt tensioning – with 2 ½" diameter discharge pressure gauge
- Making belt changes as easy as possible a motor hinge plate lifting and locking mechanism is included with DN100-300 units and a hydraulic bottle jack is supplied with DN50 and 80 units.
- Set of vibration isolating mounts under the entire blower package
- Inlet silencer – filter with filter maintenance indicator
- Narrow V-belt drive and protection guard
- Pressure safety valve
- Discharge manifold with integral check valve and flexible pipe connector
- Standard paint system
- NEMA electric motor TEFC, Premium efficiency, VFD duty, with conduit box on top
- First oil fill and "Service kit"
- Packaging for domestic trucking
- Standard documentation in electronic format: English language, drawings with US-customary and metric units of measure

Standard options include (not limited to)

- Inlet pipe connection kit
- Sound enclosure with skid / oil-drip pan and forced ventilation
- Start-unloading valve Aeromat, with or without solenoid valve
- Pressure modulating valve Aeropress or Aeropress10S, pilot operated
- Other motors, e.g. misc vendors Premium Efficiency with conduit box on top
- Instrumentation & controls, e.g. AERtronic Aerzen blower controller

Description of the main components

The combination of key components marked with a * in the description below significantly contribute to the reliability and performance of the Aerzen Blower:

At the heart of the package: The Aerzen Rotary Lobe Blower

Low vibration and low pulsations - a key feature:

* Internal pulsation interference channels in conjunction with 3-lobe rotors reduce the pulse in the discharge air stream by as much as 90% or 20 dB at the lobe-passing frequency. This significant attenuation contributes strongly to reducing vibrations in the entire package and lowering the noise emitted by the downstream piping.

Positive displacement characteristic:

— The blower moves a fixed volume of gas with each shaft rotation, nearly independently from the operating pressure.
— At constant differential pressure, the load torque remains constant.
— For a given pressure, the power is directly proportional to the speed.

Flow across the blower stage:

— Vertical from top to bottom

Drive shaft location:

— On the left when facing the blower shaft

Rotation:

— Counterclockwise when facing the blower shaft

Housing:

— The central section, "the cylinder" and the two side-plates house the rotors, while a gear case and a drive end cover contain the lubricating oil for bearings and gears. Individual side plates allow for optimal setting of the radial rotor clearances: a valuable feature on blowers with the gas flowing perpendicular to the rotors.
— Connections: full-size, flat-faced flanges
* — Maintaining internal alignment under all operating conditions is paramount for the reliability of any rotating equipment. The housing is, for this purpose, designed to support the entire blower stage on its outlet flange only; no need to worry about a "soft foot" or uneven base support
— Materials: Gray cast iron EN-GJL-200 equivalent to ASTM A48 Cl.30 AISI A278 Cl. 30

Rotors:

✱
- Up to and including the model GM 80L, rotors and shafts are made of a single, drop forged steel piece made from C45 steel equivalent to AISI Type 1045. Models GM35S, 50L, 90S, and 130L are made from a single piece of EN-GJS-500-7 nodular cast iron equivalent to ASTM A 536. Model GM150S rotors are comprised of a through shaft made from C45 steel equivalent to AISI Type 1045 and a rotor made from EN-GJS-400-15 nodular cast iron equivalent to ASTM A536 Gr. 60-40-18. Solid or dust-tight rotors do not have any open cavities that can trap contaminants. This is particularly important in food applications and applications requiring high purity. Moreover, rotor balance is maintained, and vibration is therefore minimized.
- Stiff rotor design: the rotors' first critical speed is always at least 10% above the maximum operating speed.
- The rotors meet or exceed the ISO 1940 / ANSI S2.19 G6.3 criteria of dynamic balancing

Timing gears:

- Helical gears with hardened and ground teeth to meet AGMA 12 quality standard with an AGMA service factor of 1.70.

✱
- To maintain the advantage of high-quality gears, the gear wheels are secured onto the shafts by means of a tapered interference fit. Optimum concentricity is achieved and neither gear hub nor shaft keys are used. To prevent damaging the seats, gear installation and removal are carried out using hydraulic pressure to expand the gear wheels within their elastic limit.

Bearings:

- The rotors are supported by anti-friction bearings
- The bearings are housed in the side-plates and are sized for an expected 5 years between overhauls.
- The drive-shaft bearing is a cylindrical roller bearing whereas the other bearings are selected to achieve the proper clearances between rotors and housing, axial loads from the helical bearings: smaller machines up to GM 50L feature double angular ball bearings.

Lubrication:

- Oil splash lubrication of all bearings and gears through oil spray disks on both blower ends
- An oil sight glass is provided on each oil sump.
- An oil drain valve is provided on each oil sump (units without sound enclosure). The oil drain valves are directly mounted to the oil sump covers for clean, easy and fast oil change.
- Units with sound enclosure are plumbed together to an oil reservoir that serves as oil fill and drain device, and its oil sight glass is visibly mounted to the maintenance side of the enclosure.
- Aerzen USA provides the first oil fill with a lubricant as recommended in the operating manual as well as a service-kit containing oil fill funnel, and oil drain hose.

Seals at the rotor chamber:

✱
- The rotor chamber is sealed from the oil chambers by four, all metal, non-rubbing seals, each consisting of the following components and in that sequence:
  - Oil slinger ring
  - Two restrictive piston-rings in a labyrinth
  - "Neutral chamber" located between the piston rings used for venting the seal
  - Two restrictive piston-rings in a grooved labyrinth bushing

Seal at the drive shaft:

- Double, permanently lubricated Viton seal ring
- Shaft sleeve: replaceable, hardened steel

Testing

- Each blower stage is subject to a full-load test to verify the volumetric flow and power values.
- * Acceptance criteria are +5% on power and –5% on flow for all machine sizes.
- Orifice flow measurement and conversion of results to the operating conditions in accordance with ISO 1217, simplified

The package component Aerzen Rotary Lobe Blower

Intake air silencer & filter

- * Absorption-type silencer upstream of the air filter element. For reasons of cleanliness, there is no silencing material between the filter and the inlet blower flange.
- The carbon steel housing is powder coated. Quick-release latches for quick access to the filter element
- Filter performance: G4 per EN 779 (greater than 90% of synthetic dust particles), equivalent to ASHRAE 52.2 MERV 7 (50-70% @3-10 microns)
- Progressively compressed, thermally bound polyester fibers, free of PVC, smoothened and compressed on the clean airside for highest dust separation and retention capacity. The filter media is made of a single, 30 mm thick continuous mat that is white in color and is food safe. Filter element mounts with a quick release turn and lock arrangement.
- Included is a filter maintenance indicator. If the sound enclosure option is selected, the filter maintenance indicator is mounted to the enclosure wall.

Base with integral discharge silencer:

- In addition to the blower's internal pulsation cancellation feature, the combination discharge, three-chamber reactive silencer is used to further reduce the noise and residual pulsation in the air stream across a wide range of operating speeds. The residual pulsation downstream of the silencer meets or exceeds the API 619 recommended 2% peak-to-peak of the absolute line pressure.
- * The discharge silencer is combined with the support base into one compact rugged unit. It is made from pressure vessel steel it forms a torsion resistant cylindrical vessel supporting the blower stage and other components.
- * The mounting surface for the blower is a full-size steel flange machined and continuously welded to the base with the full number of tapped holes for the studs to fasten the blower to the base - no need to align blower feet or to worry about a soft-foot condition. A surface sealant is used instead of a gasket.
- * Maximum operating pressure: 1.1 bar gauge (16 psig) and 150ºC (300ºF), built and certified to the latest European Pressure Vessel Code, PED. Test pressure: 1.9 bar g. (27.6 psig)
- The base is mounted on a set of vibration-isolating mounts

Belt drive

- Narrow, anti-static V-belts
- Selected for a minimum service factor of 1.4 times operating power (BHP), or 1.1 times the motor nominal power (nameplate HP), whichever is greater.[2]
- * The Aerzen Delta Blower Generation 5 package provides entirely automatic tensioning of the belts. Thanks to the package configuration, the drive geometry is such that the motor hinges parallel to the motor shaft centerline, using only the motor mass to maintain this tension without need for adjustments or springs. This not only reduces maintenance; it also reduces the potential for operating with too little (slipping belts) or excessive belt tension (excessive bearing and shaft load).
- DN100-300 blower packages feature a multipurpose lifting device for the motor swing plate. In its most basic function, it serves as shipping locking device preventing the motor from unwanted movement. It also serves as the lifting mechanism for changing out the drive belts. Another additional purpose is limiting the belt tension when oversized motors are used. Finally, the device can be configured to aid limited movement for seismic or mobile blower package service. The maintenance kit provided by Aerzen USA also includes a ratchet wrench used for lifting the motor to change V belts.
- DN50 & DN80 blower packages have a simple to use bracket and hydraulic jack included in the maintenance kit to lift the motor and change or install the belts.
- Sheaves and bushings are dynamically balanced to ISO 1940 / ANSI S2.19 G6.3. For linear tip speeds > 6500 ft/min (33 m/s), nodular cast-iron, ventilated sheaves are used.

Belt guard

- OSHA compliant personnel guard, made of galvanized steel: either perforated steel or solid sheets with vents, depending upon the model.
- Units with sound enclosure feature hand protection fan and belt guards, and the enclosure itself serves as the ultimate protection device. The removable maintenance panels comprise lockable latches that help facilitate OSHA prescribed tag-out-lock-out procedures.

Vibration isolating mounts

- A set of vibration isolating mounts are located under the blower package to hinder the transmission of structure borne noise from the blower and the discharge silencer into any structure the package is installed on, such as a mounting skid if supplied with acoustic enclosure.

Discharge manifold

- Flange-mounted to the discharge silencer, the discharge manifold serves for mounting the pressure safety valve, an optional start-unloading valve and for connecting the blower package to the discharge piping.
- Materials of construction: Gray Cast Iron EN-GJL-250 equivalent to ASTM A48 (Aluminum stub pipe for DN50)
- The discharge manifold houses the discharge check-valve

Pressure safety valve

- DN100-300 blower packages have a vertically mounted, spring loaded, safety pressure valve sized for the full flow of the blower. DN50 and DN80 blower packages feature horizontally mounted safety relief valves.

---

[2] Higher values are not necessarily better as they could lead to belt slippage due to excessive stiffness, and also shaft damage (deflection) caused by higher tension values required by over sized v-belt drives.

* — The valve's characteristic is nearly proportional. It not only opens, but also closes at the set pressure
* — The valve has a built-in dampener that allows the valve to actuate smoothly, which prevents the "pop-off" effect commercially available valves exhibit.
— Pressure rise up to 10% at full flow. Certification of conformity to PED
— Being an all-metal valve, it is not suitable as a pressure modulating valve. If this function is needed use an Aerzen pilot operated Aeropress or Aeropress10S pressure modulating valve.
— Materials: seat of gray cast iron and, depending on the size, a brass or anodized aluminum bell and piston, galvanized spring, steel spring rod, and an aluminum or fabricated external steel cylinder.
— Standard set points are 15.2 psig (1050 mbar) for "S" model blowers operating above 10 psi (700 mbar), and 10.9 psig (750 mbar) for all machines operating under 10 psi (700 mbar), including all "L" model blowers[3].
— The valve protects the blower stage against line surges, and spikes. It does not protect against prolonged overloads or excessive discharge temperature. Therefore, it is not an absolute protection device, nor is it "bubble tight".

Discharge check valve

* — A full-bore check valve that can be easily removed for inspection and maintenance without disconnecting the discharge piping[4]
— With its horizontal top-located steel shaft[5], the check valve naturally closes by gravity at no-flow.
— Without any springs, the check valve will not chatter, even at low flow conditions (for example in adjustable speed applications)
— Flap material: EPDM on steel for operating temperatures up to the blower limit
— Optional check valve flap material: Silicone rubber

Discharge flexible connector

— A reinforced silicone-rubber discharge flexible connector with heavy-duty clamps connects to the discharge piping.
— It prevents the transmission of structure-borne noise from the blower and its discharge silencer to the discharge piping.
* — Located downstream of the silencer and with only a small gap (~1/2") between the package and the pipe, the noise sent to the outside is maintained at a minimum.
— The sleeves are sized for standard, schedule 40 pipe diameters.

Discharge pressure gauge

— Liquid filled, 2 ½ "dial. Units: mbar and psi
— If the sound enclosure option is selected, the discharge pressure gauge is mounted to the sound enclosure wall.

[3] The valves are adjustable, and different springs are available for other set points depending upon operating conditions, motor limitations, or customer's requests.

[4] Except DN50

[5] Except DN50

Optional sound enclosure

- Covering the entire blower package with the drive motor, the enclosure provides suitable protection for outdoor installation up to 50 mph winds and 25 lb/ft^2 snow load and rain at a 45º angle
- * The enclosure and the blower package are both mounted on a skid / oil-drip pan, designed for meeting environmental protection standards as well as for easy transportation and installation.
- * The unique Aerzen package design makes it possible to mount multiple blowers side-by-side without hindering access to the maintenance side (front). All pipe and wiring connections are made from the backside. This offers the best use of available floor space.
- * All maintenance activities can be carried out from the front of the package, e.g. air filter, belts, and oil maintenance. The oil level is visible from the outside and eliminates any guesswork. Oil can be filled and drained from a common reservoir that also houses the oil level gauge.[6] The oil level check can be done with the blower in operation.
- The enclosure reduces the package noise level to less than 80 dB(A) – 75dB(A) in most cases- at 1 m, free field, per DIN 45635.
- Quick release panels, each less than 50 lb (as mandated by MSHA) provide quick and easy access to the blower and the package components for routine maintenance.
- * Blower packages are fitted with a shaft-mounted cooling fan for sufficient heat removal. There is no need for a separate electric driven fan and required interlock and controls.
- Aerzen mounts the blower package in the sound enclosure at our factory prior to shipment.
- * Panels are made of galvanized steel sheet, with self-extinguishing, non-dripping high-density polyester foam as absorption material.
- The enclosure is powder coated in a UV resistant Aerzen Royal Blue color, accented with light gray maintenance panels

[6] Except DN50

Hebevorrichtung für Motorwippe

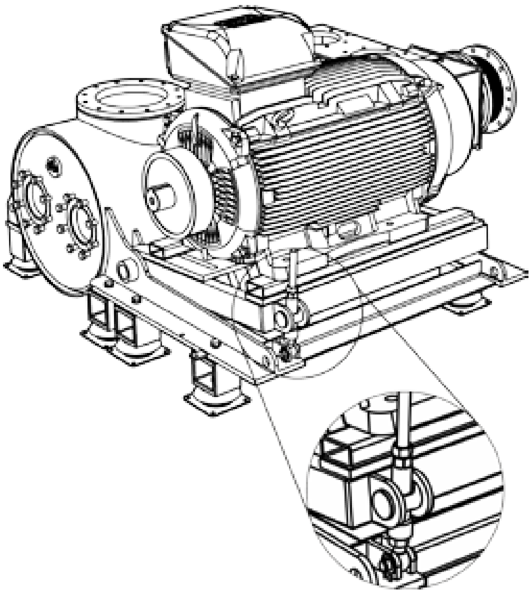
Lifting device for motor base

Dispositif de levage pour moto-interrupteur à bascule

Hijsinrichtung voor motorwip

Mecanismo de elevación para base de motor

Dispositivo di sollevamento per basamento oscillante del motore



DEUTSCH ENGLISH FRANÇAIS NEDERLANDS ESPAÑOL ITALIANO

AERZEN

AERZENER MASCHINENFABRIK GMBH

G4-079 B XT	
... ...	03-2014

1. General notes

- This description serves as guide for the operation of the hinged motor lifting device.
- Usage requires special knowledge in using and handling this kind of machine.
- For correct operation of the hinged motor in the Delta unit, qualified and trained specialists are required.
- Only use envisaged and suitable tools for adjusting the hinged motor.

Every person involved in the adjustment of the hinged motor should read and understand this description and the corresponding operating instructions and especially the safety instructions!

WARNING!
Danger of injury if insufficiently qualified!
Incorrect use can lead to considerable personal injury and property damage.

- All actions should therefore only be carried out by adequately qualified specialists.

Specialists
are due to their technical training, knowledge and experience as well as knowledge of the relevant provisions able to carry out all work assigned to them and to recognise and avoid possible dangers.

Only personnel are allowed to work whom it can be expected to carry out the work in a reliable manner.

Persons whose responsiveness is influenced due to drugs, alcohol or medication are not allowed.

Age and job-specific regulations should be taken into consideration with the choice of personnel.

2. Safety information

The hinged motor should only be set or adjusted when the machine is not in operation and secured against reactivation!

Securing against reactivation

The machine should be secured against reactivation for all actions that require the machine to be in a non moving condition (e.g. work or fault rectification).

WARNING!
Lethal danger due to unauthorised, uncontrolled or impermissible reactivation!
Unauthorised or uncontrolled reactivation of the machine can lead to serious injuries or death!
Persons could be in the hazardous area.

Applying power can lethally injure these persons.
- Secure the main switch and lock.
- Signs should be placed on the main switch and users informed of the possible dangers.
- Before reactivation ensure that all safety equipment is assembled and fully functional and that there are no dangers existing to persons.
- Always adhere to the following procedure for securing against reactivation.

1. Switch off energy supply.
2. Secure the main switch using a lock which should be locked and a relevant sign should be placed on the main switch.
3. The key should be kept safe with a responsible person.
4. If the main switch cannot be secured, relevant signs should be placed indicating the dangers.
5. After all work is completed check that there are no persons in the hazardous area.
6. Make sure that all protection devices are installed and fully functional.
7. Unlock the main switch and remove the signs.

CAUTION!
Danger of injury due to sharp edges and pointed corners!
Sharp edges and pointed corners can cause abrasions and cuts to the skin.

- Proceed carefully when working near sharp edges and pointed corners.
- If in doubt wear protection gloves.

WARNING!
Danger of injury due to moving and rotating components!
Moving and rotating components can cause serious injuries.

- Correctly take the machine out of operation and secure against reactivation before adjusting the hinged motor.
- During the adjustment of the hinged motor do not touch or grasp any moving components.
- Wear close fitting protective clothing with a low tear resistance when in the hazardous area.

WARNING!
Shear and crushing danger due to moving parts!
Moving components can cause shear and crushing injuries.

- Do not grasp between any moving components when working on the hinged motor.
- Never enter the swivel range of the hinged motor.

- Only use the ratchet spanner and the original mounting material that were delivered to adjust the hinged motor!

- The hinged motor should not rest on the guide bushing when in the operating position.
  Exception: Hinged motor support for motors with increased weight.

  Otherwise the belts slip and wear out sooner.
  Danger of property damage!

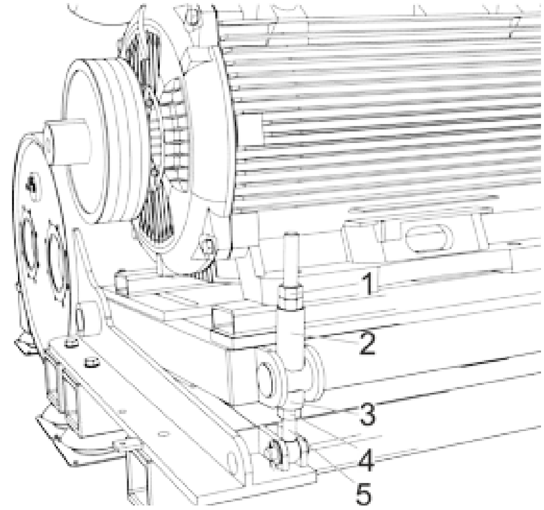
  The hinged motor should also have sufficient space to place the guide bushing after the belt has stretched.

Design with acoustic hood

- After adjusting the hinged motor correctly close the acoustic hood.

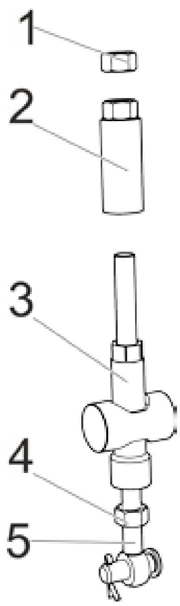
3. Delivery condition

Factory delivery condition / without drive belts.



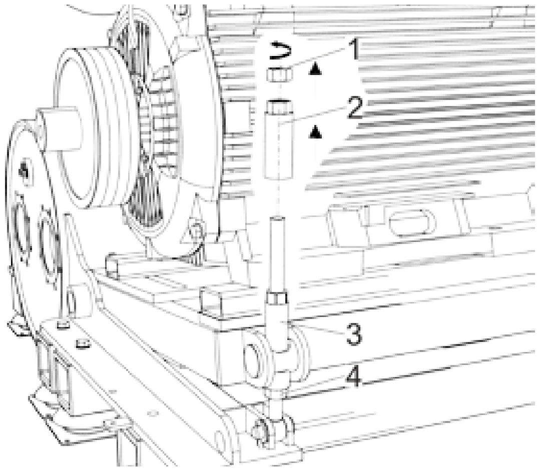
Fixed hinged motor / transportation lock

4. Assembly overview



Pos.	designation
1	Locking nut 1
2	Locking sleeve
3	Guide bushing
4	Locking nut 2
5	Eyebolt

5. Adjusting the hinged motor before commissioning



- Disassemble locking nut (1) and locking sleeve (2).

Check to direction of rotation
Observe the red direction of rotation label on the unit.
Briefly start the drive motor. (approx. 1 - 2 seconds)

Important: WITHOUT belt on the motor disc!

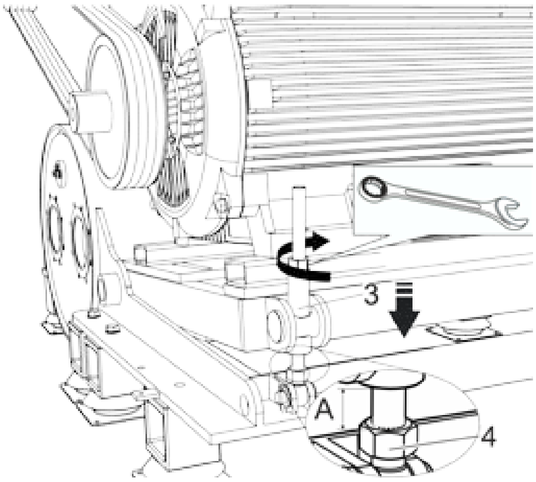
Incorrect direction will destroy the unit!
Direction of the drive motor and the unit must be the same.

- Mount the belt.

MOUNTING

Typ / *type*

Delta Hybrid
Delta Blower Generation 5
Delta Screw Generation 5



Pre tension the belt

- Screw down the guide bushing (3) with the ratchet spanner.
- The hinged motor is still slightly on the guide bushing (3).

Adjust dimension A

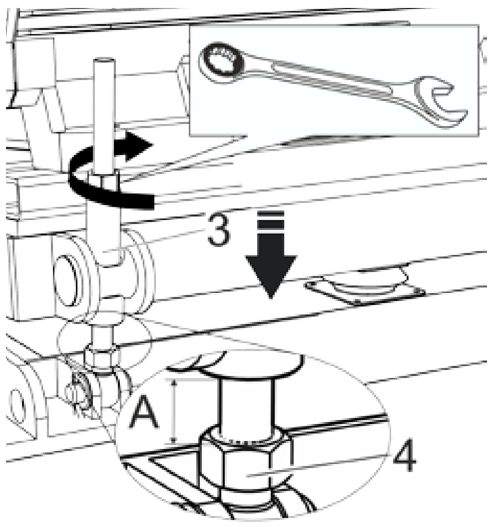
- Adjust the locking nut (4) to dimension A.
- Turn the guide bushing (3) onto the locking nut (4) with the ratchet spanner.

Delta Blower

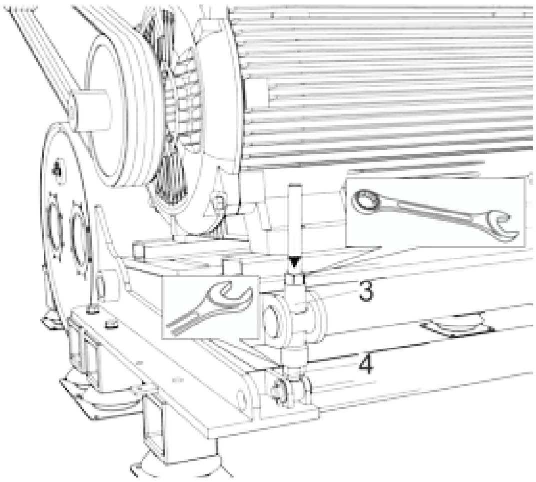
DN	dimension A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50

Delta Hybrid

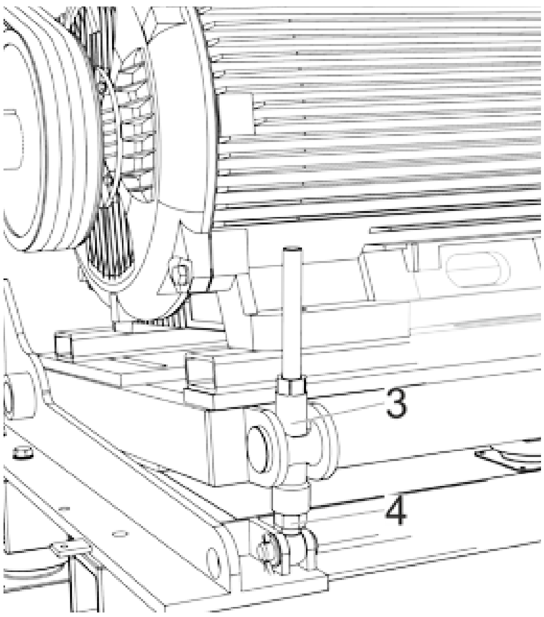
DN	dimensions A in mm
100	25
125	25
150	30
200	35
250	40
300	45



- Lock the guide bushing (3) against the locking nut (4).
- The hinged motor is completely held into place by the belt drive.



6. Operating condition, normal use



7. Adjustment of the hinged motor for truck, ship and earthquake preparation

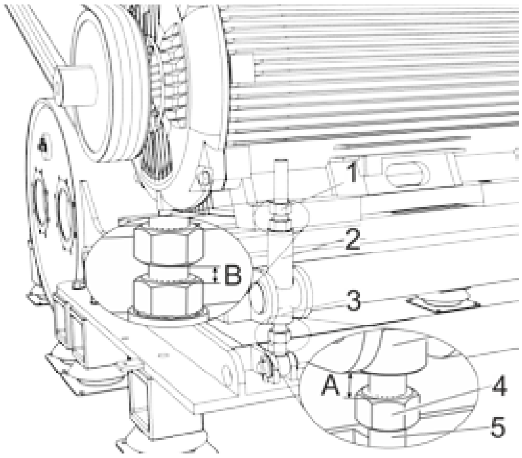
Prepare the lifting device as with the standard application and set dimension A.

Rocker limit set to the upper position.

- Screw and tighten the locking sleeve (2) completely onto the eyebolt (5),
- Adjust the locking nut (1) to dimension B.

Delta Blower

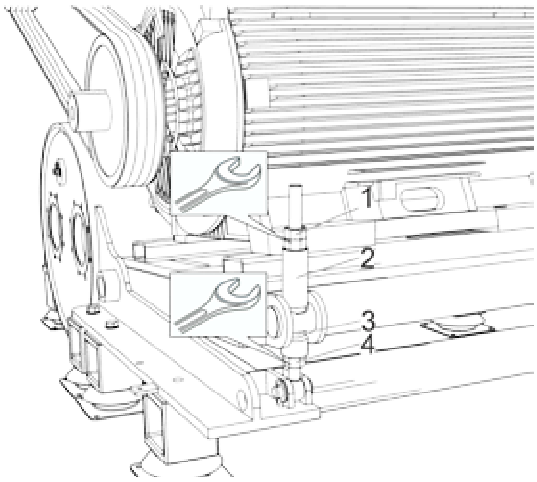
DN	Size B in mm
80	5
100	5
125	5
150	10
200	10
250	10
300	10



Delta Hybrid

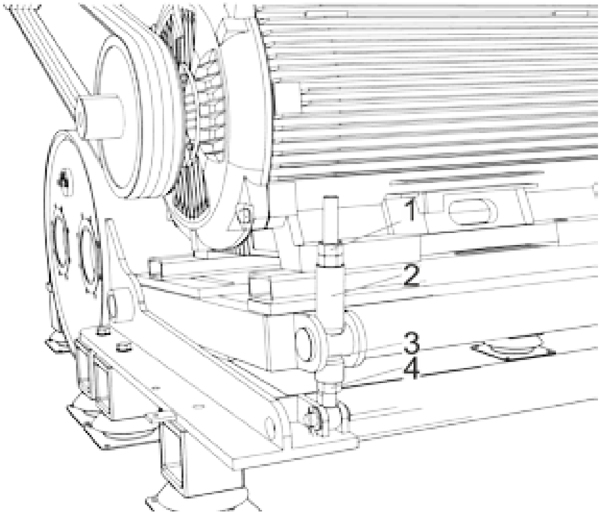
DN	Size B in mm
100	**5**
125	**5**
150	**5**
200	**5**
250	**5**
300	**5**

- Loosen the locking sleeve (2) turn upwards and lock with the locking nut (1).



ENGLISH

8. Operating condition Truck, ship and earthquake preparation

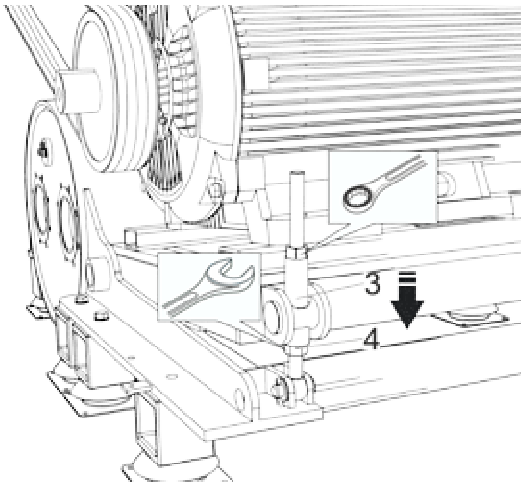


9. Adjustment of the hinged motor for rocker support

Prepare the lifting device as with normal use.

Lower the hinged motor until the belt is tensioned.

- Check the belt tension.
- If the belt tension is incorrect, lock the guide bushing (3) and the locking nut (2).
- Check the belt tension after the following intervals and adjust if necessary:
  after 24 op. hrs. after 500 op. hrs after 4000 opt. hrs

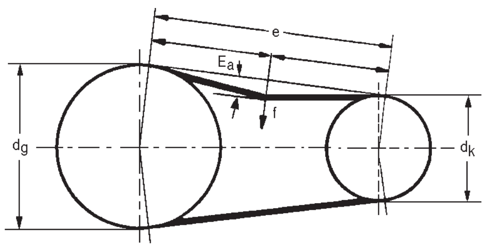


Belt tensioning

1. Set the testing force via the profile type.
2. Determine the disc diameter **dk** on the drive and derive from this the indentation depth **E.**
3. Calculate the indentation depth**Ea** with the existing axial distance **e.**
4. The testing force **f** is to be asserted in the middle of the axial distance **e** on the drive belt. The testing force should be exerted vertically on the strand!
Pretension the drive to the calculated indentation depth **Ea.**

Pretension example: **Profile** = SPZ; **dk** = 100 mm; **e** = 380 mm;
f = 2.5 daN; **E** = 2.00 mm; **Ea** = 7.6 mm

The drive belts should be re-tensioned after 30 min. of operation and be checked if possible after 24 hours.



e = axial distance
E = indentation depth every 100 mm axial distance
E_a = indentation depth of the strand
f = testing force

$$E_a = \frac{E \cdot e}{100}$$

Profile	Testing force f for each drive belt (daN)	Diameter d_k (mm)	indentation depth E (mm) each 100 mm Strand length with initial as-sembly	indentation depth E (mm) each 100 mm Strand length in operation after running in.
 SPZ/3V XPZ/3VX	2.5	≥ 56 - 71 > 71 - 90 > 90 - 125 > 125	2.20 1.95 1.50 1.20	2.45 2.20 2.00 1.70
SPA XPA	5.0	≥ 71 - 100 > 100 - 140 > 140 - 200 > 200	2.80 2.50 2.20 2.15	3.20 2.85 2.55 2.40
SPB/5V XPB/5VX	7.5	≥ 112 - 160 > 160 - 224 > 224 - 355 > 355	2.40 2.10 1.70 1.40	3.00 2.65 2.22 1.90
SPC XPC	12.5	≥ 180 - 250 > 250 - 355 > 355 - 560 > 560	2.30 1.90 1.65 1.60	2.65 2.30 1.90 1.70

Technische Dokumentation

Technical Documentation

Aerzener Maschinenfabrik GmbH
Reherweg 28 31855 Aerzen

Postfach 1163 31849 Aerzen
Telefax 0 51 54 / 81-191
e-mail info@aerzener.de

Kundenservice
0 51 54 / 81-7529

Aerzener International Rental B.V.
www.airental.nl
phone +31 (0) 26 44 64 723
Telefax +31 (0) 26 44 63 570
e-mail info@airental.nl

Aerzen im Internet
www.aerzener.com

SECTION 3

G-5 Combination Base - Discharge Silencer

Description: Combination base - discharge silencer

Base/discharge silencer includes three-chamber reactive silencer built as a pressure vessel, blower mounting-flange with studs, discharge connection with integrated check valve, hinged motor plate, entirely supported on vibration isolating feet.

Materials of construction:

Silencer: Pressure vessel quality carbon steel S 235 JR (St 37-2) equivalent to ASTM A 283 Grade B

Pressure vessel code: PED (European directive) PED – AD 2000, DGRL 97/23/EG with consideration given to static and dynamic stress (fatigue resistance)

Maximum operating data: 150 ºC (300 ºF) and 1.1 bar gauge (16 psig)

Test pressure: 1.9 bar gauge (27.5 psig)

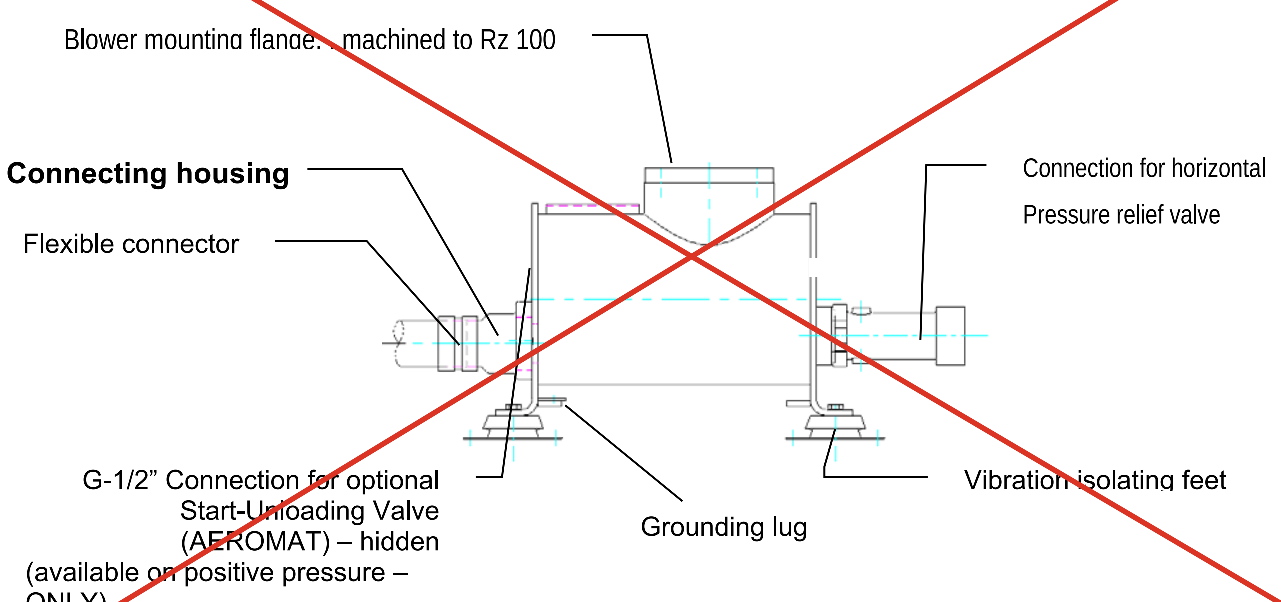
Shell wall thickness: depending on size: 6mm (1/4") for DN-50 → 15mm (5/8") for DN-300

Performance:

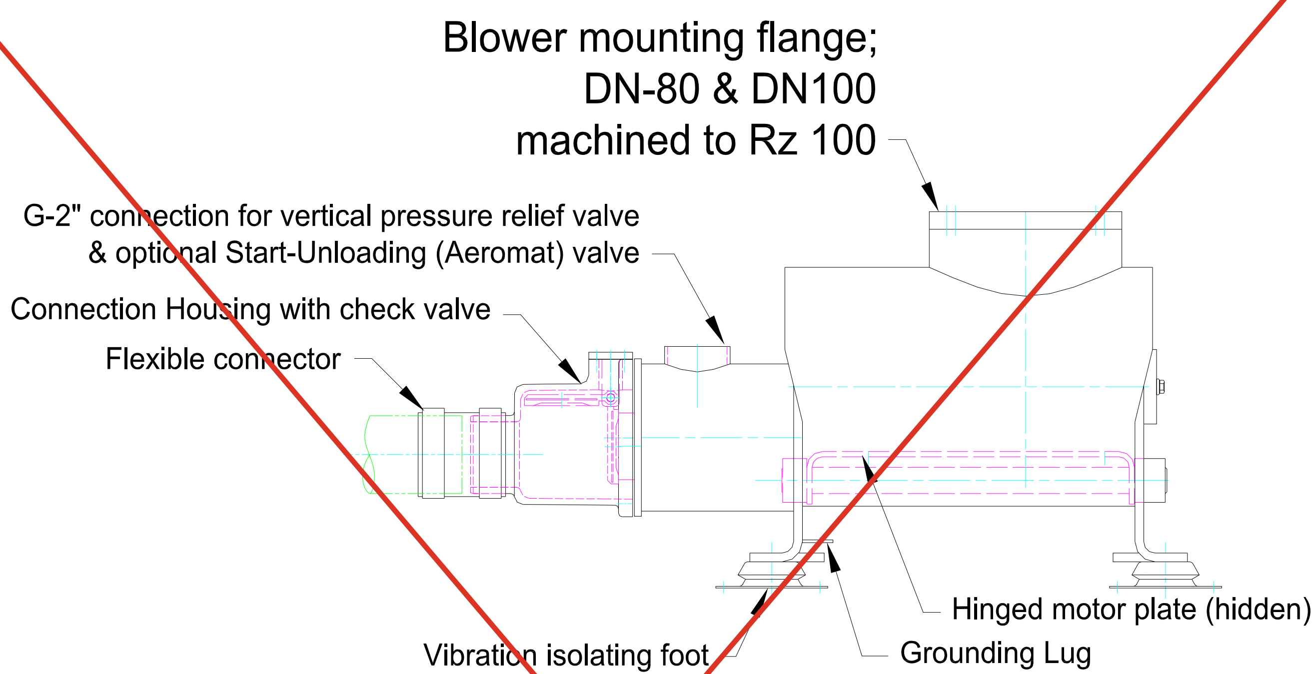
Pulsations in the air stream are reduced below the API 619 standard of 2% peak-to-peak of the mean line pressure.

Pressure drop of the entire Base-Silencer with connecting housing and check valve, at the maximum allowable flow: 35 mbar (0.5 psi); included in the power calculations of the Delta Blower package

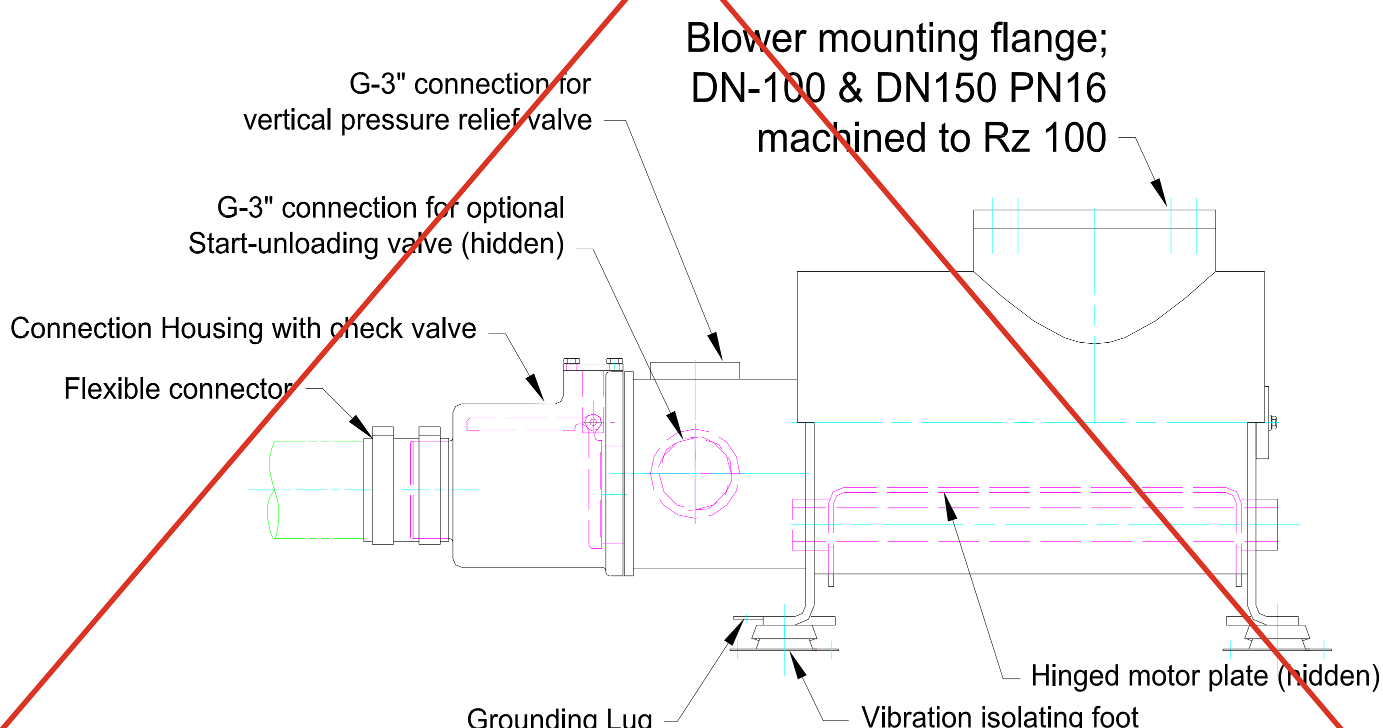
Combination Base - Discharge Silencer DN50



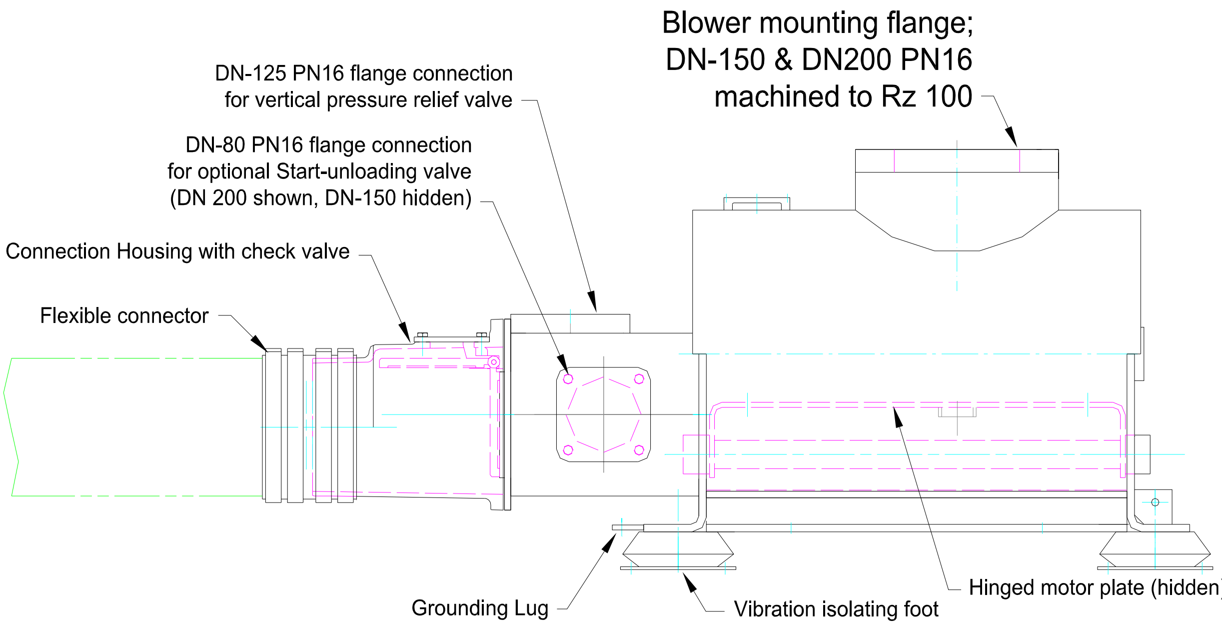
Combination Base - Discharge Silencer DN80



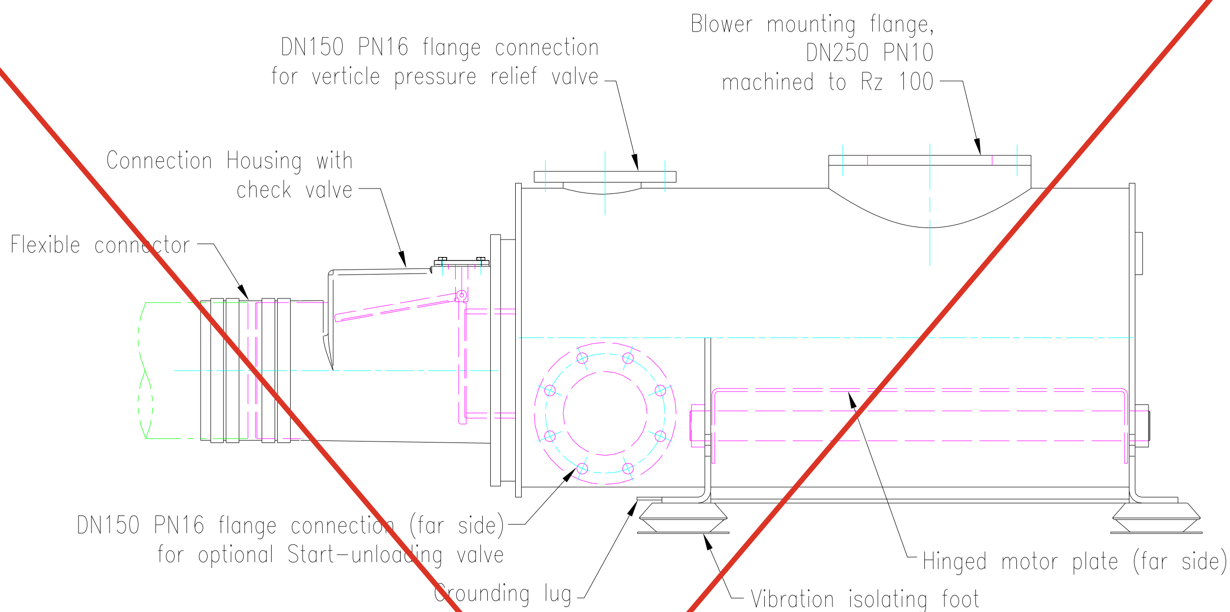
Combination Base - Discharge Silencer DN100/125



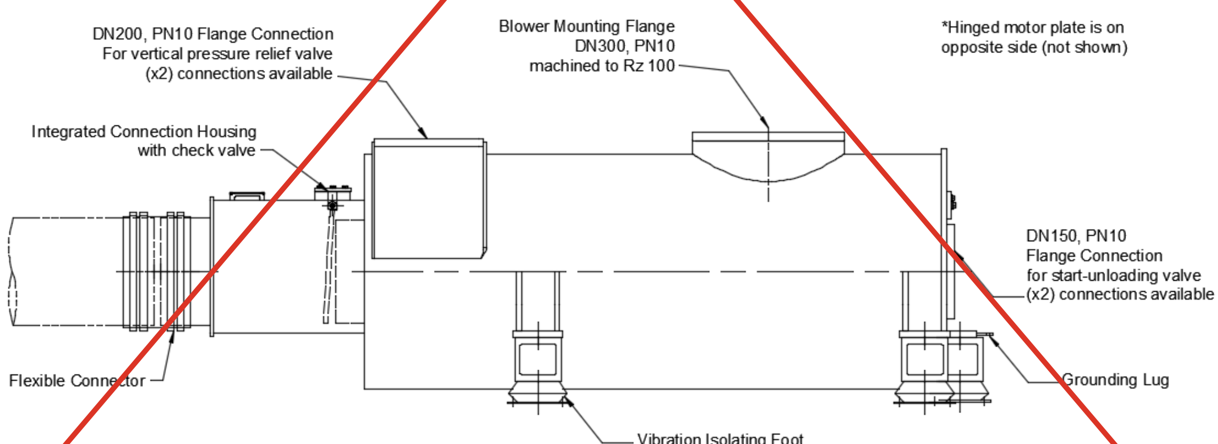
Combination Base - Discharge Silencer DN150 & DN-200



Combination Base-Discharge Silencer DN-250



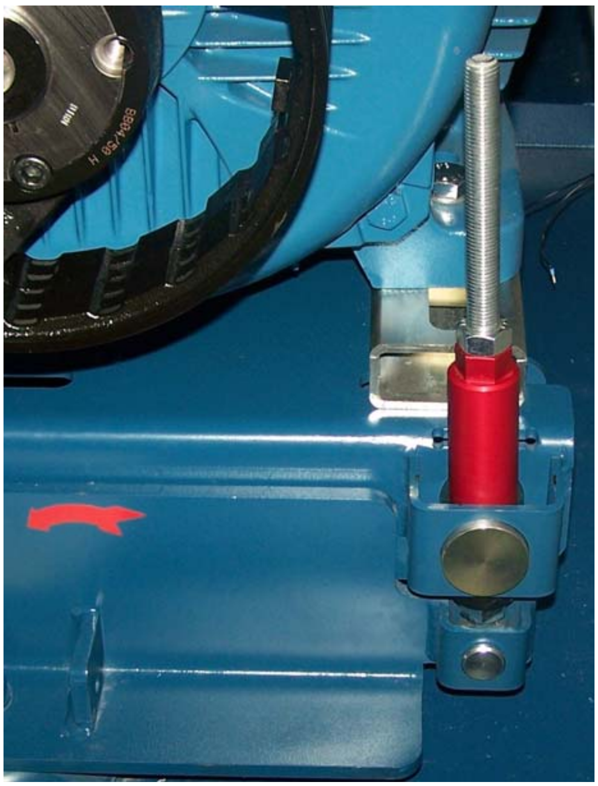
Combination Base-Discharge Silencer DN-300



Combination Base - Discharge Silencer

Hinged Motor Plate DN50 –DN300

The hinged motor plate for sizes DN100 through DN250 features a multipurpose lifting device. In its most basic function it serves as shipping locking device (red part) preventing the motor from unwanted movement. It also serves as the lifting mechanism (black part) for changing the drive belts. During normal operation the motor mass tensions the drive belts in the tried and true Aerzen way. The motor swing plate does not rest on the lifting mechanism (see photo on the right below). No special adjustments are necessary during normal operation of the blower package. Another additional purpose is limiting the belt tension when oversized motors are used. Finally, the device can be configured to aid limited movement for seismic or mobile blower package service. Refer to G4-079 B XT for operation of Multipurpose Lifting Device. Depending on motor weight, DN300 units can have (1) or (2) lifting devices.



Lifting Device on Arrival

The red locking sleeve serves to keep the motor swing plate stable during shipping. It may also be used in seismic and mobile applications as a motor swing stop

Lifting Device in Normal Operation

The black guide bushing serves as a belt installation aid. Using an Aerzen supplied ratchet wrench, it helps lift the motor swing plate during belt installation and maintenance. Once new belts are installed it is backed down to the lock nut. **The motor hinge plate does not rest on the guide bushing during normal operation**. The guide bushing may also be used as tension limiter for use with overweight motors.

Shown is a DN-125 Sound Enclosure

Rear View of the Enclosure

Description: The sound enclosure surrounds the entire blower package to reduce noise and protect the machine from the weather while allowing easy access for maintenance. The base of the enclosure supports the entire blower package and contains an oil drip pan for environmental protection. Aerzen mounts the entire blower package within the sound enclosure at the factory prior to shipment. Transportation and installation are simplified by having the entire package supported and contained within the enclosure. The unit may be moved with a pallet jack or forklift.

The sound enclosure is designed with strategic consideration for airflow through the unit. A fan is mounted on the end of the blower shaft, so there is no need for a separate electric motor driven fan. From the cool, front side of the blower, air is drawn in through a sound trap. The air then passes over the motor and blower housings and finally is exhausted through the floor at the rear of the unit.

Quick release panels, each less than 45 lbs., provide access for routine maintenance of the blower and the package components. All maintenance and connections are located in the front and rear, allowing multiple machines to be placed side-by-side.

The oil level gauge is visible from the outside of the sound enclosure in sizes GM 4S DN-80 through GM 150 S DN-300 with the oil fill port and drain mounted to the enclosure just inside a removable panel.

The smallest size, GM 3S DN-50, has an easily removable roof to facilitate maintenance.

Materials:

Base pan – Polyester based powder coated steel weldment, 3 to 5 mm thick

Exterior panels - Polyester based powder coated galvanized steel

Sound insulation -Self-extinguishing, non-dripping high-density polyester foam

Technical:

Package noise level reduced to 80 dB, or less, at 1 m, free field, per DIN 45635.

Snow Load – 122 kg / m^2 (25 lbs / ft^2)

Wind Load – 80.4 km / hr (50 mph)

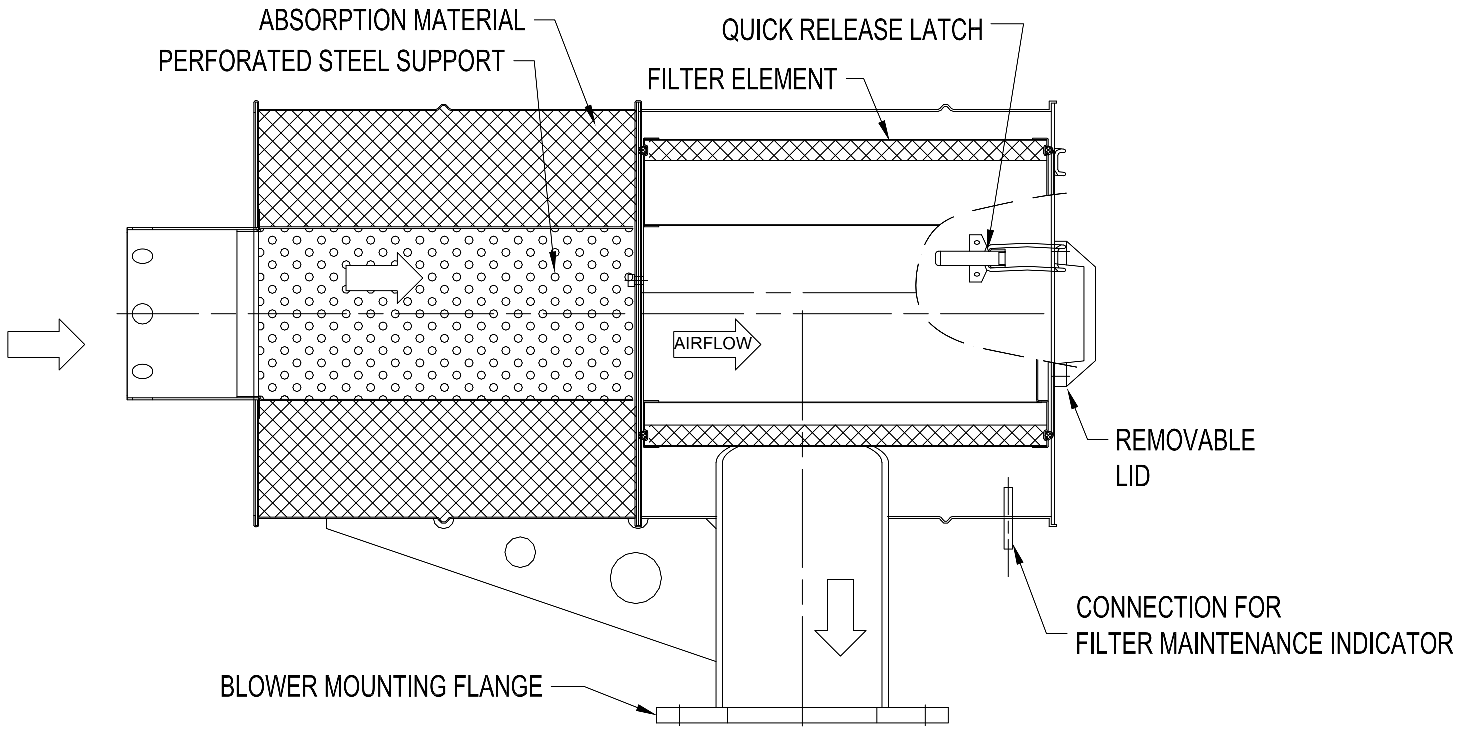
Suitable for indoor or outdoor installation

Part Numbers:

<table>
<tr><th>Size</th><th>Part No.</th></tr>
<tr><td>DN-050</td><td>180723</td></tr>
<tr><td>DN-080</td><td>180724</td></tr>
<tr><td>DN-100</td><td rowspan="2">180725</td></tr>
<tr><td>DN-125</td></tr>
<tr><td>DN-150</td><td>180740</td></tr>
<tr><td>DN-200</td><td>180741</td></tr>
<tr><td>DN-250</td><td>181753</td></tr>
<tr><td>DN-300</td><td>184737</td></tr>
</table>

G5 Pressure Inlet Filter/ Silencer

DN 50 - DN 300



Description: Combination dry air intake filter and absorption type silencer with filter (or strainer) element located downstream from the silencer chamber

Materials of construction:

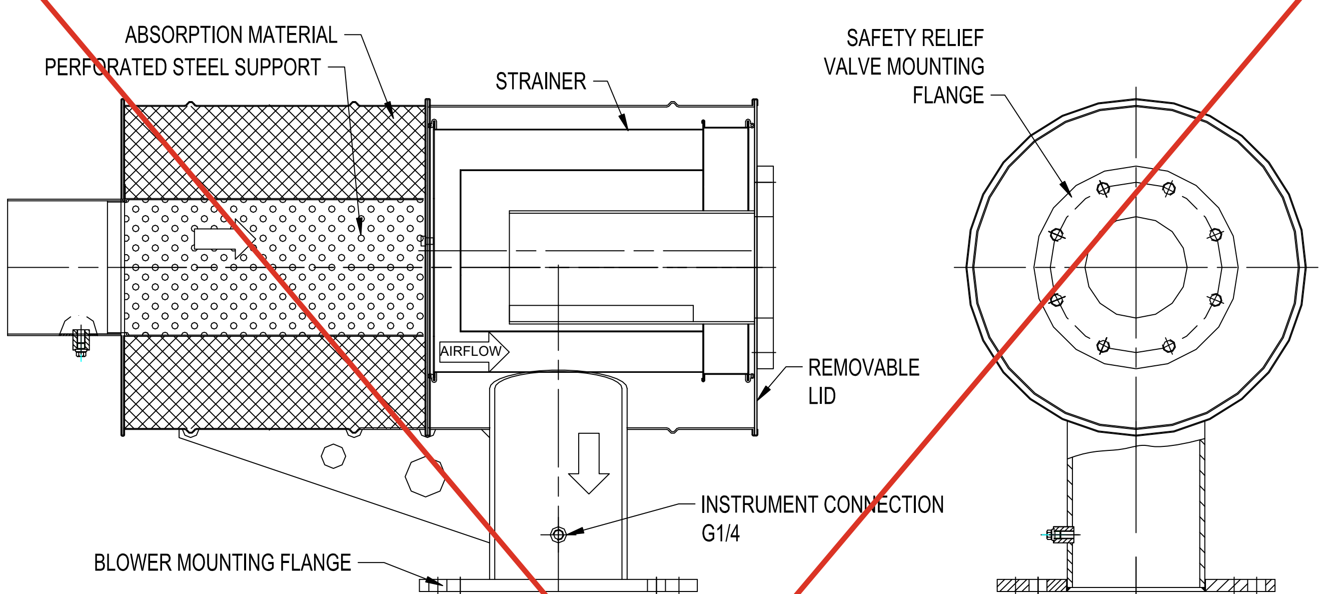
Casing:	Powder coated (RAL# 5001) Carbon Steel Maximum operating data: 60 °C (140 °F) and – 70 mbar (-2.07"Hg) Removable maintenance lid is held in place with quick release clamps
Absorption material:	Flame retardant, polyester based urethane foam, grey in color, secured in place with perforated steel
Filter element:	Thermally bound, food safe, polyester fibers, free of PVC, white in color Filter element mounts with a quick release turn and lock arrangement.

Performance:

Filtration class: G4 per EN 779 (greater than 90% of synthetic dust particles), equivalent to ASHRAE 52.2 MERV 7 (50-70% @3-10 microns)
Pressure-drop of the entire silencer and clean filter at the maximum allowable flow: 10 mbar (0.15 psi)
Pressure drop filter element: 5 mbar (2" WC) clean, or replace at 45 mbar max. (18" WC)
Noise reduction: 10-15 dB mean noise reduction across audible octave bands

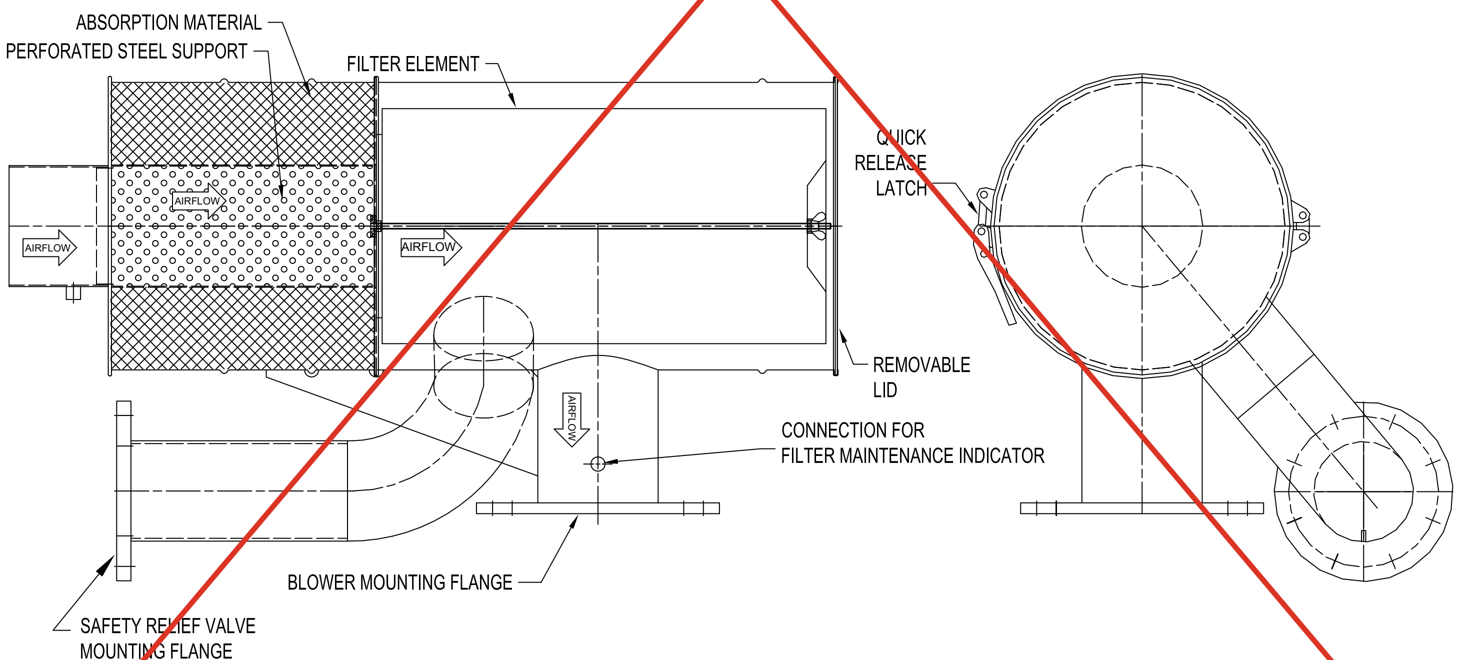
G5 Vacuum Inlet Silencer w/ Internal Strainer (No Filter)

DN 80 - DN 200



G5 Vacuum Inlet Filter/ Silencer

DN 80 - DN 200



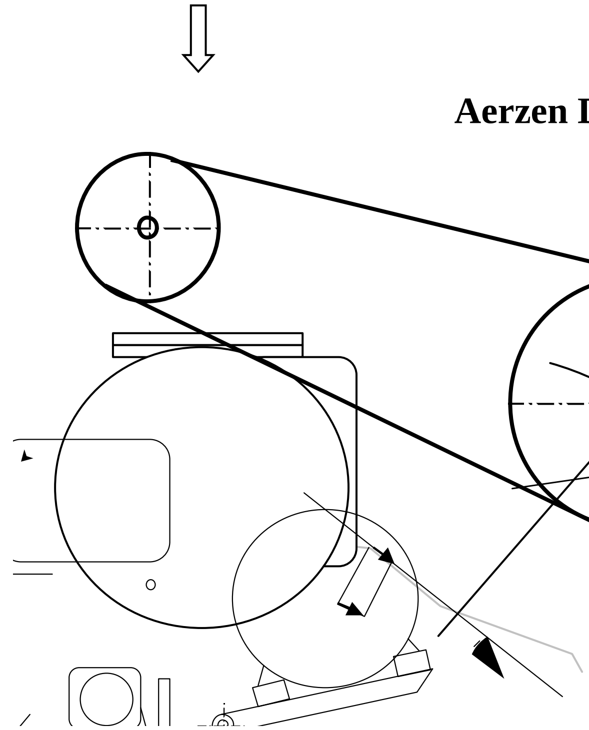
G5-WA Inlet Silencer Part Numbers

Filter nominal size	DN-50	DN-80		DN-100	DN-125	DN-150		DN-200	DN-250	DN-300
Blower size	**GM 3S**	**GM 4S GM 7L**	**GM 10S**	**GM 10S GM 15L**	**GM 25S**	**GM 30L GM 35S**	**GM 50L**	**GM 50L GM 60S**	**GM 80L GM 90S GM 100S**	**GM 130L/ GM 150S**
Pressure Filter / Silencer Assembly	182111	182112	182113	182114	182115	182116	182117		183114	184444/ 184443
Pressure Replacement Filter Element	2000049284	2000049285		2000049286		2000049287	2000049288		2000049289	2000049289 (x2)
Vacuum Inlet Silencer Assembly (No Filter)	182119	182120	182121	182122	182123	182124		182125	N/A	
Vacuum Filter / Silencer Assembly	N/A	184238001	184239001	184234001	184235001	186234000		184252001	N/A	
Vacuum Replacement Filter Element	N/A	2000008104		2000008109		185662		2000008113	N/A	

G5 (Original) Inlet Silencer Part Numbers

Filter nominal size	DN-50	DN-80		DN-100	DN-125	DN-150		DN-200	DN-250	DN-300
Blower size	**GM 3S**	**GM 4S GM 7L**	**GM 10S**	**GM 10S GM 15L**	**GM 25S**	**GM 30L GM 35S**	**GM 50L**	**GM 50L GM 60S**	**GM 80L GM 90S GM 100S**	**GM 130L GM 150S**
Filter / Silencer Assembly	175018	178810	173924	173882	173883	174143	173925		176294	N/A
Replacement Filter Element	2000049284	2000049285		2000049286		2000049287	2000049288		2000049289	2000049289 (x2)

Aerzen Delta Blower + G5

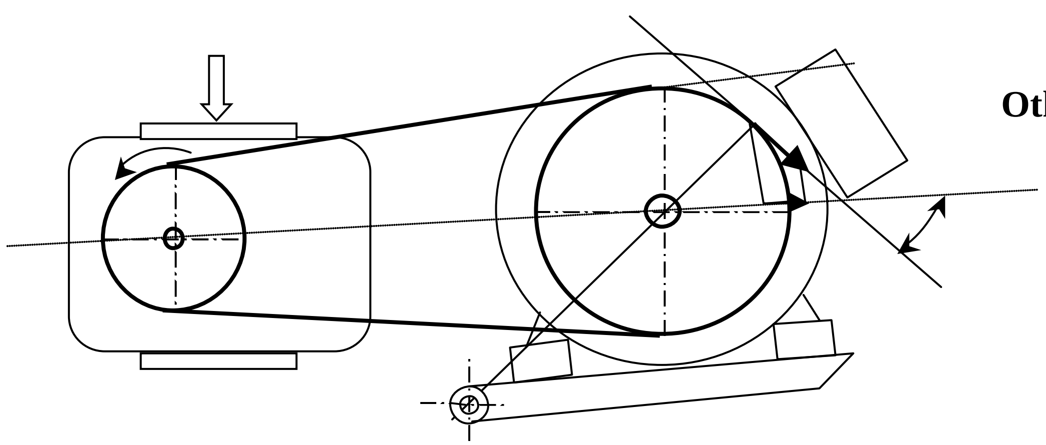


The drive configuration of the Aerzen Delta Blower is such that any change in the belt length (due to belt stretching) results in a nearly proportional displacement of the motor. Therefore, the motor weight alone can be used reliably for automatic belt tension adjustment.

This, however, is not achievable with a different geometry, such as shown below: In such cases, a slight change in the belt length requires a much greater displacement of the motor making a manual adjustment necessary. Improper adjustment leads to belt failure and other, more significant damages can follow.

Our belt tensioning principle offer two more benefits to the user, which are superior to any other system offered: We do not need any other tensioning mechanisms to tension the belts. This eliminates further wear and tear items that the user does not have to maintain or even check up on. Secondly, we have eliminated the need for re-aligning the motor upon changing belts. The motor stays put and is merely pivoted up and down during a belt change.

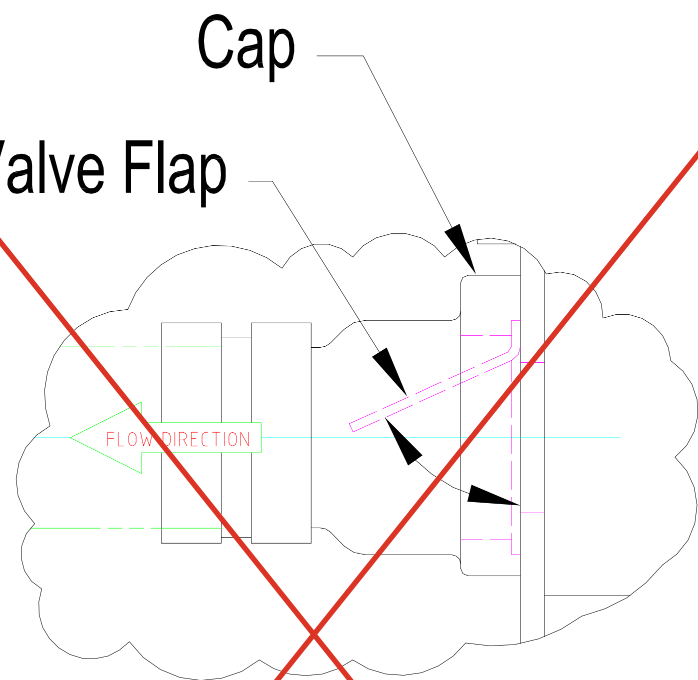
Others



DN-50 Check Valve

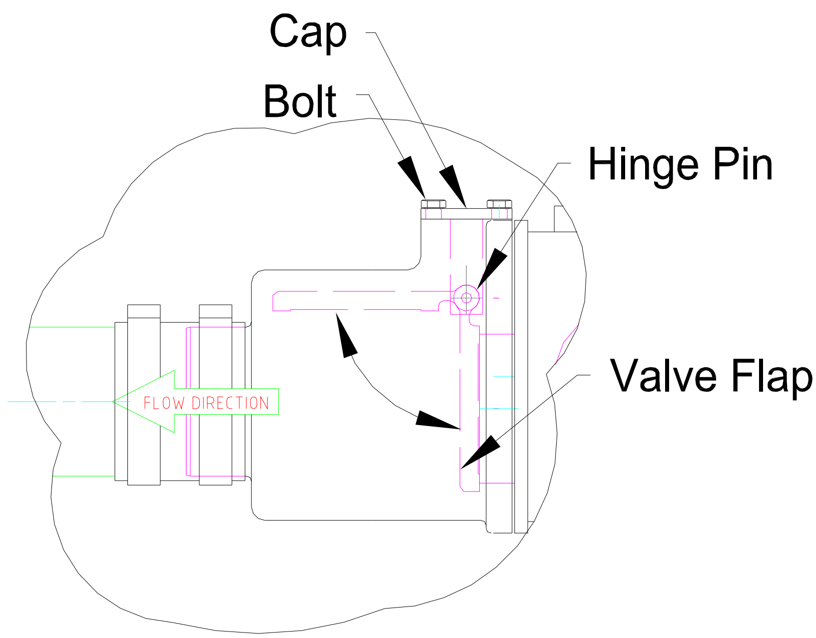
Description: The DN-50 check valve is a full-bore, cast aluminum housing with an embedded Viton flap sandwiched between the connection housing and the baseframe. The hinge is integrated to the rubber and closes naturally by gravity without use of a spring. Operating range is up to 150°C or 302°F.

Check Valve Assembly w/ Viton flap P/N: **146756**



Check Valve - DN-80 Through DN-300

Description: Housed in the connecting housing is a full-bore, steel embedded in rubber check-valve that closes naturally by gravity without use of spring. The check-valve flap can easily be pulled out for inspection, maintenance or replacement without disconnecting the piping: removing the bolts and lifting the cap.



Materials of construction:

Temperature	Flap Sealing Material
Up to 149 °C (300 °F)	EPDM (standard)*
Up to 200 °C (392 °F)	Silicon*

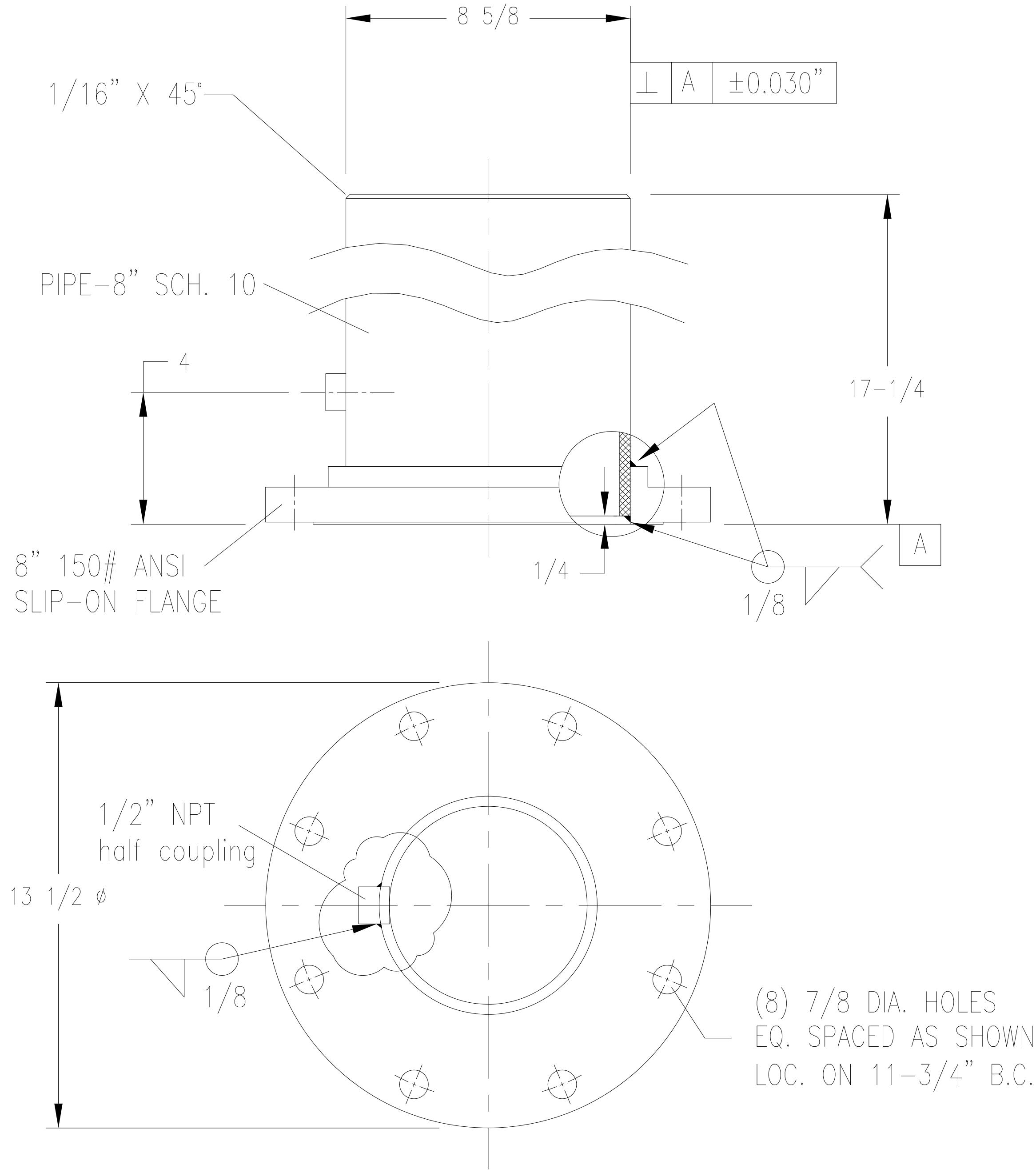
*DN-250 & DN-300 units: Stainless steel plate with outer ring made of the sealing material

**DN-200 and smaller units: Steel plate fully embedded in the sealing material

Part Numbers:

Size DN	EPDM Check Valve Assembly P/N	EPDM Flap Only P/N	Silicone Check Valve Assembly P/N	Silicone Flap Only P/N
80	178653	178647	180877	N/A
100	178654	178648	180878	178651
125	178654	178648	180878	178651
150	178655	178649	180879	178652
200	178655	178649	180879	178652
250	168705	N/A	168711	N/A
300	158608	N/A	178266	N/A

Discharge



NOTES

1. STD TOLER: UNLESS O'WISE NOTED
   FRACTIONAL = ±1/32
   .X=±0.03 .XX=±0.01 .XXX=±0.005
   ANGULAR = ±1/4° (INCL IMPLIED 90°)
   WELDMENTS = ±1/16
2. BREAK ALL SHARP EDGES
3. AIR TIGHT ASSEMBLY
4. POWDER COAT AERZEN RIVER ROCK BLUE (RAL 5001)
5. NO POWDER COAT ON INSIDE OF PIPE OR FLANGE FACE

NONE = without coupling
–01 = with coupling

NAVISION #:	21–002827–14
DRAWING NO.	PA–005100–08–14 REV "C"

AERZEN USA CORP.
108 Independence Way, COATESVILLE PA 19320
(610) 380–0244 PH, (610) 380–0278 FX

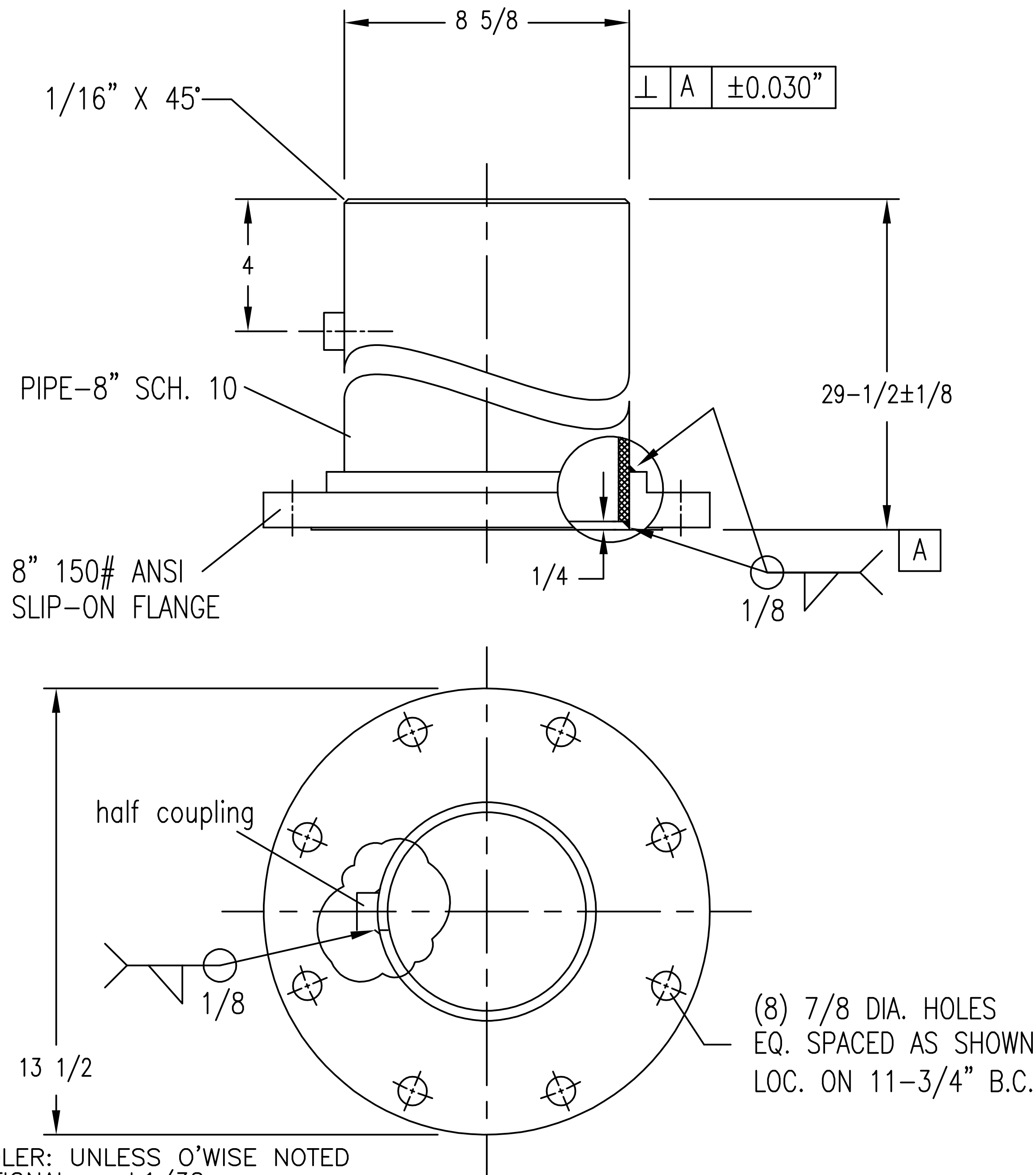
TITLE
STUB PIPE – CARBON STEEL
8" PIPE X 8" FLANGE X 17–1/4" LONG

SCALE	DATE	DRAWN BY	CHECKED BY
MODEL SPACE 1:1	08/27/2009	J. P. SHIELDS	D.L.M.

NOTICE:

THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF AERZEN USA INC. AND ITS SUBSIDIARIES AND SHALL NOT BE REPRODUCED BY ANY MEANS IN WHOLE OR IN PART OR USED AS THE BASIS FOR MANUFACTURE WITHOUT WRITTEN PERMISSION.

Inlet



NOTES

1. STD TOLER: UNLESS O'WISE NOTED
   FRACTIONAL = ±1/32
   .X=±0.03 .XX=±0.01 .XXX=±0.005
   ANGULAR = ±1/4° (INCL IMPLIED 90°)
   WELDMENTS = ±1/16
2. BREAK ALL SHARP EDGES
3. AIR TIGHT ASSEMBLY
4. POWDER COATED RIVER ROCK BLUE
5. DO NOT PAINT INSIDE OF PIPE (D)
6. DO NOT PAINT FLANGE RAISED FACE

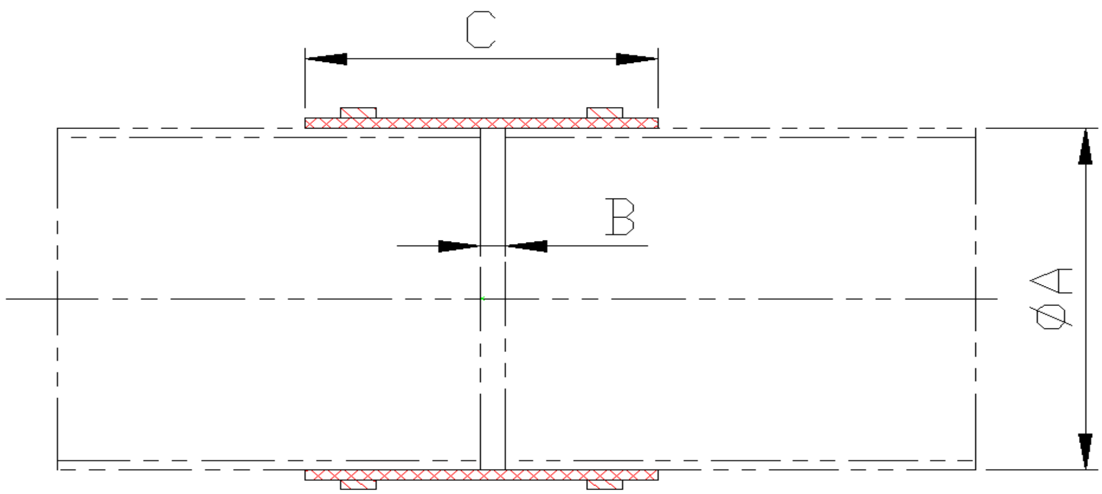
NONE = without coupling
–01 = with 1/2"NPT coupling
–02 = with G3/8 coupling

NAVISION #:	21–002827–08 & 21–002827–08–XX
DRAWING NO.	PA–005100–08–08 REV "D"

AERZEN USA CORP.
108 Independence Way, COATESVILLE PA 19320
(610) 380–0244 PH, (610) 380–0278 FX

TITLE
STUB PIPE – CARBON STEEL
8" PIPE X 8" FLANGE X 29–1/2" LONG

SCALE	DATE	DRAWN BY	CHECKED BY
MODEL SPACE 1:1	11/01/2007	J. P. SHIELDS	D.L.M.



Nominal Pipe		Sleeve	Pipe O.D A		End Clearance B		Maximum Misalignment		Sleeve Length C		# of clamps	Clamp P/N
DN	USA	P/N	mm	in.	mm	in.	mm	in.	mm	in.		
50	2”	159127	60.3	2-3/8	10	3/8	3	.12	50	2	2	168036
80	3”	159128	88.9	3-1/2	10	3/8	3	.12	100	4	2	163238
100	4”	159129	114.3	4-1/2	10	3/8	3	.12	100	4	2	169603
125	5”	162677	139.7	5-1/2	10	3/8	5	.20	150	6	2	162923
150	6”	159131	168.3	6-5/8	10	3/8	5	.20	150	6	4	165903
200	8”	159132	219.1	8-5/8	10	3/8	5	.20	150	6	4	168658
250	10”	159134	273	10-3/4	15	5/8	7	.28	200	8	4	159353
300	12”	159135	323.9	12-3/4	20	3/4	11	.43	200	8	4	160404
400	16	157607	406.3	16	20	3/4	15	.59	300	12	4	157608

Technical Data

Maximum operating pressure: 1.2 bar g (17.4 psig)

Test pressure: 2.4 bar (34.8 psig)

Operating temperature –40 to 180° C (-40 to 356° F)

Materials

Silicone Rubber with embedded woven fiber reinforcement up to DN-300

Perbunan rubber in DN-400

60 +/- 5 Shore A

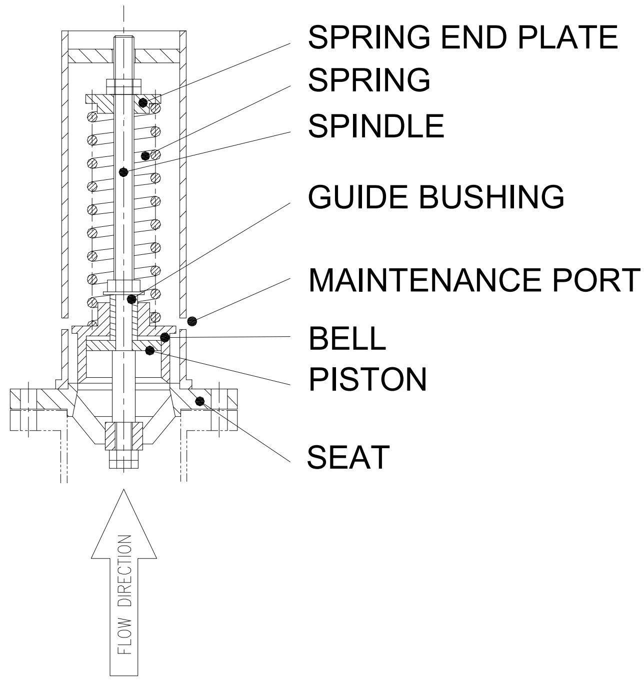
Shelf-life: up to 20 years, under clean, cool & dry conditions

CAUTION:

- Pipe misalignment could cause leaks and premature failure of the sleeve.
- It is imperative to maintain the recommended pipe-end clearance for the pipe connection to retain its flexibility and reduce the transmission of noise and vibrations from the blower package to the process piping.

Description:

The Pressure Relief Valve is designed for use with air or inert gasses to protect the blower and its accessories from damage in the event of excessive pressure. It is not to be used as a pressure regulating device. It contains a spring-loaded valve guided by a spindle and surrounded by a protective sheath that is capable of venting the entire volume flow of the blower. In positive pressure machines, it is installed downstream from the positive displacement blower and before the check valve or any shut-off valve. In vacuum applications, it is installed on the intake side of the blower.



QTY	DESCRIPTION	MATERIAL
1	Connection Flange or Thread with Valve Seat	Grey Cast Iron
1	Valve Spindle	Carbon Steel
1	Bell	Brass
1	Spring End Plate	Carbon Steel
2	Hex Nut	Carbon Steel

QTY	DESCRIPTION	MATERIAL
2	Guide Nut	Carbon Steel
1	Spring	Spring Steel
1	Valve Disc / Piston	Brass
1	Valve Guide / Bushing	Brass
1	Cover	Aluminum

Technical Data:

Maximum Temperature: 150° C (302° F)

Conforms to PED 97 / 23 / EG

Maximum Pressure: 1.1 Bar (15.9 PSIG)

Valve Characteristic: Proportional

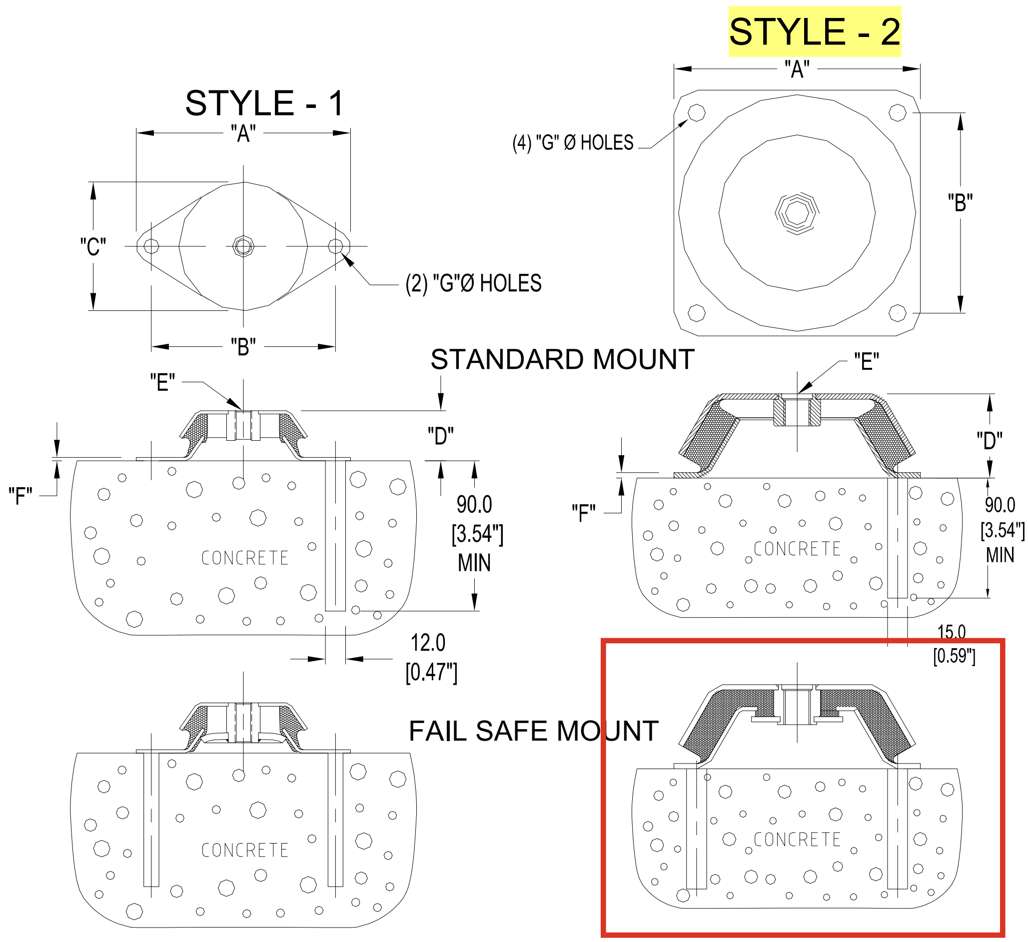
Pressure Rise: 10%

Relief Valves

Nominal Package Size	Blower Designation	Valve Size	Positive Pressure Valve Connection	Vacuum Valve Connection
DN-50	GM 3S	DN -50	G-2” External	DN-50 PN 16 Flange
DN-80	GM 4S			
	GM 7L			
	GM 10S			
DN-100	GM 10S	DN-80	G-3” External	DN-80 PN 16 Flange
	GM 15L			
DN-125	GM 25S			
DN-150	GM 30L	DN-125	DN-125, PN16 Flange	DN-125, PN16 Flange
	GM 35S			
	GM 50L			
DN-200	GM 50L			
	GM 60S			
DN-250	GM 80L	DN-150	DN-150, PN16 Flange	DN-150, PN16 Flange
	GM 90S			
	GM100S			
DN-300	GM 130L	DN-150	DN-150, PN16 Flange	DN-150, PN16 Flange
	GM 150S			

Maintenance:

Periodically inspect for free movement of the valve. While the machine is stopped and the motor locked out, insert flat blade screw drivers into both maintenance ports and lift the valve. Remove the screw drivers and visibly ensure the valve is properly seated. When operated in clean environments, inspect valve either every six months or 1000 run hours, whichever occurs sooner. In dusty conditions, inspect every month. Refer to document G4-002 for complete operating instructions.



Only (1) anchor per foot is required for Standard mounts, anchor each hole ("G") for Fail-safe mounts.

Standard mounts are not recommended for use where negative loads occur, (marine or earthquake zones) use Fail-safe mounts or contact Aerzen for alternates.

All vibrations isolators have a natural frequency that will not interfere with the fundamental blower package frequencies.

Baseframe	Standard P/N	Fail Safe P/N	Style	A (mm)	B (mm)	C (mm)	D (mm)	E	F (mm)	G (mm)	Maximum Load Per Foot		Recommended Anchor
											KN	Lbf	Aerzen P/N
DN-50	184818	184818	1	127	110	77	30	M10	2	9	1,4	315	200053552
DN-80													
DN-100	176394	184819	1	127	110	77	30	M10	2	9	2	450	200053552
DN-125													
DN-150	177128	184820	2	168	132	-	50	M16	4	13	4	899	120835000
DN-200			2	184	150	-	60	M20	4.5	13	9	2023	120835000
DN-250	184821	184821	2	184	150	-	60	M20	4.5	13	9	2023	120835000
DN-300													

Tri-Vent® Series P09

Intake Filter Silencers

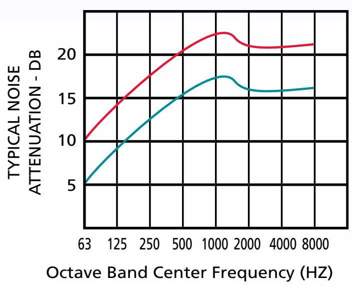
No Compromise

For a generation, everyone assumed that high-efficiency filters increased maintenance costs, and the only way to make a filter element last longer was to allow more dirt to pass through. This is known as "the filtration compromise."

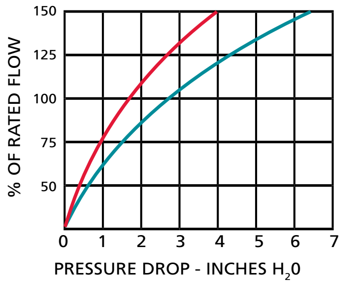
Tri-Vent® technology makes no compromise. Our high-efficiency filters reduce energy consumption, and our exclusive Enduralast® Synthetic Media provide optimal filter element life in the harshest environments.

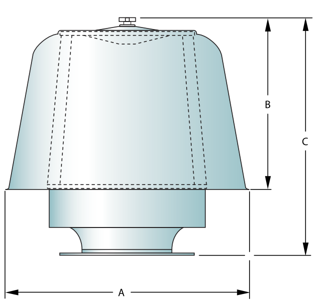
Reduce cost, reduce weight, and reduce maintenance. Don't compromise.

TYPICAL NOISE ATTENUATION



FLOW CURVE



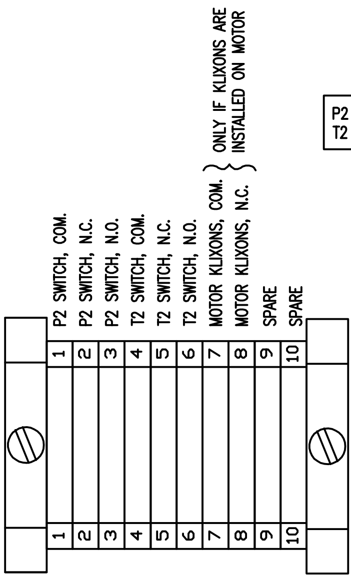


Model #	Enduralast® Element Number: Ultra Synthetic, 99.97% eff. @ 1-μ (nom)	Enduralast® Element Number: Hi-Flow Synthetic, 98% eff. @ 10-μ (nom)	FLG Size	Nominal Dimensions: A	Nominal Dimensions: B	Nominal Dimensions: C	Rated Flow SCFM	Weight
P09RG-	E045773	E047933	3"	16	8	18	600	30
P09RH-	E045773	E047933	4"	16	8	18	900	30
P09RR-	E045773	E047933	5"	16	8	18	1100	30
P09RI-	E045773	E047933	6"	16	8	18	1350	30
P09RI-	E045774	E047934	6"	26	11	21	2000	50
P09RI-	E045775	E047935	6"	27	15	25	2250	60
P09RJ-	E045774	E047934	8"	26	11	21	2500	60
P09RJ-	E045775	E047935	8"	27	15	25	2900	70
P09RJ-	E045776	E047936	8"	28	20	29	3300	75
P09RK-	E045774	E047934	10"	26	11	21	3750	70
P09RK-	E045775	E047935	10"	27	15	25	4000	75
P09RK-	E045776	E047936	10"	28	20	29	4250	80
P09RL-	E045775	E047935	12"	27	15	25	5150	80
P09RL-	E045776	E047936	12"	28	20	29	6500	85
P09RL-	E045777	E047937	12"	38	26	35	8250	90
P09RM-	E045777	E047937	14"	38	26	35	12,000	105
P09RN-	E045777	E047937	16"	38	26	35	15,000	115
P09RS-	E045777	E047937	18"	38	26	35	18,000	125

Options

- 3-6" NPT connections
- Wire Mesh Medium, 60% eff. @ ISO Fine Dust
- Stainless steel or aluminum
- Custom fittings
- Special coatings
- FDA/USDA standards
- HEPA/ULPA
- Over 75 media types

SECTION 4



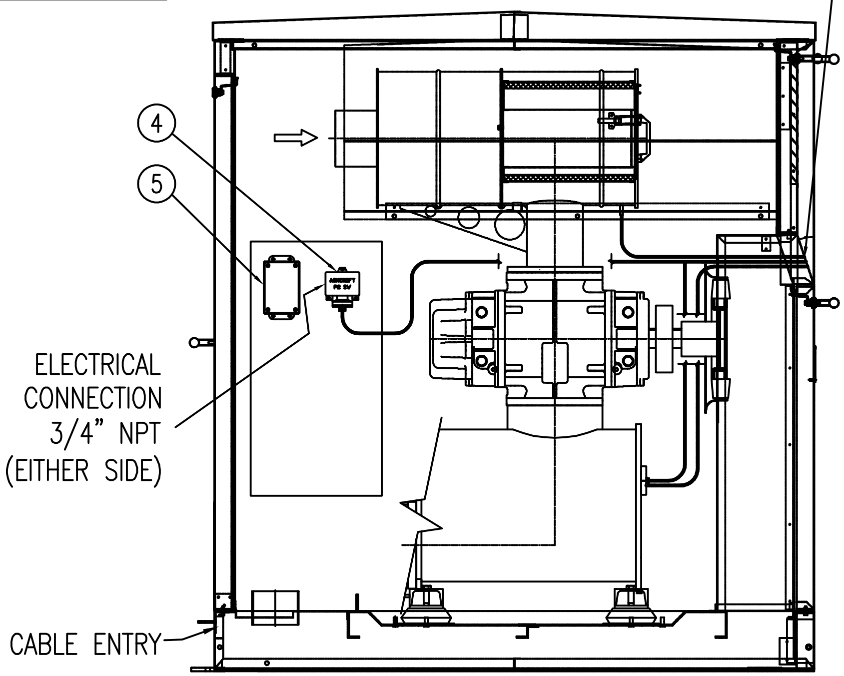
CUSTOMER CONNECTION SIDE

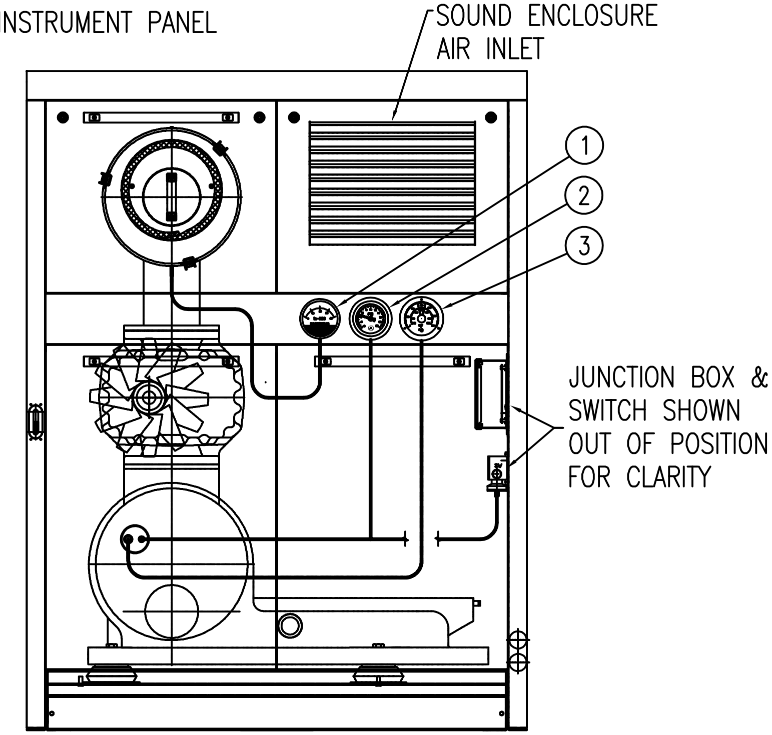
RATED: 30VDC/250VAC @ 2.0A

DETAIL

TERMINAL BLOCK DIAGRAM FOR JUNCTION BOX

P2 = DISCHARGE PRESSURE
T2 = DISCHARGE TEMPERATURE





FRONT PANEL

NOTES:
1. ALL PRESSURE GAUGES & SWITCHES ARE INSTALLED WITH PULSATION DAMPERS. (EXCEPT IF GAUGE HAS A LIQUID FILL)

MAIN COMPONENTS

ITEM	DESCRIPTION	PART NO.
1	FILTER MAINTENANCE INDICATOR	21–006757
2	DISCHARGE PRESSURE GAUGE	21-010129
3	DISCHARGE TEMPERATURE GAUGE/SWITCH	21–006756
4	DISCHARGE PRESSURE SWITCH	21–000746–02
5	JUNCTION BOX	21–000990_06X04_01

AERZEN

AERZEN USA CORP.
108 Independence Way, COATESVILLE PA 19320
(610) 380–0244 PH, (610) 380–0278 FX

TITLE

G-5 BLOWER - INSTR. (S.E.)

FILTER MAINTENANCE INDICATOR
DISCHARGE PRESSURE GAUGE & SWITCH
DISCHARGE TEMPERATURE GAUGE/SWITCH

DATE	DRAWN BY:	CHECKED BY:	P.M. APPROVAL :	SCALE:
07/12/2017	RJP	DLM	–	MSPACE 1 :1

DRAWING NO:	REVISION NO:	SHEET:
G5–IM–PS07–4001–00	D	1/1

Series PCS

ALL STAINLESS STEEL LOW PRESSURE GAUGE

REOTEMP's Series PC low pressure gauges offer accurate and reliable measurements of gaseous media. Offered with stainless steel internals, the Series PC is designed to withstand corrosive media and ensure a long-lasting instrument.

PC25S1

PC40S1

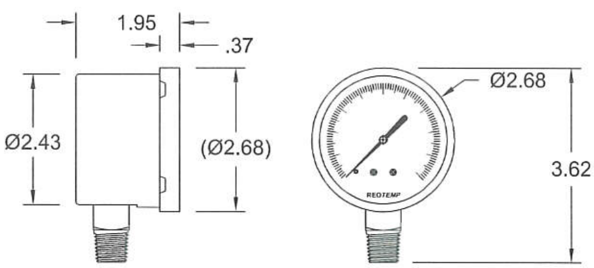
PC60S1

Dials | Custom Logo | Diaphragm Seal Compatible

FEATURES / BENEFITS

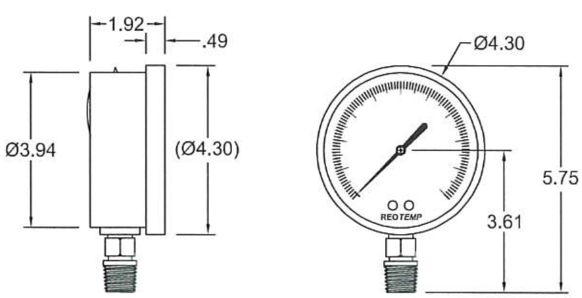
- Sensitive Diaphragm/Capsule Mechanism
- All-Welded 316 Stainless Steel Capsule and Socket
- Easy-Access Zero Reset Screw on Dial

ASME B40.100 | NACE



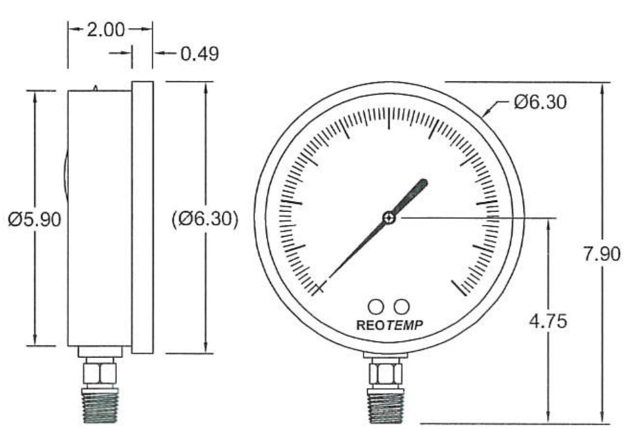
PC25S1

*dimensions in inches



PC40S1

*dimensions in inches



PC60S1

*dimensions in inches

SPECIFICATIONS

Construction Materials:

Non Wetted
- Case: 304SS
- Ring: 304SS, Bayonet Twist-Off
- Dial: White Aluminum, Black Letters

Wetted
- Capsule: 316LSS
- Socket: 316SS

Case-to-Socket
- Screw Connection
- Vented Case

Lens
- Tempered Safety Glass (Standard), Plastic, or Laminated Safety Glass

Temperature Limits:

Ambient: -40°F — 150°F

Process: -40°F — 200°F

Process Temperature Limits When Assembled with a Diaphragm Seal

-60°F — 350°F Direct Mount

-100°F — 750°F Remote Mount or Cooling Tower

*Exact temperature limits will depend on diaphragm seal & fill fluid.

Accuracy: 2-1.6-2%

Fillable: No

Restrictor Screw: Yes

Weight: 2.5" = 0.5 lbs
4" = 1.1 lbs
6" = 2.1 lbs

Maximum Working Pressure:
Stable = 100%
Momentary = 130% of scale

ALL STAINLESS STEEL LOW PRESSURE GAUGE

HOW TO ORDER: Choose options to build a part number. For example: PC40S1A2P52-D-T-HV

PC40	S	1	A	2	P52	-D	-T	-HV
DIAL SIZE	CASE TYPE	CAPSULE & SOCKET	MOUNT TYPE	CONNECTION	RANGE CODE	CASE FILL	LENS	OPTIONS

DIAL SIZE
- **PC25** = 2.5"
- **PC40** = 4"
- **PC60** = 6"

CASE TYPE
- **S** = 304SS Case & Bezel w/ Removable Bayonet, Zero Correction on Dial
- C = crimped ring 304SS

CAPSULE & SOCKET
- **1** = 316SS
- 2 = copper alloy

MOUNT TYPE (PC25)
- **A** = Bottom
- **B** = Bottom/Rear Flange
- ***C** = Center Back
- ***D** = Center Back "U" Clamp
- ***E** = Center Back/Front Flange

CONNECTION (PC25)
- **4** = 1/4" NPT

MOUNT TYPE (PC40, PC60)
- **A** = Bottom
- **B** = Bottom/Rear Flange
- ***C** = Lower Back
- ***E** = Lower Back/Front Flange

CONNECTION (PC40, PC60)
- **4** = 1/4" NPT
- **2** = 1/2" NPT

RANGE CODE

See Master Range Code Sheet on Page 46

Common Ranges
- **P50** = 0-10 in H_2O
- **P51** = 0-15 in H_2O
- **P52** = 0-30 in H_2O
- **P53** = 0-60 in H_2O
- **P54** = 0-100 in H_2O
- **P55** = 0-160 in H_2O
- **P56** = 0-200 in H_2O

Available Ranges
- 10" to 300" Water Column
- Gauge Pressure, Vacuum, or Compound

Standard Units
- in H_2O

Available Units
- kPa
- inHg
- mbar
- mmHg
- psi
- oz/in²
- mmH_2O
- & more

P905 = -40..0 "H20

CASE FILL

Case is Not Fillable
- **-D** = Dry

LENS
- **-T** = Tempered Safety Glass (std)
- **-P** = Plastic
- **-S** = Laminated Safety Glass

OPTIONS
- **-HV** = Hi-Vis™ Dial
- **-OX** = Cleaned for O_2 Service
- **-C3** = 3 pt. Calibration Certificate
- **-TS** = Stainless Steel Tag
- **-NC** = NACE Compliance Certificate
- **-PM** = Positive Material Identification Certification
- **-R5** = 1.5% Full Scale Accuracy (Not Available on Compound Ranges)

*Non-standard configuration

Diaphragm Seal Suitability Guide

Low pressure capsule gauges are very sensitive and require diaphragm seals with high fluid displacement. If a diaphragm seal is required to isolate the process fluid from the pressure gauge, the following seal model types are available for the Series PC.

Diaphragm Seal Model

High Displacement

Total Gauge Span* (in H_2O)

	10"	15"	20"	30"	40"	60"	100"	160"	200"	300"
W6	X	X	X	X	X	X	S	S	T	T
W7	X	X	X	S	S	T	T	T		
V5	X	S	S	T	T	T	T	T		
T6	X	X	X	X	X	S	S	S	S	S

*Total gauge span is additive of negative and positive pressures.

Example: -15 - 0 - 30 psi = 45 psi span

- (green) Assembly will function correctly with minimal accuracy degradation.
- T Assembly will function correctly given stable temperature.
- S Assembly is highly sensitive to orientation and temperature variance. REOTEMP cannot guarantee a stated accuracy.
- X Assembly will not work. The diaphragm does not displace enough fill fluid to drive the pressure gauge.

PRESSURE GAUGE RANGES AND CODES

SPECIAL RANGE TYPES

Receiver Ranges

Code	Element	Dial Range
P60	3-15psi	0-100%
P61	3-15psi	0-10 sq rt
P62	3-15psi	0-100% & 0-10 sq.rt.

Refrigerant Ranges

Code	Dial Range	Refrigerant
N06	-30inHg to 160psi	Ammonia
R06	-30inHg to 160psi	R134A
R06A	-30inHg to 160psi	R22
R06C	-30inHg to 160psi	R404A
N07	-30inHg to 200psi	Ammonia
N08	-30inHg to 300psi	Ammonia

Tank Level Ranges

Code	Range
F14	0-24ft H2O
F15	0-30ft H2O
F15C	0-40ft H2O
F16	0-60ft H2O
F165	0-100ft H2O

LOW PRESSURE RANGES (PC SERIES ONLY)

inH_2O		oz/in^2		inH_2O & oz/in^2		mbar		psi	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
Low Pressure Ranges									
P50	0-10	Z50	0-6	Q50Z	0-10 inH_2O & 0-6 oz/in^2				
P51	0-15	Z51	0-8			M51	0-40		
P49	0-20	Z49	0-10	Q49C	0-20 inH_2O & 0-12 oz/in^2				
P515	0-25	Z52E	0-15						
P52	0-30			Q52N	0-30 inH_2O & 0-18 oz/in^2	M521	0-70	I52	0-1
P525	0-40	Z52	0-20	Q525W	0-40 inH_2O & 0-24 oz/in^2	M525	0-100		
P53	0-60	Z53	0-30	Q53	0-60 inH_2O & 0-35 oz/in^2	M53F	0-150	I53	0-2
P54	0-100	Z54	0-60	Q54B	0-100 inH_2O & 0-60 oz/in^2	M54	0-250	I54	0-3
P55	0-160					M55	0-400	I55	0-5
P56	0-200	Z56	0-100	Q56C	0-200 inH_2O & 0-115 oz/in^2	M56	0-500	I56	0-7
Vacuum Ranges									
P88	-10-0	Z88	-6-0	Q88	-10/0 inH_2O & -6/0 oz/in^2				
P90	-30-0	Z90	-20-0	Q90	-30/0 inH_2O & -18/0 oz/in^2	M905	-100-0	I90	-1-0
P91	-60-0	Z91	-30-0	Q91	-60/0 inH_2O & -35/0 oz/in^2	M94	-200-0	I91	-2-0
P92	-100-0	Z92	-60-0	Q92	-100/0 inH_2O & -60/0 oz/in^2	M95	-400-0		
Compound Ranges									
P7A	-5/0/5	Z7A	-3/0/3			M71	-20/0/20		
P70	-10/0/10			Q70C	-10/0/10 inH_2O & -6/0/6 $ozin^2$	M72E	-30/0/30		
P71	-15/0/15					M72	-40/0/40		
P72	-20/0/20	Z72	-10/0/10	Q72C	-20/0/20 inH_2O & -12/0/12 oz/in^2			I73	-1-0-1
P73	-30/0/30			Q73C	-30/0/30 inH_2O & -18/0/18 oz/in^2	M735	-100/0/100	I74	-2-0-2
P74	-60/0/60	Z745	-30/0/30					I55U	-3/0/3
P75	-100/0/100			Q75B	-100/0/100 inH_2O & -60/0/60 oz/in^2			P14C	-5/0/5

DIFFERENTIAL PRESSURE RANGES (DP GAUGES ONLY)

psid		inH_2Od		bard		mbard		kPad	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
PD1	0-1	ID10	0-10	BD1	0-1	MD40	0-40	AD2.5	0-2.5
PD3	0-3	ID20	0-20	BD1.6	0-1.6	MD60	0-60	AD6	0-6
PD5	0-5	ID30	0-30	BD2.5	0-2.5	MD100	0-100	AD10	0-10
PD10	0-10	ID50	0-50	BD4	0-4	MD160	0-160	AD25	0-25
PD20	0-20	ID100	0-100	BD6	0-6	MD250	0-250	AD40	0-40
PD50	0-50	ID150	0-150	BD7	0-7	MD400	0-400	AD100	0-100
PD100	0-100	ID200	0-200	BD11	0-11	MD600	0-600	AD250	0-250
PD200	0-200	ID400	0-400	BD55	0-55	MD1000	0-1000	AD700	0-700
PD6000	0-6000			BD400	0-400				

PRESSURE GAUGE OPTIONS

		Heavy-Duty Industrial Gauges				Process Gauges			Stainless Steel Case Industrial Gauges			Commercial Gauges		Low Pressure Capsule Gauges			Test Gauges
Part #	Description	PR25	PR35	PR40	PR60	PT45P	PT45T	PI45	PM	PG**C	PG**S	PD15/20/25	PD35/40	PC25N	PC25S	PC40/45/60	PL60/45
	CASE FILL OPTIONS																
-G	Glycerin Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-W	Glycerin Water Filled Case (65/35)	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-S	Silicone Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-T	Teflon-coated Movement (No case fill)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
	LENS OPTIONS																
-P	Plastic Lens	STD	✓	✓	✓	✓	✓	STD	STD	STD	✓	✓	MQ	✓	✓	✓	✓
-T	Tempered Safety Glass Lens	✓	STD	STD	STD	STD	STD	N/A	N/A	N/A	STD	N/A	N/A	N/A	STD	STD	STD
-S	Laminated Safety Glass Lens	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-G	Plain Glass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	MQ	MQ	N/A	MQ	STD	N/A	N/A	N/A	N/A
	POINTER OPTIONS																
-RP	Red Pointer	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-MP	Min/Max Pointer (Drag Hand)	✓	N/A	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-MQ	Min/Max Pointer (Tamper-proof)	✓	N/A	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-RH	Red Set Hand (Manual Adjustment)	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-EC	Electrical Contacts	N/A	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DIAL OPTIONS																
-CL	Custom Logo Dial	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	✓
-HV	Hi-Vis Dial	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	N/A
-CB	Color Band	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-CP	Color Pie	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-DM	Dial Marking	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-LP	Removable Lens Protector	N/A	N/A	N/A	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CALIBRATION OPTIONS																
-R1	Upgrade to 1% FS Accuracy	✓	✓	STD	STD	N/A	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-R2	Upgrade to 0.5% FS Accuracy	N/A	N/A	✓	✓	STD	STD	STD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-R5	Upgrade to 1.5% FS Accuracy	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	N/A
-C1	1pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C3	3pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C5	5pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-CX	10pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	STD
-CS	Calibration Sticker (No logged pts.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
	TAG OPTION																
-TS	Stainless Steel Tag (1-10 Characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TM	Stainless Steel Tag (11-80 characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TP	Paper Tag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CERTIFICATION OPTIONS																
-CM	General Material Conformance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-NC	Certificate of NACE Compliance	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
-PM	Positive Material Identifiaction Certificate (PMI)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-HT	Hydrostatic Test per ASME B31.3 (5 min)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-LC	Argon Leak Check Certificate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	CLEANING OPTIONS																
-DG	Degreased - Wiped Clean of Oils, Shipped in Sealed Bag	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓
-OX	Cleaned for Oxygen Service per ASME B40.1	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-OY	Cleaned for Oxygen Service per MIL-STD-1330D	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓

✓	Indicates that the option is available with the model.	N/A	Indicates the option is not available with this model.
STD	Indicates standard options with no additional cost.	MQ	Minimum order quantity applies.

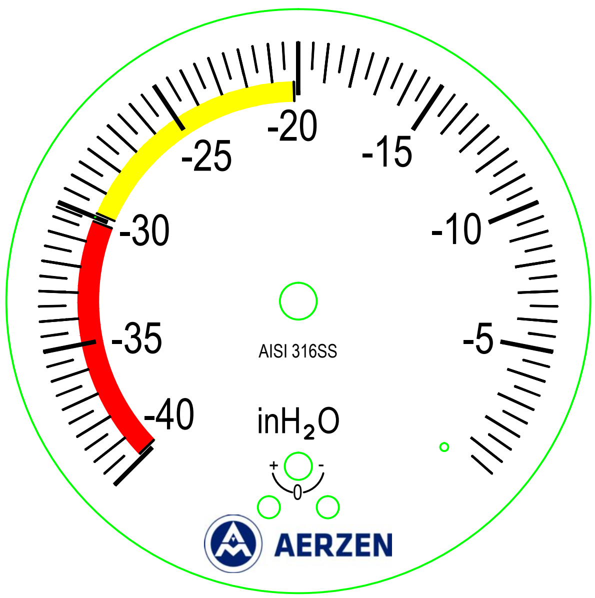
PRESSURE GAUGES

OEM CODE	TBD	PART NAME	DIAL MARKING DIAL

LOGO: AERZEN

RANGE: -40/0 inH_2O

SIZE: PC40



REOTEMP Instrument Corporation

REOTEMP INSTRUMENTS

10656 Roselle Street
San Diego, CA 92121 USA
Phone: (858) 784-0710
Fax: (858) 784-0720

DATE 1/25/19	DRAWN BY ML	APPROVED	
SIZE	CAGE CODE: 24793	DWG NO.	REV A
SCALE: NTS	FILE NAME:	SHEET 1 OF 1	

21-010129
PC40C2D4P15B-ARZ-D-P-MP

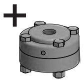
ALL STAINLESS STEEL LOW PRESSURE GAUGE

Reotemp's Series PC low pressure gauges offer accurate and reliable measurements of gaseous media. Offered with stainless steel internals, the Series PC is designed to withstand corrosive media and ensure a long-lasting instrument.

PC40S1

PC60S1

Dials | Custom Logo | Diaphragm Seal Compatible



FEATURES / BENEFITS

- Sensitive Diaphragm/Capsule Mechanism
- All-Welded 316 Stainless Steel Capsule and Socket
- Easy-Access Zero Reset Screw on Dial

ASME B40.100 NACE International

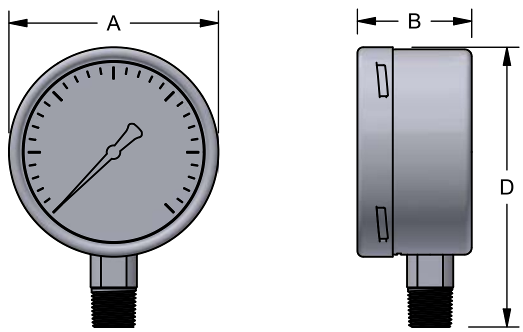
SPECIFICATIONS

Accuracy	±1.6%
Ambient Limits	-40°F/150°F
Process Limits	-40°F/200°F
Process Limits with Diaphragm Seal	-60°F/350°F (Direct Mount)* -110°F/750°F (Remote Mount or Cooling Tower)* *Exact limits depend on diaphragm seal and fill fluids.
Wetted Materials	Capsule: 316L Socket: 316L
Lens	Laminated Safety Glass (Standard) or Plastic
Other Materials	Case: 304SS Ring: 304SS, Bayonet Twist-Off Dial: White Aluminum, Black Letters Case-to-Socket: FPM O-Ring, Vented Case
Fillable	Yes, ≥ 40 in H_2O Range Span
Restrictor Screw	Yes
Maximum Working Pressure	Stable = 100% Momentary = 130% of scale
Weight	4" = 1.3 lbs, Filled 2.1 lbs 6" = 2.2 lbs. Filled 4 10"= 4.41lbs (Not Fillable)

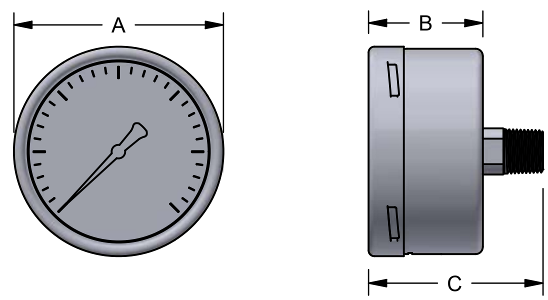
PC40/60/10S

REOTEMP

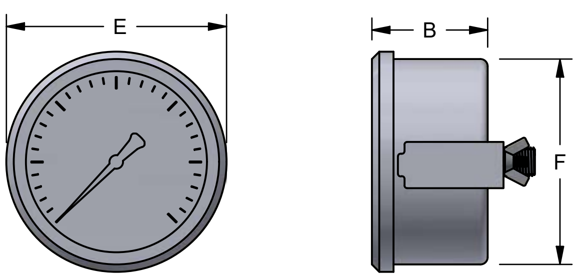
ALL STAINLESS STEEL LOW PRESSURE GAUGE



Bottom Bayonet Case

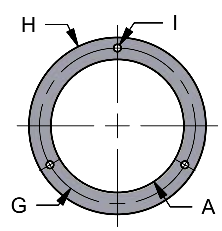


Back Connect Bayonet Case



U-Clamp Crimped Case

Recommended Panel Cutout
PC40 = 4.02" ± 0.02"
PC60 = 6.38" ± 0.02"



Mounting Flange Bayonet Case

Recommended Panel Cutout
PC40 = 4.09" ± 0.02"
PC60 = 6.46" ± 0.02"
PC10 = 10.00" ± 0.02"

Table

	A	B	C	D	E	F	G	H	I
PC40	3.98"	2.17"	3.31"	5.30"	4.17"	3.90"	4.57"	5.20"	0.19"
PC60 ≤6 inH$_2$0	6.34"	2.17"	3.31"	7.70"	6.57"	6.26"	7.01"	7.72"	0.23"
PC60 ≥10 inH$_2$0	6.34"	2.01"	3.15"	7.70"	6.57"	6.26"	7.01"	7.72"	0.23"
PC10	9.88"	2.28"	3.46"	11.44"	N/A	N/A	10.63"	11.22"	0.23"

21-010129
PC40C2D4P15B-ARZ-D-P-MP

ALL STAINLESS STEEL LOW PRESSURE GAUGE

HOW TO ORDER: Choose options to build a part number. For example: PC40S1A2P52-D-S-HV

PC40 | C | 2 | D | 4 | P15 | B | P | MP

DIAL SIZE	CASE TYPE	CAPSULE & SOCKET	MOUNT TYPE	CONNECTION	RANGE CODE	CASE FILL	LENS	OPTIONS
PC40 = 4" **PC60** = 6" **PC10** = 10"[2]	**S** = 304SS Case & Bezel w/ Removable Bayonet, Zero Correction on Dial ***C** = 304SS Crimped Case, Zero Correction on Dial Access Through Window ***T** = 316SS Case and Bezel with Removable Bayonet	**1** = 316SS 2 = Copper Alloy	**A** = Bottom **B** = Bottom/Rear Flange ***C** = Center Back ***D** = Center Back "U" Clamp[1] ***E** = Center Back/Front Flange	**4** = 1/4" NPT **2** = 1/2" NPT	P15 = 0 to 20 PSI **P504** = 0-4 in H_2O **P506** = 0-6 in H_2O **P50** = 0-10 in H_2O **P51** = 0-15 in H_2O **P52** = 0-30 in H_2O **P53** = 0-60 in H_2O **P54** = 0-100 in H_2O **P55** = 0-160 in H_2O **P56** = 0-200 in H_2O *Available Ranges* ■ 1.6" to 300" Water Column ■ Gauge Pressure, Vacuum, or Compound *Standard Units* ■ in H_2O *Available Units* ■ kPa ■ inHg ■ mbar ■ mmHg ■ psi ■ oz/in² ■ mmH_2O ■ & more *For Additional Range Codes See Page 70*	**-D** = Dry **-G** = Glycerin** Dry case, field fillable *Greater* *Case is Not Field Fillable*	**-S** = Laminated Safety Glass (Standard) **-P** = Plastic	MP = Max Pointer (Drag Hand) **-C3** = 3 pt. Calibration Certificate **-TS** = Stainless Steel Tag **-NC** = NACE Compliance Certificate **-PM** = Positive Material Identification Certification **-R1** = ± 1% Full Scale Accuracy Upgrade[3] *For Additional Pressure Gauge Options See Page 75*

*Non-standard configuration
[1]Mount type D must select case type C
[2]PC10S1 only available with mount type A
[3]≥10 in H_2O Span and Dry Case Only

Diaphragm Seal Suitability Guide

Low pressure capsule gauges are very sensitive and require diaphragm seals with high sensitivity and high fluid displacement. If a diaphragm seal is required to isolate the process fluid from the pressure gauge, the following seal model types are available for the Series PC.

Diaphragm Seal Model

High Displacement

Total Gauge Span* (in H_2O)

	10"	15"	20"	30"	40"	60"	100"	160"	200"	300"
W6	X	X	X	X	X	X	S	S	T	T
W7	X	X	X	S	S	T	T	T		
V5	X	S	S	T	T	T	T	T		
T6	X	X	X	X	X	S	S	S	S	S

*Total gauge span is additive of negative and positive pressures.

Example: -15 - 0 - 30 psi = 45 psi span

(green) Assembly will function correctly with minimal accuracy degradation.

T Assembly will function correctly given stable temperature.

S Assembly is highly sensitive to orientation and temperature variance. Reotemp cannot guarantee a stated accuracy.

X Assembly will not work. The diaphragm does not displace enough fill fluid to drive the pressure gauge.

PRESSURE GAUGE RANGES AND CODES

LOW PRESSURE RANGES (PC SERIES ONLY)

inH$_2$O		oz/in^2		inH$_2$O & oz/in^2		mbar		psi	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
Low Pressure Ranges									
P50D	0-1.6 inH$_2$O *					M50D	0-4 mbar*		
P504	0-4*					M504	0-10*		
P506	0-6*					M506	0-16*		
P50	0-10	Z50	0-6 oz/in^2	Q50Z	0-10 inH$_2$O & 0-6 oz/in^2	M50	0-25		
P51	0-15	Z51	0-8			M51	0-40		
P49	0-20	Z49	0-10	Q49C	0-20 & 0-12				
P515	0-25	Z52E	0-15			M522	0-60		
P52	0-30			Q52N	0-30 & 0-18	M521	0-70	I52	0-1 psi
P525	0-40	Z52	0-20	Q525W	0-40 & 0-24	M525	0-100		
P53	0-60	Z535	0-35	Q53	0-60 & 0-35	M53F	0-150	I53	0-2**
P54	0-100	Z54	0-60	Q54B	0-100 & 0-60	M54	0-250	I54	0-3
P55	0-160					M55	0-400	I55	0-5
P56	0-200	Z56	0-100	Q56C	0-200 & 0-115	M56	0-500	I56	0-7
Vacuum Ranges									
P88	-10-0 inH$_2$O	Z88	-6-0 oz/in^2	Q88	-10/0 inH$_2$O & -6/0 oz/in^2				
P90	-30-0	Z90	-20-0	Q90	-30/0 & -18/0	M905	-100-0 mbar	I90	-1-0 psi
P91	-60-0	Z91	-30-0	Q91	-60/0 & -35/0	M94	-200-0	I91	-2-0
P92	-100-0	Z92	-60-0	Q92	-100/0 & -60/0	M95	-400-0		
Compound Ranges									
P7A	-5/0/5 inH$_2$O	Z7A	-3/0/3 oz/in^2			M71	-20/0/20 mbar		
P70	-10/0/10			Q70C	-10/0/10 inH$_2$O & -6/0/6 oz/in^2	M72E	-30/0/30		
P71	-15/0/15					M72	-40/0/40		
P72	-20/0/20	Z72	-10/0/10	Q72C	-20/0/20 & -12/0/12	M72A	-50/0/50	I73	-1-0-1 psi
P73	-30/0/30			Q73C	-30/0/30 & -18/0/18	M735	-100/0/100	I74	-2-0-2
P74	-60/0/60	Z745	-30/0/30					I55U	-3/0/3
P75	-100/0/100			Q75B	-100/0/100 & -60/0/60			P14C	-5/0/5

**available on 4" & 6" sizes only*
***short scaled range*

PRESSURE GAUGE OPTIONS

		Commercial Gauges		Low Pressure Capsule Gauges				Test Gauges
Part #	Description	PD15/20/25	PD35/40	PC25N	PC25S2	PC25/40/60S1	PC45	PL60/45
	CASE FILL OPTIONS							
-G	Glycerin Filled Case	N/A	N/A	N/A	N/A	✓	N/A	N/A
-W	Glycerin Water Filled Case (65/35)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-S	Silicone Filled Case	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-T	Teflon-coated Movement (No Case Fill)	N/A	N/A	N/A	N/A	✓	✓	✓
-I	Inert Case Fill	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	LENS OPTIONS							
-P	Plastic Lens	✓	MQ	✓	✓	✓	✓	✓
-T	Tempered Safety Glass Lens	N/A	N/A	N/A	N/A	N/A	STD	STD
-S	Laminated Safety Glass Lens	N/A	N/A	N/A	N/A	STD	✓	✓
-G	Plain Glass	MQ	STD	N/A	STD	N/A	N/A	N/A
	POINTER OPTIONS							
-RP	Red Pointer	N/A	N/A	N/A	N/A	N/A	N/A	✓
-MP	Min/Max Pointer (Drag Hand)†	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-MQ	Min/Max Pointer (Tamper-proof)†	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-RH	Red Set Hand (Manual Adjustment)	N/A	N/A	N/A	N/A	N/A	✓	N/A
-EC	Electrical Contacts	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DIAL OPTIONS							
-CL	Custom Logo Dial	MQ	MQ	MQ	MQ	✓	✓	✓
-HV	Hi-Vis Dial	✓	✓	✓	✓	✓	✓	N/A
-CB	Color Band	MQ	MQ	MQ	MQ	✓	✓	N/A
-CP	Color Pie	MQ	MQ	MQ	MQ	✓	✓	N/A
-DM	Dial Marking	MQ	MQ	✓	✓	✓	✓	✓
-LP	Removable Lens Protector	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CALIBRATION OPTIONS							
-R1	Upgrade to 1% FS Accuracy	N/A	N/A	N/A	N/A	✓	✓	N/A
-R2	Upgrade to 0.5% FS Accuracy	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-R5	Upgrade to 1.5% or 1.6% FS Accuracy	N/A	N/A	N/A	N/A	STD	✓	N/A
-C1	1pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	N/A
-C3	3pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	N/A
-C5	5pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	N/A
-CX	10pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	
-CS	Calibration Sticker (No logged pts.)	✓	✓	✓	✓	✓	✓	N/A
	TAG OPTION							
-TS	Stainless Steel Tag (1-10 Characters)	✓	✓	✓	✓	✓	✓	✓
-TM	Stainless Steel Tag (11-80 characters)	✓	✓	✓	✓	✓	✓	✓
-TP	Paper Tag	✓	✓	✓	✓	✓	✓	✓
	CERTIFICATION OPTIONS							
-CM	General Material Conformance	✓	✓	✓	✓	✓	✓	✓
-NC	Certificate of NACE Compliance	N/A	N/A	N/A	N/A	✓	✓	✓
-PM	Positive Material Identification Certificate (PMI)	✓	✓	✓	✓	✓	✓	✓
-HT	Hydrostatic Test per ASME B31.3 (5 min)	✓	✓	✓	✓	✓	✓	✓
-LC	Argon Leak Check Certificate	✓	✓	✓	✓	✓	✓	✓
	CLEANING OPTIONS							
-DG	Degreased - Wiped Clean of Oils, Shipped in Sealed Bag	N/A	N/A	✓	✓	✓	✓	✓
-OX	Cleaned for Oxygen Service per ASME B40.1	MQ	MQ	✓	✓	✓	✓	✓
-OY	Cleaned for Oxygen Service per MIL-STD-1330D	N/A	N/A	✓	✓	✓	✓	✓
	OTHER OPTIONS							
-NR	No Restrictor Screw	N/A	N/A	N/A	✓	✓	✓	N/A

✓	Indicates that the option is available with the model.	N/A	Indicates the option is not available with this model.
STD	Indicates standard options with no additional cost.	MQ	Minimum order quantity applies.

†This option is only available with a plastic lens.

OEM CODE	TBD	PART NAME	DIAL MARKING DIAL

LOGO: AERZEN

RANGE: 0/20 psi

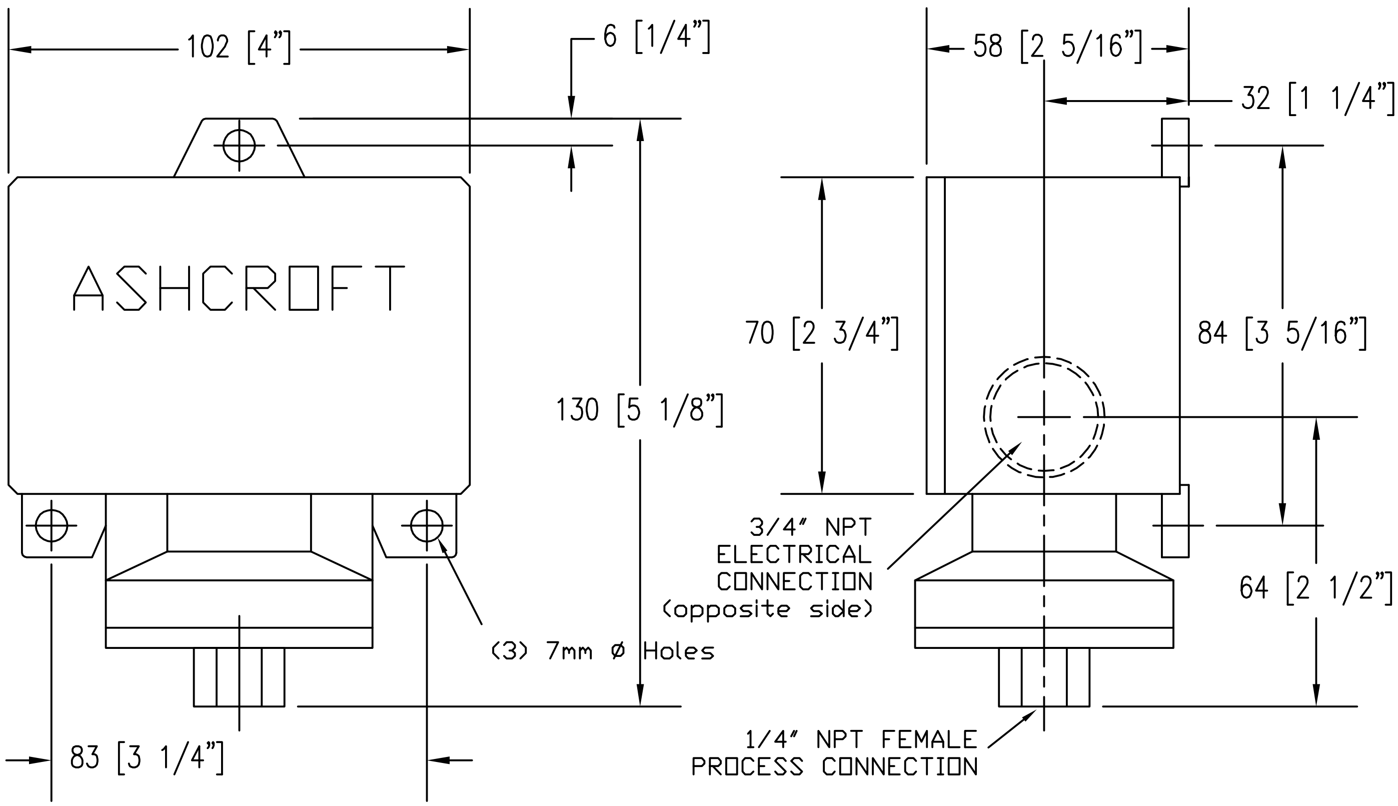
SIZE: PG40

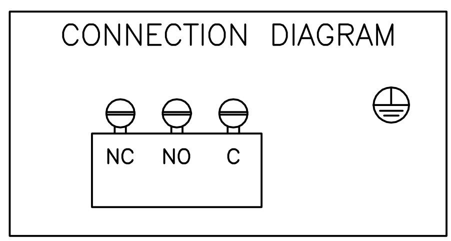
REO*TEMP* Instrument Corporation

REOTEMP INSTRUMENTS

10656 Roselle Street
San Diego, CA 92121 USA
Phone: (858) 784-0710
Fax: (858) 784-0720

DATE 1/25/19	DRAWN BY ML	APPROVED	
SIZE	CAGE CODE: 24793	DWG NO.	REV A
SCALE: NTS	FILE NAME:	SHEET 1 OF 1	





ASHCROFT TYPE B4-24-V-XRN-XJK-15 PSI

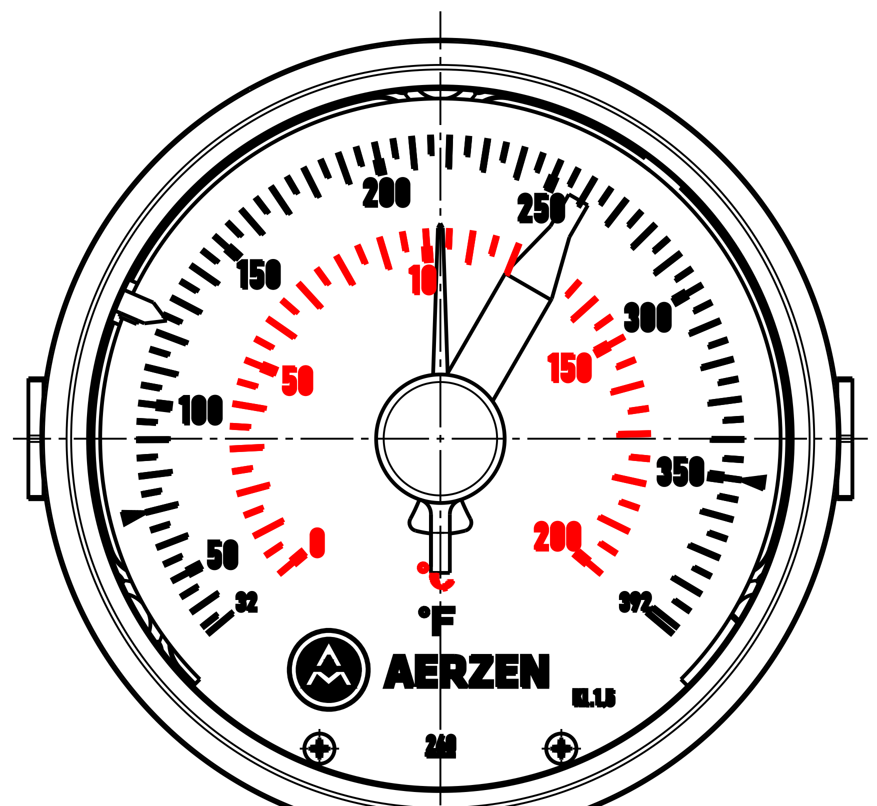
B4 = Type 400 Pressure Switch in NEMA 4X enclosure
24 = Single general purpose 15A, 110-480V switch
SPDT snap-acting,
V = Viton Actuator Seal (good for 20 to 300°F)
XRN = Internal Reference Scale
XJK = Left side conduit connection
15 = Operating Range (0 to 15 PSIG)

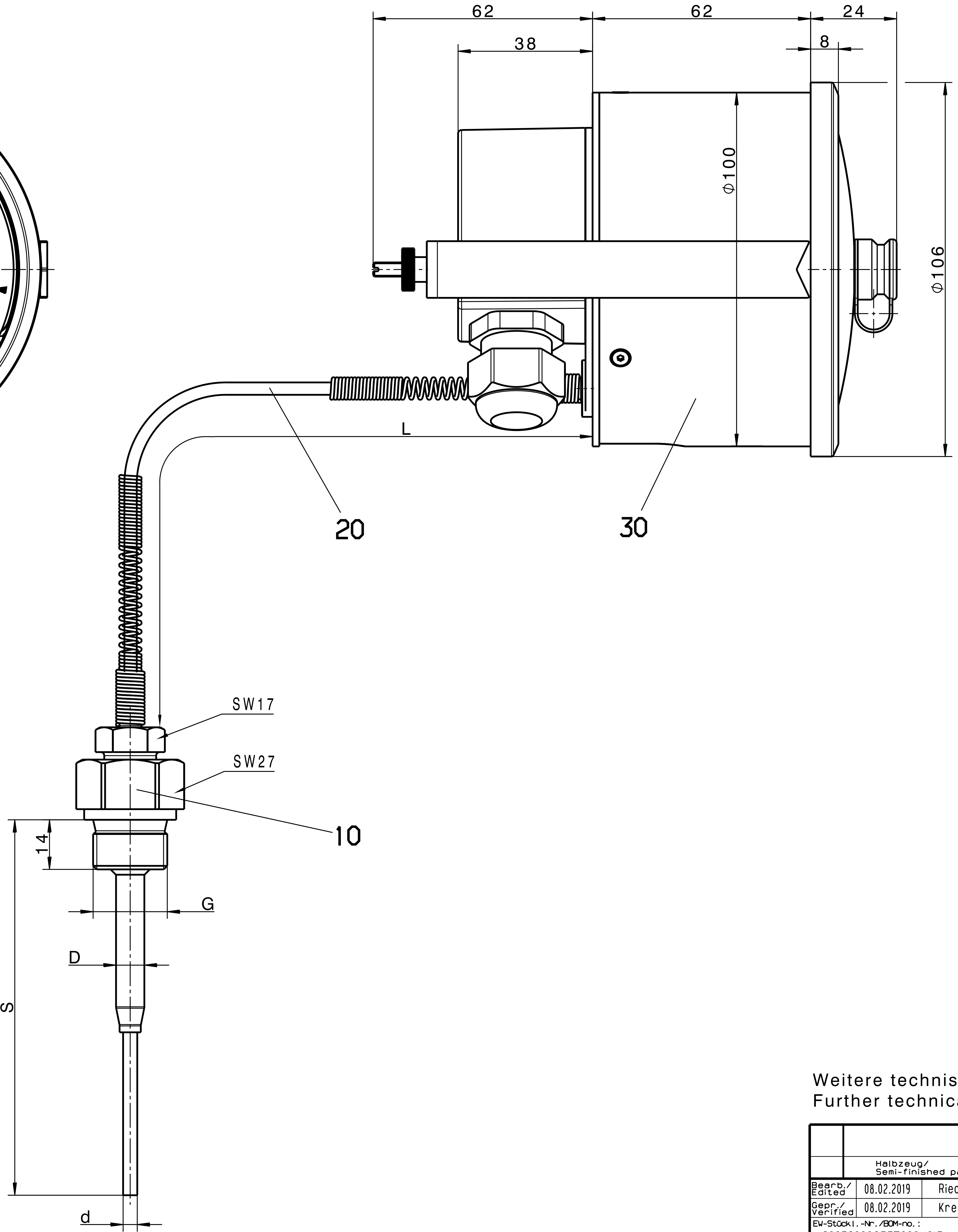
AERZEN
Aerzen USA Corp.
645 SANDS CT, COATESVILLE PA 19320
(610) 380-0244 PH, (610) 380-0278 FX
www.aerzenusa.com

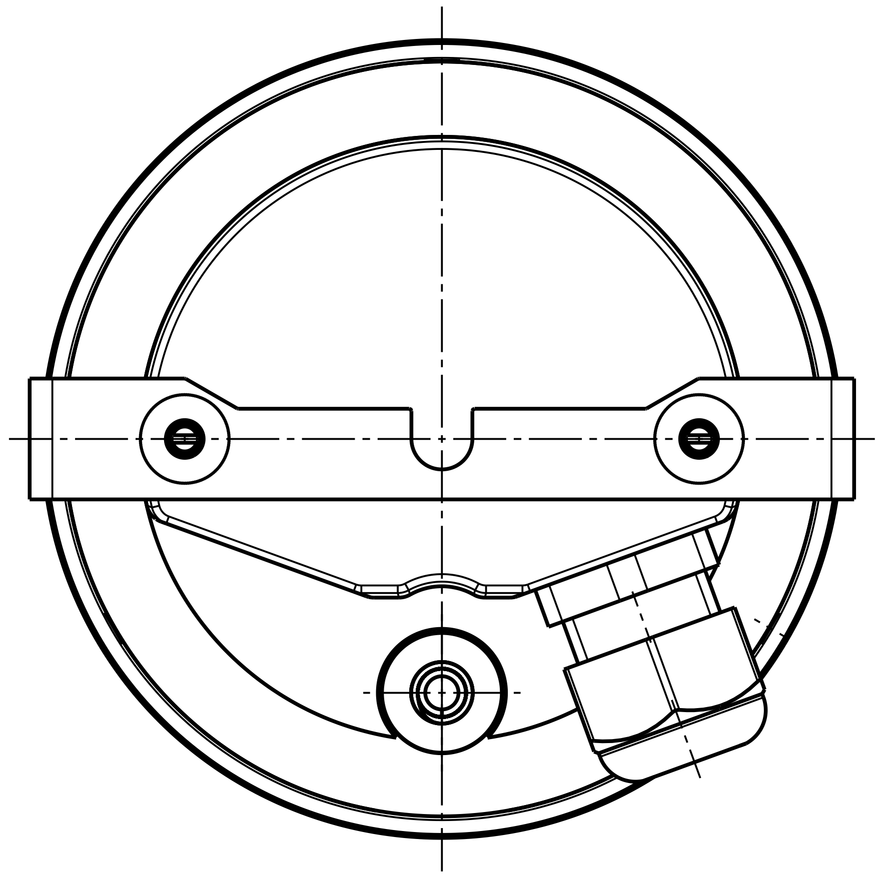
DISCHARGE PRESSURE SWITCH

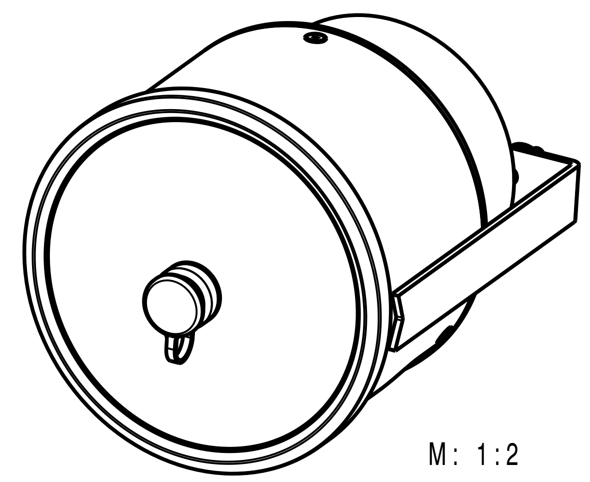
Date	Doc #		Page
May 2002	32-0021-02	revision -	1 of 1

Aerzen









Typenschlüssel/ type code: 608520/2110-832-23-4000-876-8-104-26-46-106-20/426,430,477,522

Pos.	Pos.	001
Typ	type	2110
AB [°C]	display range	0...+200
AB-Einheit	display range oneness	°F/°C
FI Typ	capillary typ	-
Werkst. Fühler	material bulb	CrNi
L [mm]	L	4000
L_2 [mm]	L_2	-
Anschluß	connection	SH 10
G Gewinde	treath	G1/2
Werkst. Anschluß	material connection	CuZn
d [mm]	d	4
D [mm]	D	8
S [mm]	S	106
Schaltausgang	switching output	SA20
TZ	extra code	426,430,477,522
Laser Nr	laser No.	2463
Weitere Angaben n. Typenblatt	more information at datasheet	60.8520
Bedienungsanleitung	user manual	B60.8520
Grundtyp	type	85.364.00.00
TN	partnumber	00717805

Weitere technische Daten nach Typenblatt 60.8520
Further technical details as per data sheet 60.8520

Halbzeug/ Semi-finished part	Werkstoff-Nr./ Material-no.	DIN-Kurzbezeichnung/ DIN-code	Oberfläche/ Surface

Bearb./ Edited	08.02.2019	Riedel	Zeigerkontakt-thermometer	02	EW-70	21.02.2019	Riedel
Gepr./ Verified	08.02.2019	Kress		01	EW-70	14.02.2019	Riedel
EW-Stückl.-Nr./BOM-no.: 60852000A53Z000K015 00718107			Zeichnungs-Nr./Drawing-no. 60852000A00Z001 K015	00	EW-70	08.02.2019	Riedel
			Ersatz für Nr./ Replace	Vers. Rev.	Änderung/ Modification	Datum/ Date	Name
JUMO GmbH & Co. KG Fulda Germany			Maße ohne Toleranzangabe/ Tol. unless otherwise specified DIN ISO 2768-m	Maßstab/Scale 1:1	Teile-Nr./Part-no.	Größe/ Size A2	Blatt/ Sheet 01/01

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Contact dial thermometer

Particularities

- Temperature controller with actual value display as panel-mounting or add-on device
- Stainless steel case with bayonet lock
- Class 1.5
- Protection class IP 53
- Case sizes ∅: 60 mm, 80 mm and 100 mm
  Front frame: 72x72 mm and 96x96 mm

Type 608520/2380

Brief description

Contact dial thermometer are devices with actual value display for temperature measurement, control and monitoring and can be used universally.

The temperature depending volume change in a measuring system filled with liquid or the temperature depending pressure change in a measuring system filled with gas is converted to a rotational movement of the actual value indicator by a bourdon tube, no transmission gear is required. The microswitch is actuated by the rotational movement of the indicator shaft via a tap system.

Type 608550/1080

Technical Data

Case and front frame	Stainless steel (1.4301)
Cover cap	Plastic (PA6), gray, UV stabilized
Protection type	IP 51 as per DIN EN 60529 (IP 53 with extra code 401)
Front pane	Acryl glass (PMMA)
Chassis	Aluminum (3.2582.05)
Scale	white, labeled in black
Display	Class 1.5 similar to DIN EN 13190
Anti-kink spring	for devices with capillary on the case and the temperature probe
Set point value setting	by set point controller in the front window
Display correction	on the rear
Limit value temperatures	for transport and storage -30°C...+70°C (for display range -40...+40°C up to max. 50°C; -30...+50°C up to max. 60°C)
Rated position	any

Technical Data

Display range (AB)	Display range in °C	Measuring range in °C	Tolerance in °C
469	-40...+40	-30...+30	1.5
643	-20...+120	-20...+120	3.0
807	0...+60	+10...+50	1.5
814	0...+100	+10...+90	1.5
818	0...+120	+20...+100	3.0
832	0...+200	+20...+180	3.0
840	0...+300	+30...+270	6.0
848	0...+400	+50...+350	6.0
854	0...+500	+50...+450	8.0
848	0...+600	+100...+500	10.0

	Liquid filling	**Gas filling**
Measuring system	Display range (AB) ≤ 350°C	Display range (AB) ÷ 400°C
Time behavior	approx. 12 s, measured in water, with a probe Ø of 6 mm made of Cu.	approx. 4 s, measured in oil, with a probe Ø of 10 mm made of stainless steel.
Ambient temperature influence effect	In % of the display range (referring to the deviation from the reference value +23°C)	
on case	0.15% of the display range per K ambient temperature change	0.05% of the display range per K ambient temperature change
on capillary (per m)	0.03% of the display range per K ambient temperature change	no influence
	Higher ambient temperature – higher temperature display – lower switching point	
Anti-kink spring	for devices with capillary on the case and the temperature probe	
Set point value setting	by set point controller in the front window	
Display correction	on the rear	
Limit value temperatures	for transport and storage -30°C...+70°C (for display range -40...+40°C up to max. 50°C; -30...+50°C up to max. 60°C)	
Rated position	any	

	standard	**Extra code (TZ) 650**
Electric contact **Type of contact**	Single-pole microswitch with mechanically actuate change-over contact	
Contact rating	AC 230V, +10/-15%, 48...63Hz, cos φ = 1 (0.6)	
	5 (1.5) A	10 (3) A
Hysteresis	approx. 1.5% of the display range	1.5 to 3% of the display range
Switching point accuracy	± 0.5% of the display range referring to the switch-off point with rising temperature	
Switching reliability	To ensure a high switching reliability, we recommend a minimum voltage of 24 V and a minimum current of 100 mA	

	standard	Design 02 and 22	**Design 10, 23 and TZ 426**	**Case ∅ 60 mm**
Electrical connection	Screw-type terminals, connection cross section up to 2.5 mm^2	Connection cable 0.5 m with screw-type terminals	Cover cap with cable screw-connection, suitable for cable Ø from 6.5 to 13 mm	Cover cap with cable screw-connection, suitable for cable Ø from 8 to 10 mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Note:

Physical and toxic features of the expansion means, which could emerge in the event of a measuring system break.

Control range with scale limit value	Hazardous reactions	Fire and explosion hazard		hazardous to waters	Information about toxicology		
		Ignition temperature	Explosion limit		irritant	dangerous to health	toxic
< +200°C		+ 355°C	0.6 - 8 V%	yes	yes	[a]	
≥ 200°C ≤ +350°C	no	+ 490°C	- -	yes	yes	[a]	no
> 350°C ≤ +500°C		no	no	no	no	no	

[a] There is currently no statement by the health authority concerning hazards to health in the event of short-term exposure and low concentration, e.g. measuring system break.

Description:

Basic type Dial contact thermometer design 21 housing size ø 100mm

Indication range 0...200 °C

Indication unit deg. F outside / deg. C inside

Capillary version FL23, copper capillary with double braiding, ø 3.6 mm

Capillary length 4000 mm

Process connection SH10, screw-in pocket, assembled

Diameter 8 mm

Thread G1/2 thread

Material of probe / CrNi 1.4571

Process connec. mat. CuZn (brass)

Insertion length 106,0 mm

Switching output SA20, one micro switch

Extra code 426 Plastic cover with cable gland M16x1,5
Extra code 430 Drag indicator
Extra code 477 Setpoint adjuster protected
Extra code 522 Customized scale

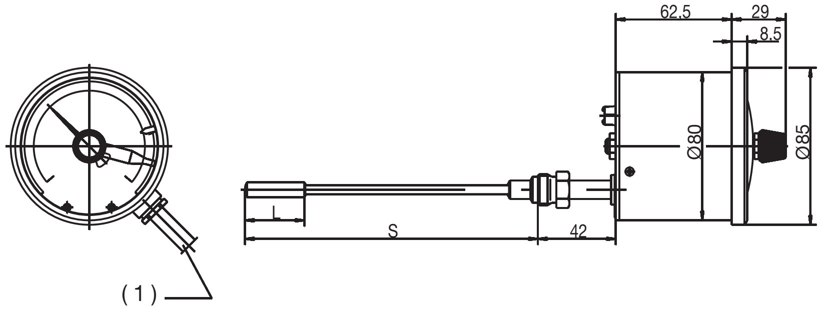
JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

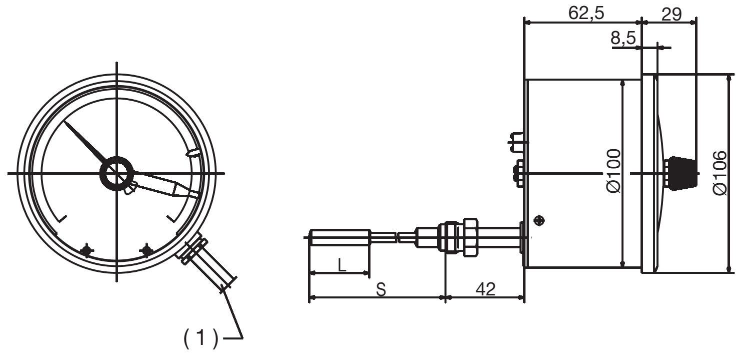
Dimensions

Type:
608520/0280



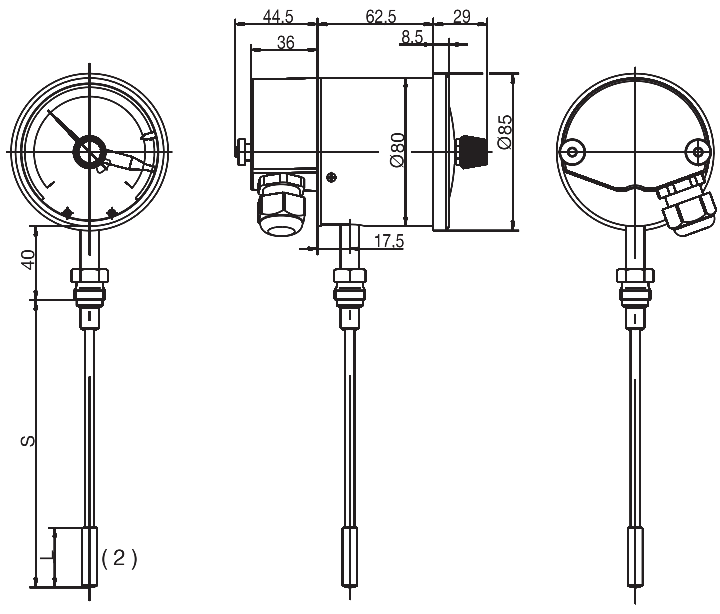
(1) Connection line 0.6 m long with screw terminal

Type:
608520/0210



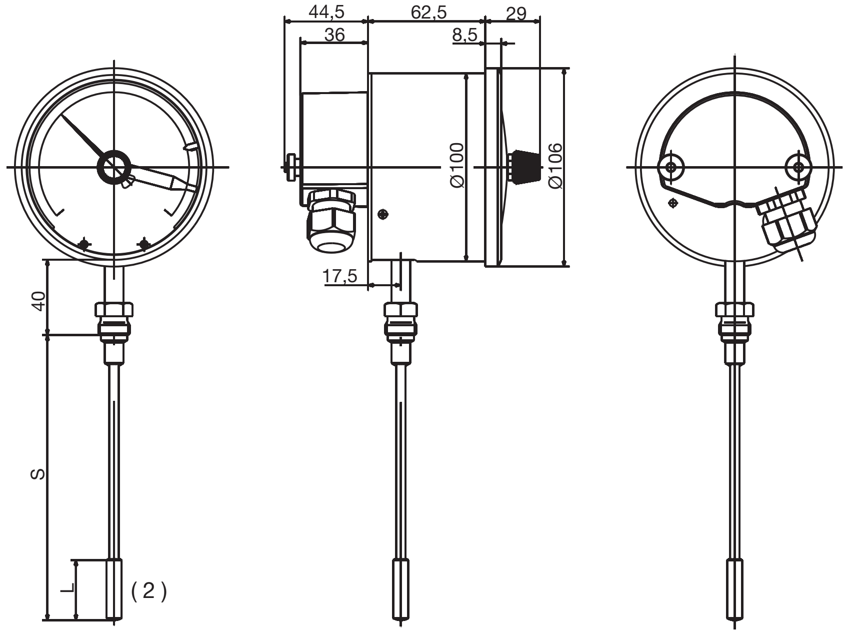
(1) Connection line 0.6 m long with screw terminal

Type:
608520/1080



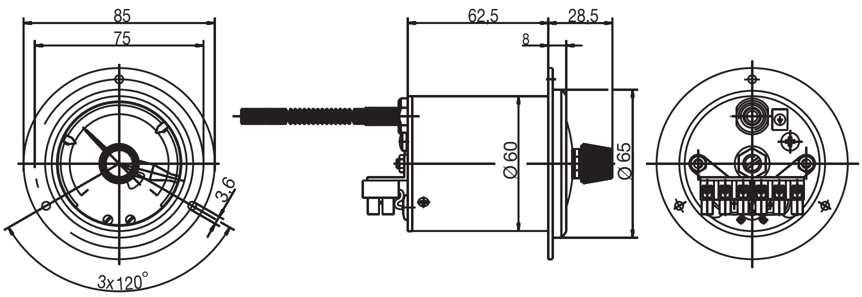
(2) active probe dimension

Type:
608520/1010



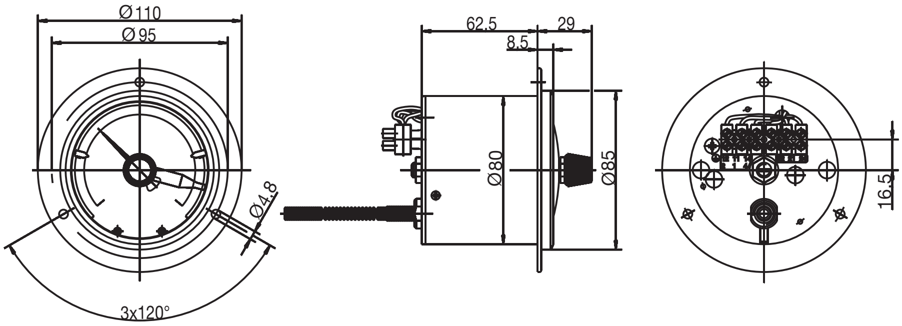
(2) active probe dimension

Type:
608520/2060



Panel cut-out for case
Ø 60 mm = $62^{+0,5}_{0}$ mm

Type:
608520/2080



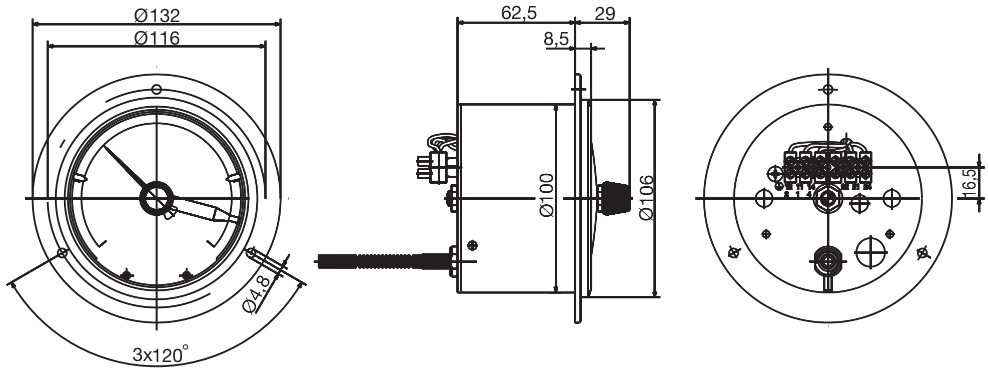
Panel cut-out for case
Ø 80 mm = $62^{+0,5}_{0}$ mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

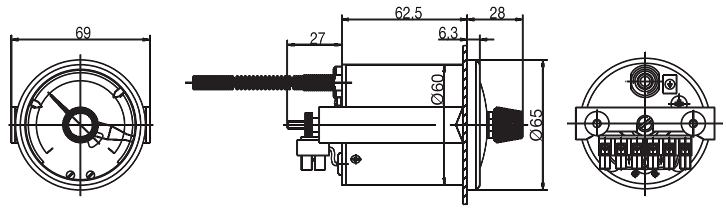
JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Type:
608520/2010



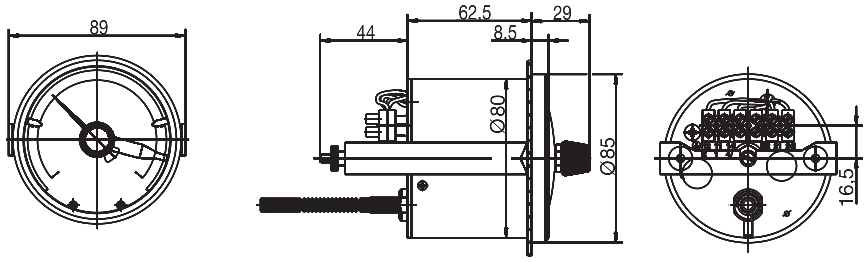
Panel cut-out for case
Ø 100 mm = $100^{+0,5}_{0}$ mm

Type:
608520/2160



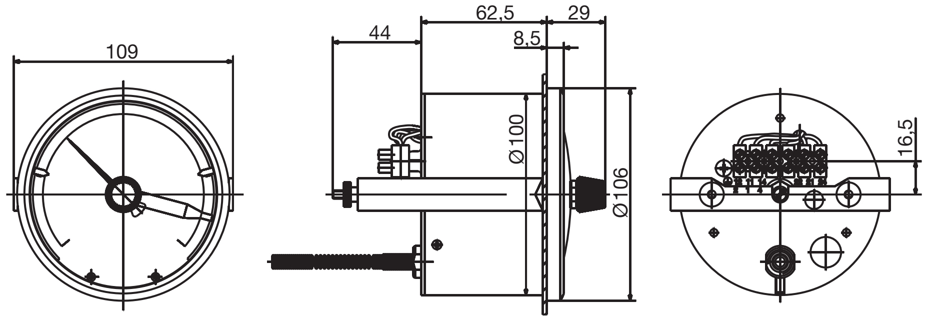
Panel cut-out for case
Ø 60 mm = $62^{+0,5}_{0}$ mm

Type:
608520/2180



Panel cut-out for case
Ø 80 mm = $62^{+0,5}_{0}$ mm

Type:
608520/2110



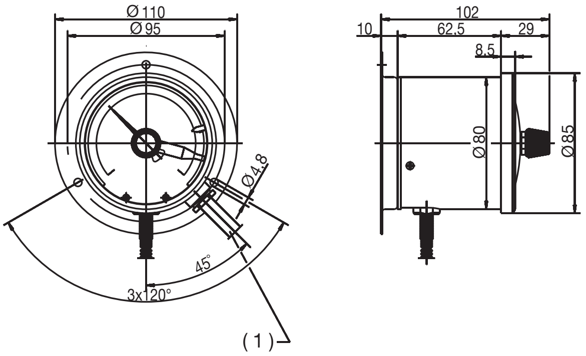
Panel cut-out for case
Ø 100 mm = $100^{+0,5}_{0}$ mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

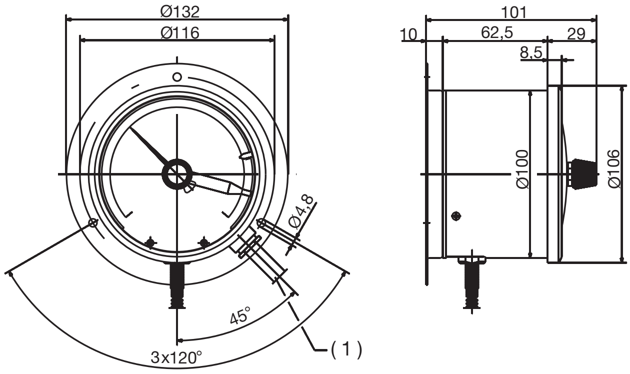
JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Type:
608520/2280



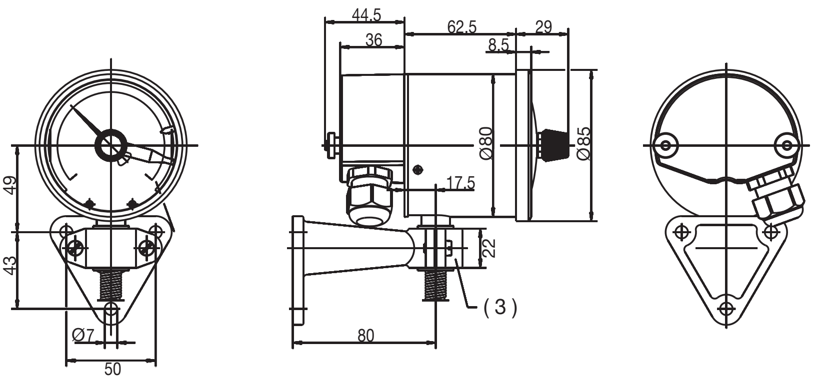
(1) Connection line 0.6 m long with screw terminal

Type:
608520/2210



(1) Connection line 0.6 m long with screw terminal

Type:
608520/2380



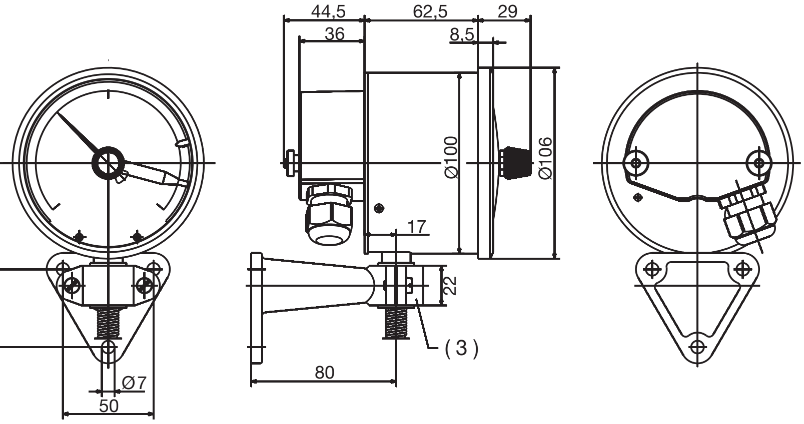
(3) Spigot Ø 20 mm

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

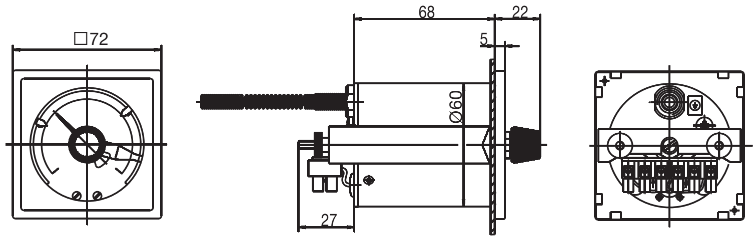
JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Type:
608520/2310



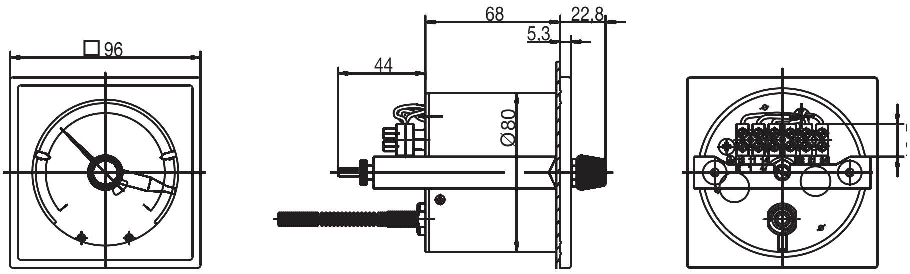
(3) Spigot Ø 20 mm

Type:
608520/2572



Panel cut-out for front frame
72 x 72 mm = Ø 62$^{+0,5}_{0}$mm

Type:
608520/2596



Panel cut-out for front frame
96 x 96 mm = Ø 82$^{+0,5}_{0}$mm oder
96 x 96 mm = 92 x 92$^{+0,5}_{0}$mm (TZ 460)

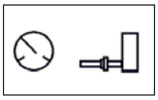
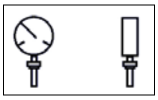
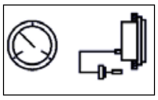
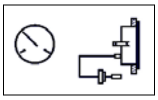
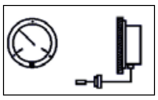
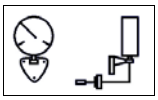
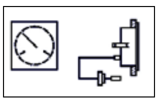
JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Order details

Order code	(1)	Basic type
608520		Mechanical Contact dial thermometer, class 1.5
608550		Mechanical Contact dial thermometer, class 1.5, Transformer version (only basic type extension 1080)

	(2)	Basic type extensions		Case size Ø
0280		Design 02		80 mm
0210				100 mm
1080		Design 10		80 mm
1010				100 mm
2060		Design 20		60 mm
2080				80 mm
2010				100 mm
2160		Design 21		60 mm
2180				80 mm
2110				100 mm
2280		Design 22		80 mm
2210				100 mm
2380		Design 23		80 mm
2310				100 mm
				Case size □
2572		Design 25		72 x 72 mm
2596				96 x 96 mm

	(3)	Display range in °C
469		-40...+40
643		-20...+120
807		0...+60
814		0...+100
818		0...+120
832		0...+200
840		0...+300
848		0...+400
854		0...+500
858		0...+600

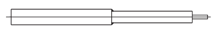
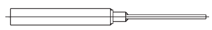
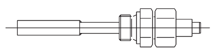
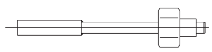
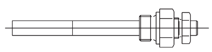
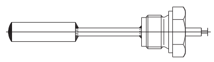
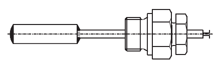
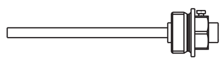
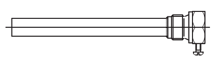
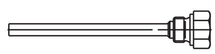
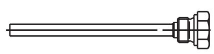
JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Order code	(4)	Capillary type (FL) [a]
00		Without (with rigid connection)
02		FL 02 Cu capillary with Cu textile braiding, approx. Ø 2.5 mm (up to AB limit value +300°C)
11		FL 11 Cu capillary with PE jacketing, approx. Ø 3.5 mm (up to AB limit value +120°C)
17		FL 17 Stainless steel capillary, approx. Ø 1.5 mm
21		FL 21 Cu capillary, approx. Ø 1.0 mm (up to AB limit value +300°C)

	(5)	Capillary [b]
0		Without (with rigid connection)
1000		1000 mm
2000		2000 mm
3000		3000 mm
4000		4000 mm
5000		5000 mm
. . . .		Special length (specifications in plain text: 1000 mm steps, maximum length 6000 mm), further lengths on request

	(6)	Process connection (PA) [a]		
750		TF 01	Temperature probe with stepped support tube	
752		TF 11	Temperature probe without support tube	
843		TA 02	Immersion tube with union nut and loose screw-connection [b]	
161		TA 03	Immersion tube with loose screw-connection	
847		TA 06	Immersion tube with displaceable clamping screw-connection on support tube [b]	
311		TA 20	Immersion tube with loose screw-connection and connection collar [b]	
872		TA 21	Immersion tube with loose screw-connection and sealing cone (only G 3/8 possible)	
873		TA 22	Immersion tube with loose pressure screw, sealing cone and loose screw-connection [b]	
874		TA 24	immersion tube with screw fitting, O ring seal and clamping screw[a b]	
401		TA 23	Immersion tube with pressure screw and contact pressure spring (only M 10x1 possible)	
913		SH 07	Screw-in sheath, multi-part, with clamping piece and locking screw (suitable for TF 01 and TF 11)	
820		SH 09	Weld-in sheath, multi-part, with clamping piece and locking screw [b] (not for FL 21 - welding collar with steel 1.4515)	
876		SH 10	Screw-in sheath, multi-part [b] (suitable for TA 21)	
871		SH 11	Screw-in sheath, multi-part [b] (suitable for TA 23)	

[a] For the description and particularities refer to data sheet 608730.
[b] Screw-in spigot as per DIN 3852, form A.

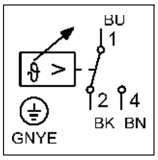
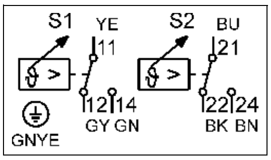
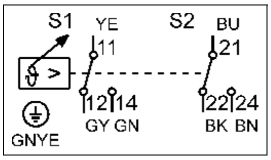
Order code	**(7)**	**Ø Process connection (PC)** [a]
6		6 mm
8		8 mm
10		10 mm
11		11 mm
12		12 mm
	(8)	**Thread type of process connection (PA)** [a]
000		Without thread (for TA 01 and TF 11)
103		Screw connection G 3/8
104		Screw-connection G 1/2
105		Screw-connection G 3/4
114		Screw-connection M 10 x 1 (only for TA 23)
	(9)	Material, probe / support tube [a]
26		Stainless steel (CrNi, 1.4571)
96		Copper (Cu) / Brass (CuZn) (up to 200°C)
95		Stainless steel (CrNi, 1.4571) - probe / Brass (CuZn) - support tube from 250°C)
	(10)	**Material of process connection (PA)** [a]
00		Without (only TF 01 and TF 11)
26		Stainless steel (CrNi, 1.4571)
46		Brass (CuZn)
	(11)	**Fitting length, process connection (PA)** [a] **(dimension "EL“ or "S“)**
0		Minimum fitting length TF 11 (active probe dimension)
50		50 mm
100		100 mm
150		150 mm
200		200 mm
. . .		Special length (specifications in plain text - 50 mm steps)

[a] For the description and particularities refer to data sheet 608730.

JUMO GmbH & Co. KG
Delivery address: Mackenrodtstraße 14
36039 Fulda, Germany
Postal address: 36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.
JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2DY, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.
6733 Myers Road
East Syracuse, NY 13057, USA
Phone: 315-437-5866
1-800-554-5866
Fax: 315-437-5860
E-mail: info.us@jumo.net
Internet: www.jumousa.com

Order code	(12)	Switching output (SA)		
20		SA 20	One contact	
21		SA 21	Two contacts	
22		SA 22	Two contacts - Sequence switch	

	(13)	Extra codes (TZ)
000		Without extra codes
430		Fly back (includes TZ 477)
426		Cover cap to protect the screw terminals against access and splashing water (standard for design 10 and 23; not for design 22; not in connection with TZ 460)
650		Microswitch 10 (3) A (AC/DC 230 V, +10/-15%, 48...63 Hz, cos φ = 1 (0.6))
518		Stop for Min. — or Max. — set point value limitation, factory set
460		Device centering for panel cut-out 92 x 92 mm (only for basic type extension 2596)
477		Set point adjustment protected by the bolted cover. Adjustment with screwdriver.
401		Protection class IP 53 as per EN 60529, includes TZ 426 and TZ 477 (not for case Ø = 60 mm and front frame 72 x 72 mm; not for design 02 and 22)
522		Customized scale

Special versions on request !

Order code

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)		(13)	
	608520	/	. . . .	-	. . .	-	. .	-	. . . .	-	. . .	-	. .	-	. . .	-	. .	-	. .	-	. . .	-	. .	/	. . .	, . . .
Order example																											
	608520	/	2010	-	818	-	21	-	2000	-	104	-	10	-	000	-	26	-	00	-	100	-	20	/	650[a]	, . . .

[a] State extra codes one after another, separated by commas.

Stock versions

Part no.	Type	Display range °C	Switching output	Temperature probe, process connection	Immersion tube mm
00455918	608550/0180-643-874-8-106-50-150-20/434-522 with fly back	-20…+120	20 (1 contact)	TF 05 d = 8 mm TA 24, G 1“, CuZn	150
00455919	608550/0180-643-874-8-106-50-150-21/434-522 with fly back		21 (2 contacts)		

Delivery within 3 working days after receipt of order

SECTION 5

Severe Duty is Standard with WEG W22 motors.

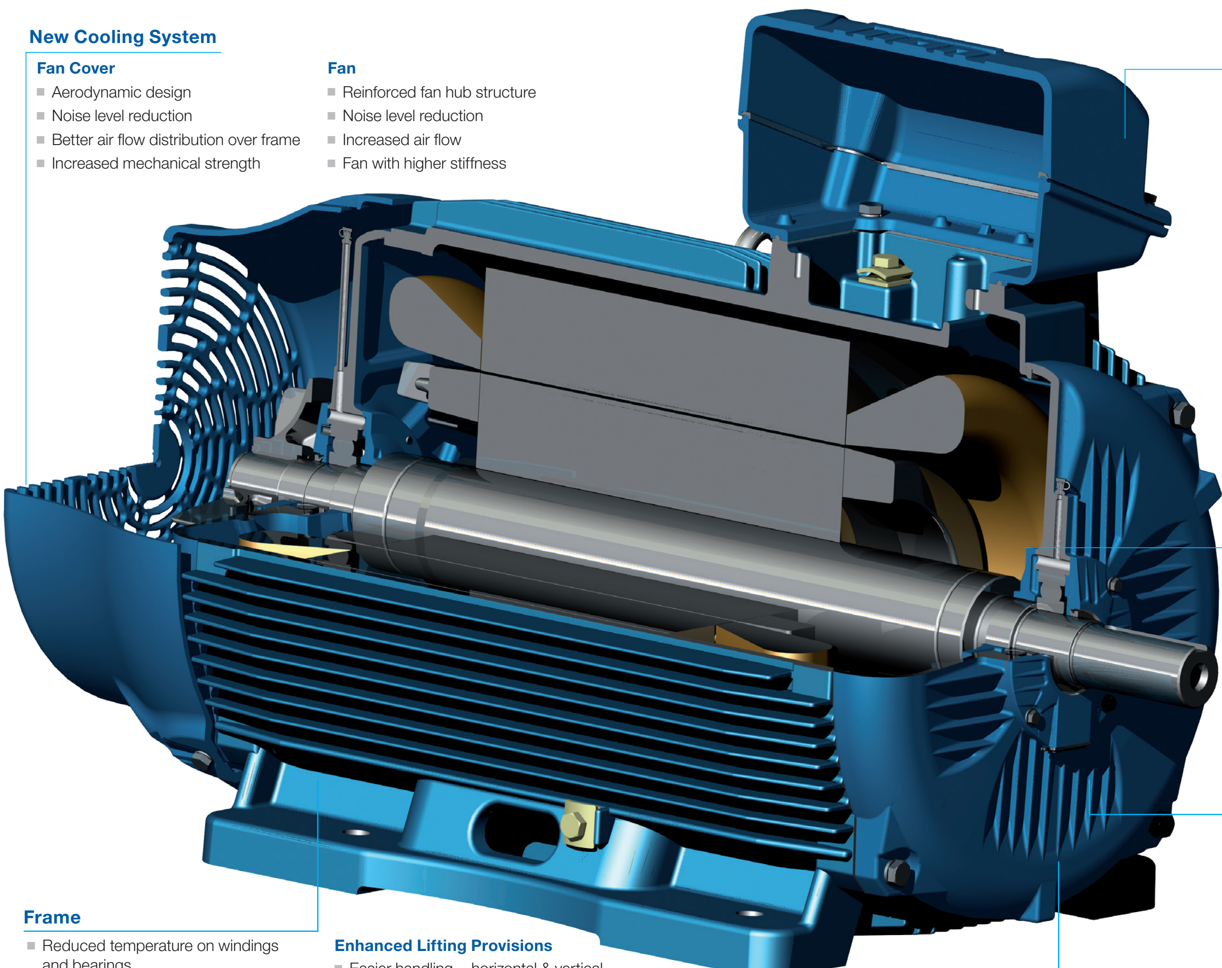
You do not need a special motor for severe duty. Severe Duty is standard with WEG W22 motors.

You do not need a special motor for severe duty. Severe Duty is standard with WEG.

Features that make a difference:

- All NEMA Premium ratings have a 1.25 service factor (up to 100 HP) resulting in cooler operation and extended life of the motor
- All Cast Iron Construction, including Terminal Box and Fan Cover (*)
- Solid feet for reduced vibration levels and impact absorption
- Optimized ventilation system for cooler operation and extended life
- High Grade FC200 cast iron provides superior mechanical strength and heat dissipation
- All WEG W22 motors are Totally Enclosed Fan Cooled with a true IP55 rating against dust and moisture. (IPW56, IPW65 and IPW66 available as optional)
- Exclusive W-Seal 364T and larger provides superior bearing protection
- Taconite Labyrinth seal 586 Frame and larger
- Exclusive WEG painting system exceed 200hrs ASTM 117 corrosion test (Exceeds IEEE841 standard)
- Balanced to 0.08 inches per second vibration limits (Meets IEEE841 standard)
- Four Bolt Conduit Cover with glued Neoprene Gasket
- Impregnation Resin and magnet wire are insulation class H
- Stainless Steel Nameplate - Laser edged with high contrast background
- Corrosion Proof Drains
- Inverter Duty per NEMA MG1, Part 31
- Certified Class I Div 2, Groups A, B, C & D; Class II, Div 2, Groups F & G

**cast iron fan cover available as an option on 143-215T frames*



New Cooling System

Fan Cover
- Aerodynamic design
- Noise level reduction
- Better air flow distribution over frame
- Increased mechanical strength

Fan
- Reinforced fan hub structure
- Noise level reduction
- Increased air flow
- Fan with higher stiffness

Terminal Box
- Better connection quality
- Easier cable handling during installation
- More space available for accessory installation
- Easier Maintenance
- Mounting F1/F2/F3
- Rotation on 90° stages

Bearing Caps

External
- Finned surface for improved bearing heat dissipation

Internal
- Change of grease path for positive lubrication
- Bearing lubrication quality improvement
- Reduced bearing temperature

Seal Subsystem
- Increased dust and moisture protection
- Increased protection to high-pressure cleaning

Frame
- Reduced temperature on windings and bearings
- Noise level reduction
- Terminal box position outlet on top

Pad for vibration sensor
- Displaced 90° from each other

Enhanced Lifting Provisions
- Easier handling - horizontal & vertical
- Higher mechanical strength and handling safety

Solid feet
- More impact resistance
- Ideal for high vibration level applications

Endshields Subsystem

DE (Drive Endshield)
- New fin design
- Bearing moved outwards for better load support
- Improved bearing heat dissipation for reduced bearing temperature
- Reinforced endshield structure

NDE (Non-Drive Endshield)
- New design with smooth exterior surface
- Improved air flow
- Noise level reduction
- Improved structural rigidity for low vibration

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer :

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11549124
		Catalog # :	12518ET3H444T-W22

Frame	: 444/5T	Locked rotor time	: 48s (cold) 27s (hot)
Output	: 125 HP	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 575 V	Altitude	: 1000 m.a.s.l.
Rated current	: 111 A	Protection degree	: IP55
L. R. Amperes	: 724 A	Cooling method	: IC411 - TEFC
LRC	: 6.5x(Code G)	Mounting	: F- 3
No load current	: 36.8 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1785 rpm	Noise level[2]	: 73.0 dB(A)
Slip	: 0.83 %	Starting method	: ~~Direct On Line~~ VFD
Rated torque	: 368 ft.lb	Approx. weight[3]	: 1651 lb
Locked rotor torque	: 200 %		
Breakdown torque	: 229 %		
Insulation class	: F		
Service factor	: 1.15		
Moment of inertia (J)	: 57.2 sq.ft.lb		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	94.9	95.0	95.4	95.4
Power Factor	0.50	0.74	0.82	0.85

Foundation loads	
Max. traction	: 1429 lb
Max. compression	: 3080 lb

Losses at normative operating points (speed;torque), in percentage of rated output power

P1 (0,9;1,0)	P2 (0,5;1,0)	P3 (0,25;1,0)	P4 (0,9;0,5)	P5 (0,5;0,5)	P6 (0,5;0,25)	P7 (0,25;0,25)
4.5	3.4	3.0	2.4	1.4	0.9	0.6

		Drive end	Non drive end
Bearing type	:	6319 C3	6316 C3
Sealing	:	WSeal	WSeal
Lubrication interval	:	8000 h	10000 h
Lubricant amount	:	45 g	34 g
Lubricant type	:	Mobil Polyrex EM	

Notes

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

Rev.	Changes Summary	Performed	Checked	Date

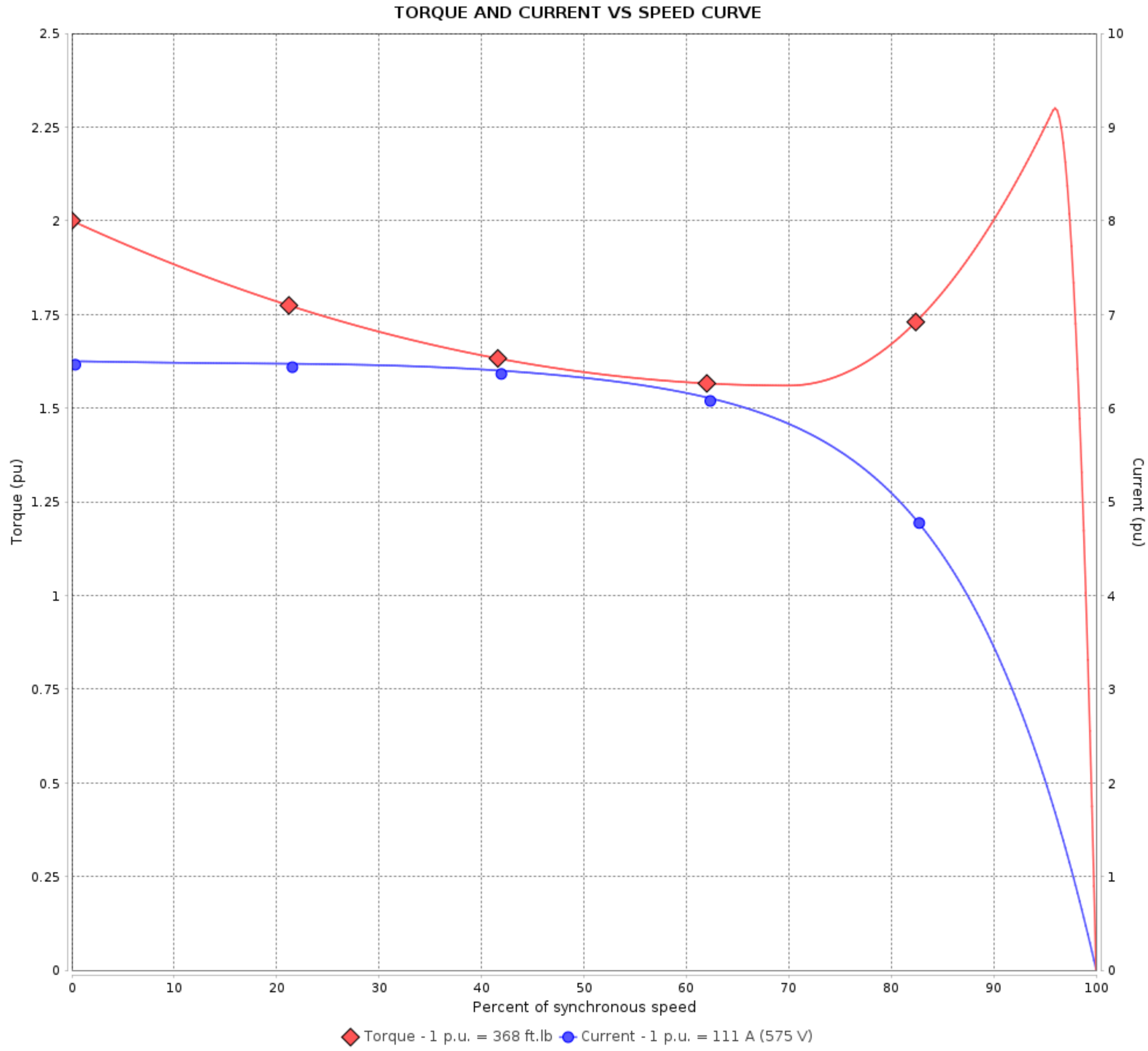
Performed by			
Checked by		Page	Revision
Date	04/09/2024	1 / 6	

TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11549124
		Catalog # :	12518ET3H444T-W22



Performance	: 575 V 60 Hz 4P		
Rated current	: 111 A	Moment of inertia (J)	: 57.2 sq.ft.lb
LRC	: 6.5	Duty cycle	: Cont.(S1)
Rated torque	: 368 ft.lb	Insulation class	: F
Locked rotor torque	: 200 %	Service factor	: 1.15
Breakdown torque	: 229 %	Temperature rise	: 80 K
Rated speed	: 1785 rpm	Design	: B
Locked rotor time	: 48s (cold) 27s (hot)		

Rev.	Changes Summary	Performed	Checked	Date

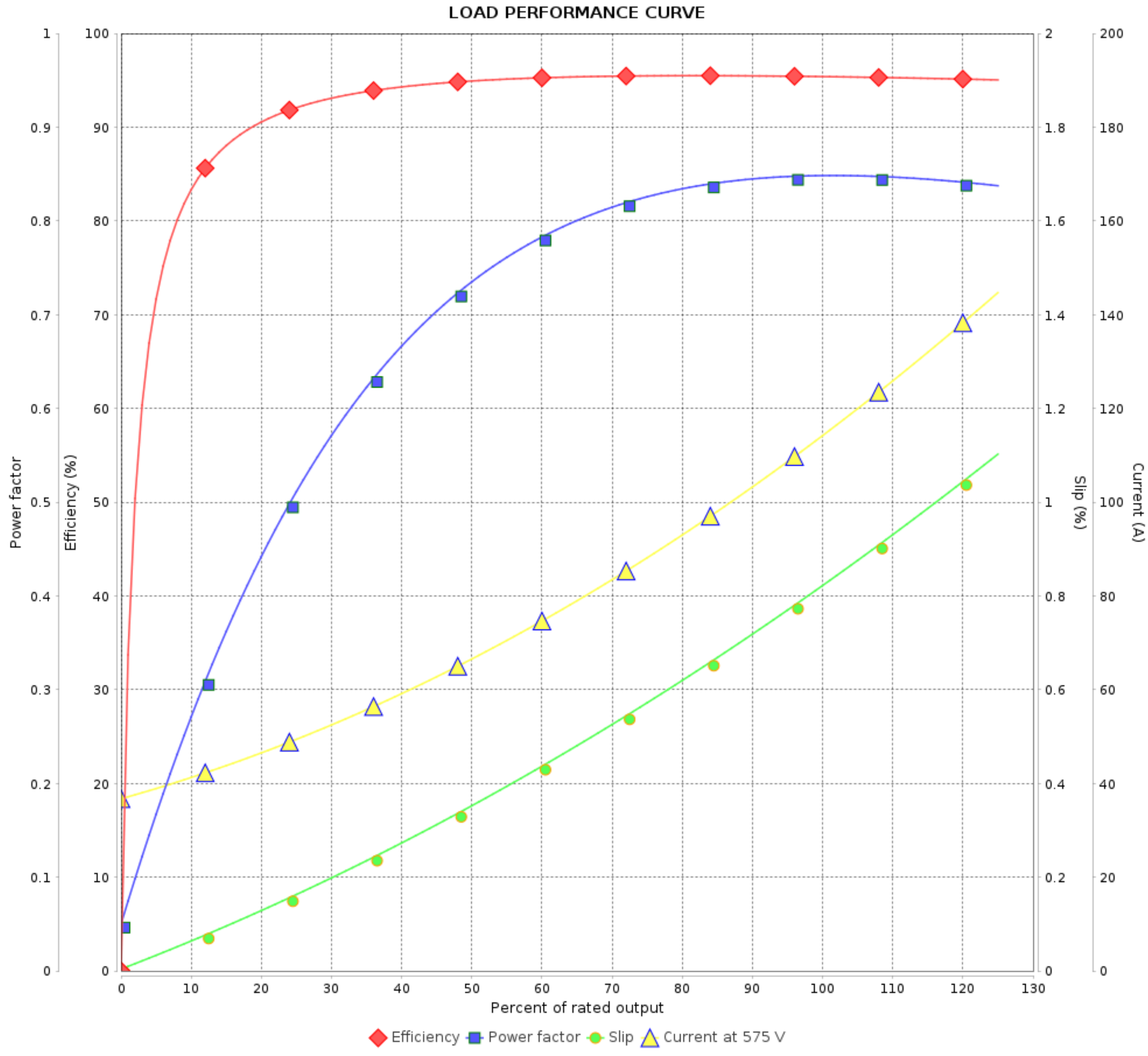
Performed by				
Checked by			Page	Revision
Date	04/09/2024		2 / 6	

LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11549124
		Catalog # :	12518ET3H444T-W22



Performance	: 575 V 60 Hz 4P		
Rated current	: 111 A	Moment of inertia (J)	: 57.2 sq.ft.lb
LRC	: 6.5	Duty cycle	: Cont.(S1)
Rated torque	: 368 ft.lb	Insulation class	: F
Locked rotor torque	: 200 %	Service factor	: 1.15
Breakdown torque	: 229 %	Temperature rise	: 80 K
Rated speed	: 1785 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	04/09/2024		3 / 6	

THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11549124
		Catalog # :	12518ET3H444T-W22

Performance	: 575 V 60 Hz 4P

Rated current	: 111 A	Moment of inertia (J)	: 57.2 sq.ft.lb
LRC	: 6.5	Duty cycle	: Cont.(S1)
Rated torque	: 368 ft.lb	Insulation class	: F
Locked rotor torque	: 200 %	Service factor	: 1.15
Breakdown torque	: 229 %	Temperature rise	: 80 K
Rated speed	: 1785 rpm	Design	: B

Heating constant	
Cooling constant	

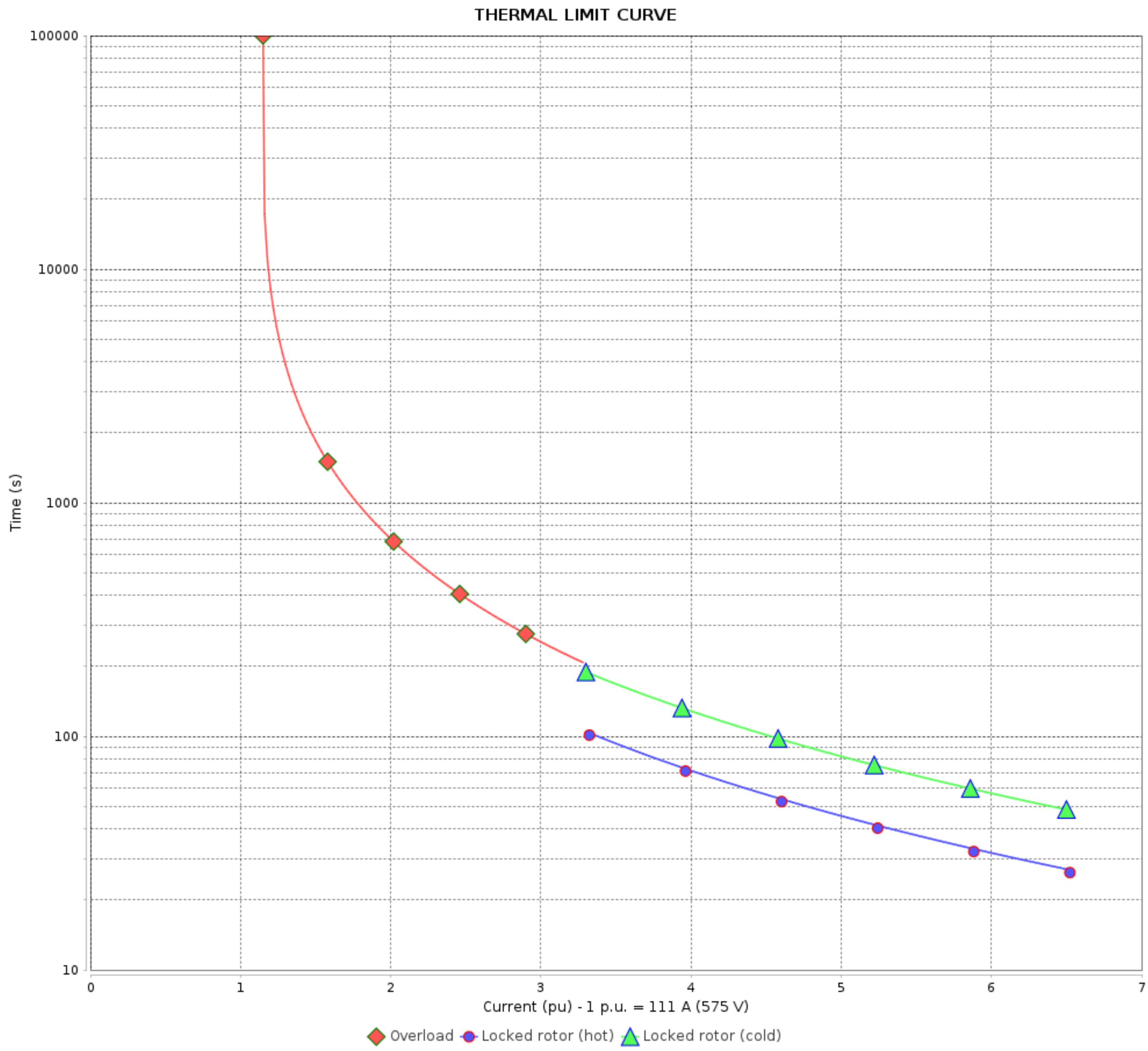
Rev.	Changes Summary	Performed	Checked	Date

Performed by				
Checked by			Page	Revision
Date	04/09/2024		4 / 6	

THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



Rev.	Changes Summary	Performed	Checked	Date

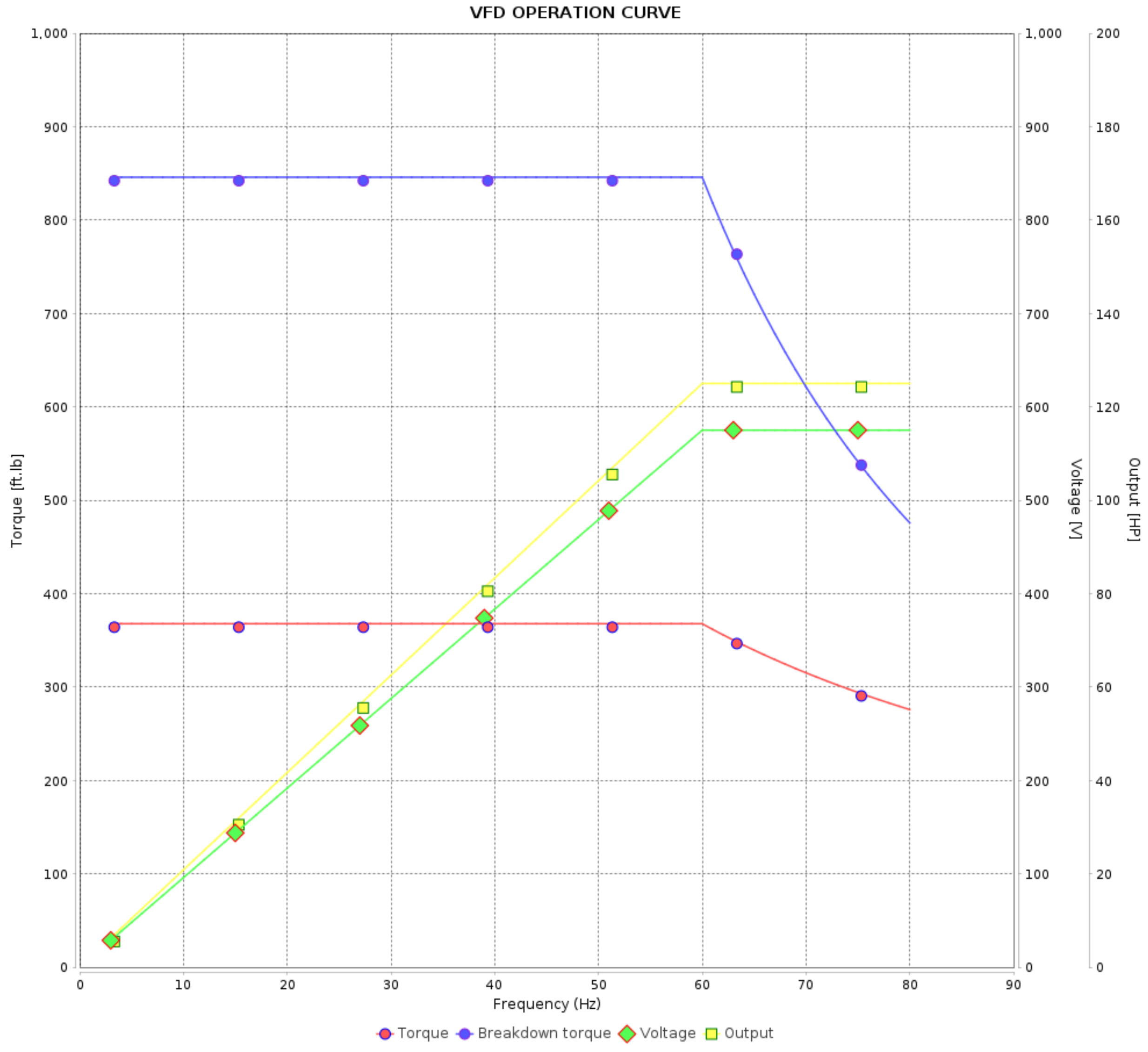
Performed by				
Checked by			Page	Revision
Date	04/09/2024		5 / 6	

VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11549124
		Catalog # :	12518ET3H444T-W22



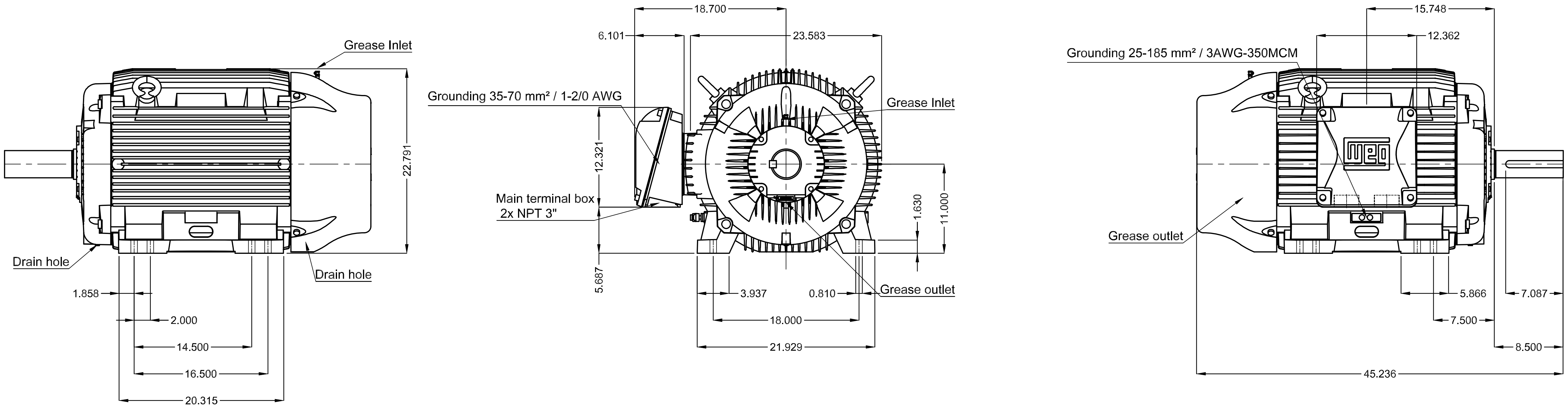
Performance : 575 V 60 Hz 4P

Rated current	: 111 A	Moment of inertia (J)	: 57.2 sq.ft.lb
LRC	: 6.5	Duty cycle	: Cont.(S1)
Rated torque	: 368 ft.lb	Insulation class	: F
Locked rotor torque	: 200 %	Service factor	: 1.15
Breakdown torque	: 229 %	Temperature rise	: 80 K
Rated speed	: 1785 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

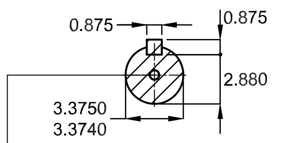
Performed by				
Checked by			Page	Revision
Date	04/09/2024		6 / 6	

1	2	3	4	5	6



Dimensions in inches

DE Shaft End



DUNC 3/4"-10 WEG WPR-7339

Color RAL 5009

Painting plan 203A

Mounting B3R(D)

125 HP 04 Poles 60 Hz — A

Scale 1 : 14

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER
			HYBRISUSER				00

EXECUTED	HYBRISUSER	THREE PH. MOTOR W22 NEMA PREM. EFF.	PREVIEW
CHECKED		FRAME 444/5T IP55 TEFC	WDD 00
RELEASED			
REL. DATE			SHEET 1 / 1

A3

MODEL 12518ET3H444T-W22
MADE IN BRAZIL
11549124

WEG W22 NEMA Premium®
CC029A
Inverter Duty Motor
Severe Duty

C UL US 3PT9 LISTED

FOR SAFE AREA
MOD.TE1BF0X0N

CSA® C US Energy Verified

Class I, Div 2, Gr. A, B, C and D – T3
Class I, Zone 2, IIC – T3
Class II, Div 2, Gr. F and G – T3C
For use on PWM, Gr. A, B, C, D and F,
VT 1000:1, CT 20:1, 1.0SF, T3A

PH 3	FR 444/5T	HP(kW) 125.0(90.0)	Hz 60
V 575	A 111		IP55
NEMA NOM EFF	95.4 %	RPM 1780	
ENCL TEFC	DUTY CONT.	INS. CL. F ΔT 80 K	
PF 0.85	DES B	CODE G	AMB. 40°C
SF 1.15	SFA 128	ALT 1000 m.a.s.l.	

T6 T4 T5
T1 T2 T3
L1 L2 L3
Δ 575V

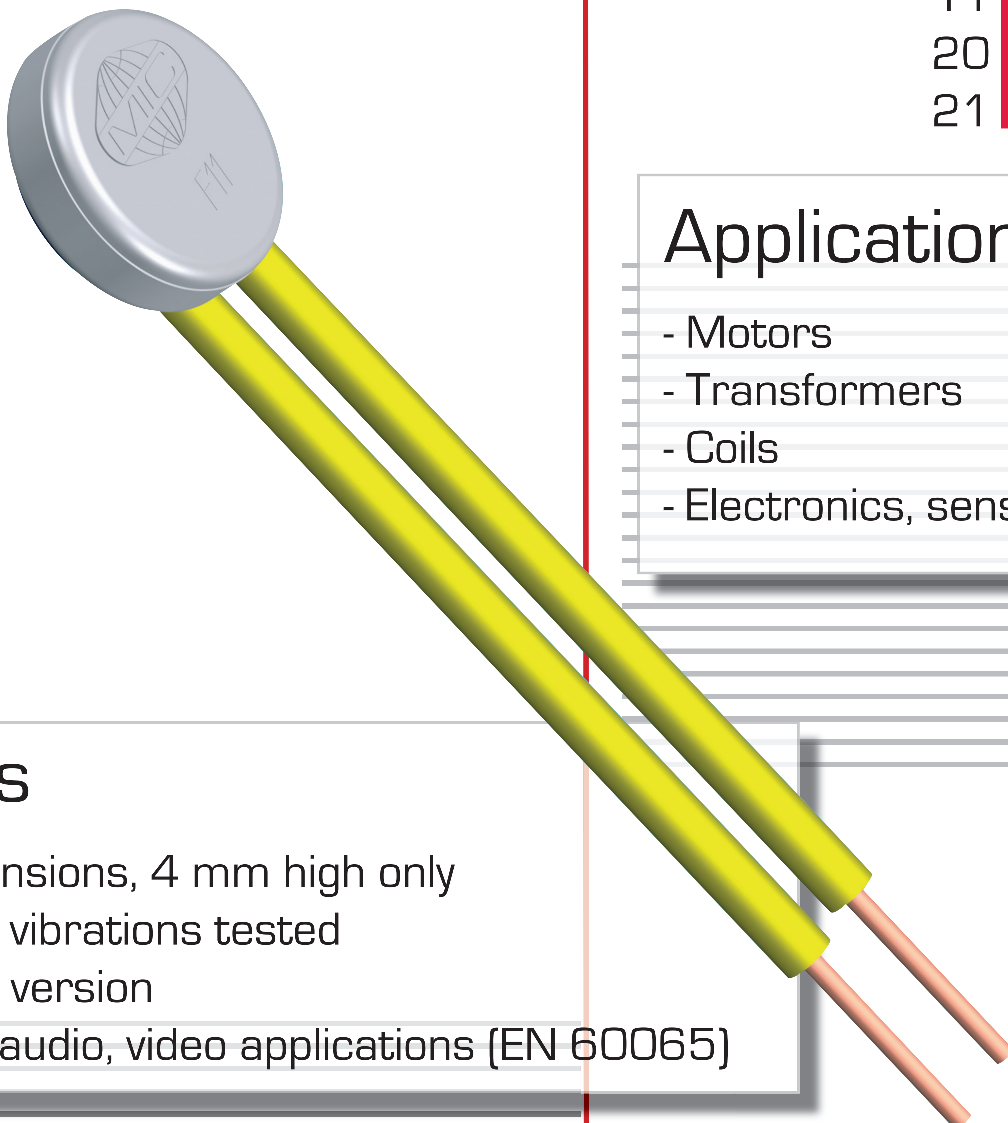
→ 6319-C3 (45g) MOBIL POLYREX EM
→ 6316-C3 (34g) 8000 h

1642 Lbs

Thermal motor protector
Temperature limiter
Thermal cut-out

F

11
20
21

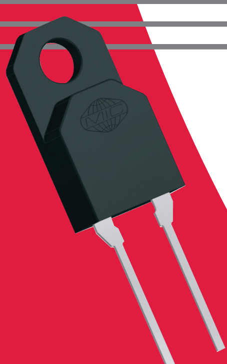


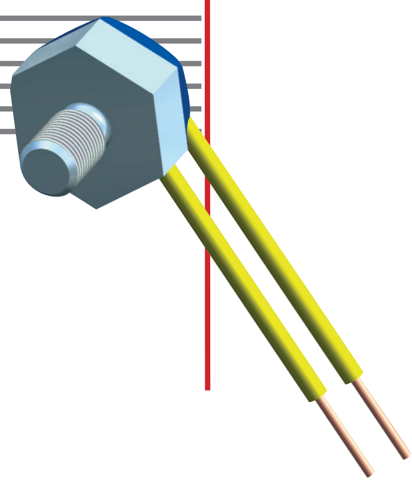
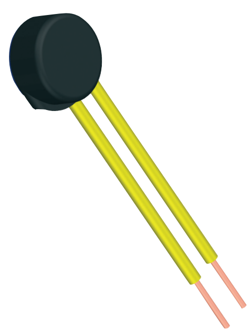
Applications

- Motors
- Transformers
- Coils
- Electronics, sensors

Benefits

- Small dimensions, 4 mm high only
- Shock- and vibrations tested
- Leadframe version
- Tested for audio, video applications (EN 60065)



MICROTHERM

Microtherm International Cooperation

Technical data

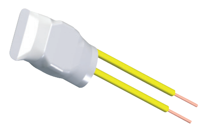
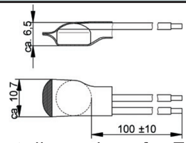
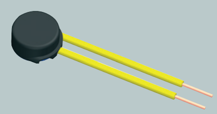
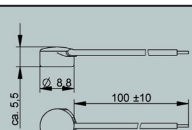
ratings / control type		F11A / E F20A / E	F20B / G	F21A / E	
version		normally closed	normally open	normally closed	
rated current at 250 V 50/60 Hz (power factor 0.95 / 0.6)		2.0 A / 1.6 A	2.0 A / 1.6 A	3.0 A / 3.0 A	6.3 A / 1.0 A
switching cycles		10,000		10,000	700
max. current at 250 V 50/60 Hz (power factor 0.95)		6.3 A		8.0 A	
switching cycles under max. current		100			
temperature rating Ta (steps in 5 K)		70 °C ... 160 °C	70 °C ... 155 °C	70 °C ... 160 °C	
tolerances		Standard: ± 5 K			
feature of automatic action		1.B, 2.B.M, 1.C, 3.C		2.B, 1.C	
contact resistance (incl. wire of 100 mm)		< 50 mΩ			
hysteresis		30 K ± 15 K			
dielectric strength (standard insulation)		2 kV			
shock- / vibration testing (similar to EN 50155)		400 m/s^2 sine half wave / 100 m/s^2 5 Hz ... 2,000 Hz sine			
resistances to impregnation		tight against ordinary resins and lacquers			
degrees of protection provided by enclosures (EN 60529)		IP00			
suitable for use in protection category		I, II			
approvals	VDE / ENEC	EN 60730-1 / -2-2 / -2-3 [1)] /-2-9			
	UL	UL 2111 / UL 873			
	CSA	C22.2 No. 77 / C22.2 No. 24 [2)]			

[1)] different power rating
[2)] on demand

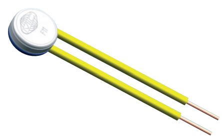
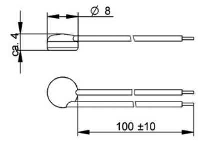
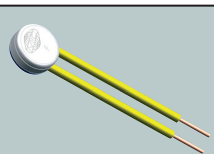
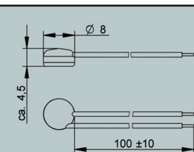
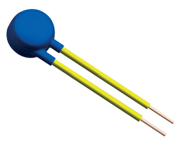
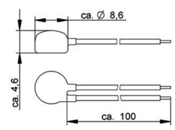
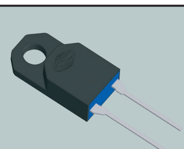
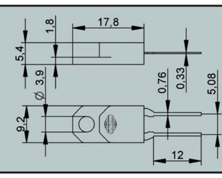
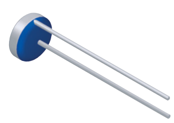
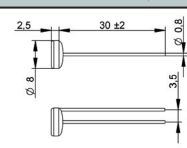
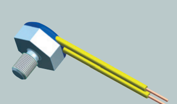
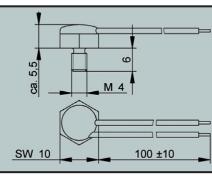
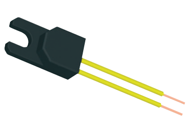
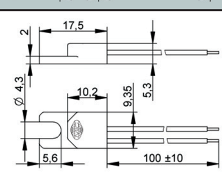
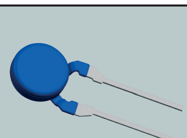
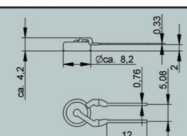
Standard wire (length 100 ± 10 mm, stripped 6 ± 1 mm)

lead	code	temperature max.	operating voltage max.	diameter insulation	cross section diameter	UL style
stranded white	L300	150 °C	300 V	1.57 mm	AWG24 / 0.21 mm^2	3398
	L310			1.80 mm	AWG20 / 0.48 mm^2	
	L330	200 °C	600 V	0.90 mm	AWG24 / 0.24 mm^2	3557
solid yellow	L400	150 °C	300 V	1.40 mm	AWG24 / 0.51 mm	3398
	L410			1.65 mm	AWG20 / 0.81 mm	
	L430	200 °C	300 V	1.21 mm	AWG24 / 0.51 mm	1332
	L440			1.71 mm	AWG20 / 0.81 mm	

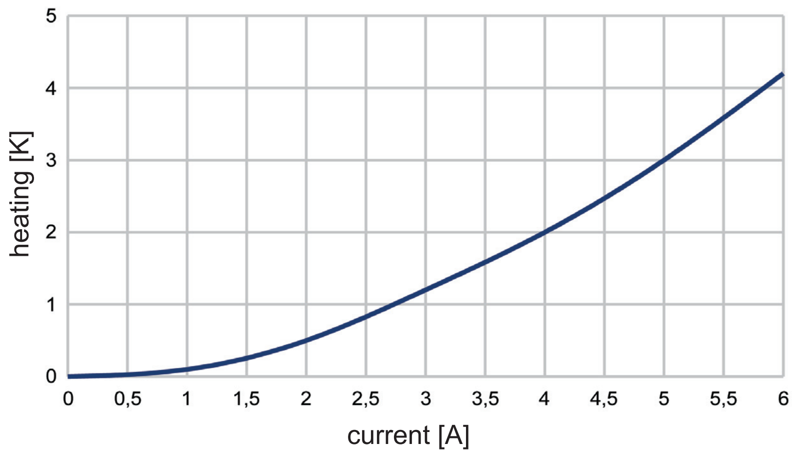
Standard insulation

control type	nc	no	code	illustration	drawing dimensions (mm)	technical specification	approvals
F11, F21 F20	A A	B	U254		 different dimensions for F20, F21	shrink cap potted Ta max. 155°C	VDE, UL
F11	A		U198		 different dimensions for F20, F21	cap of PPS potted	VDE, UL
F20 F21	A A	 B	U185				

Specific variations

control type	nc	no	code	illustration	drawing dimensions (mm)	technical specification	approvals
F11	A					not insulated potted	VDE, UL, CSA
F20 F21	A A	B				not insulated potted	VDE, UL, CSA
F11, F21 F20	A A	 B	U112		 different dimensions for F20, F21	coated	VDE, UL
F20 F21	A A	B	A150 U280			housing of PPS leadframe leads grid dimension 5.08 potted	VDE, UL
F11, F21 F20	A A	 B	A800		 different dimensions for F20, F21	not insulated potted	VDE, UL
F20 F21	E E	G	G700			aluminium housing thread M4x6 potted Attention: Ta max. 150 °C	VDE, UL
F11	A		U281			housing of PPS potted	VDE, UL
F11, F21 F20	A A	 B	A150 U112		 different dimensions for F20, F21	leadframe leads grid dimension 5.08 coated	VDE, UL

Heating by current



The diagram is measured with a thermal control without any insulation in an oil bath.

Attention:
The heating depends on the thermal conduction of the control to the equipment or part which should be protected.

Ordering and marking example

Ordering example

F11 A 120 05 L310 100 U254

- U254 – shrink cap insulation
- 100 – length 100 mm
- L310 – lead wire white, AWG20
- 05 – tolerance
- 120 – temperatue
- A – normally closed
- F11 – type

Deviations from standard controls on request.

Marking

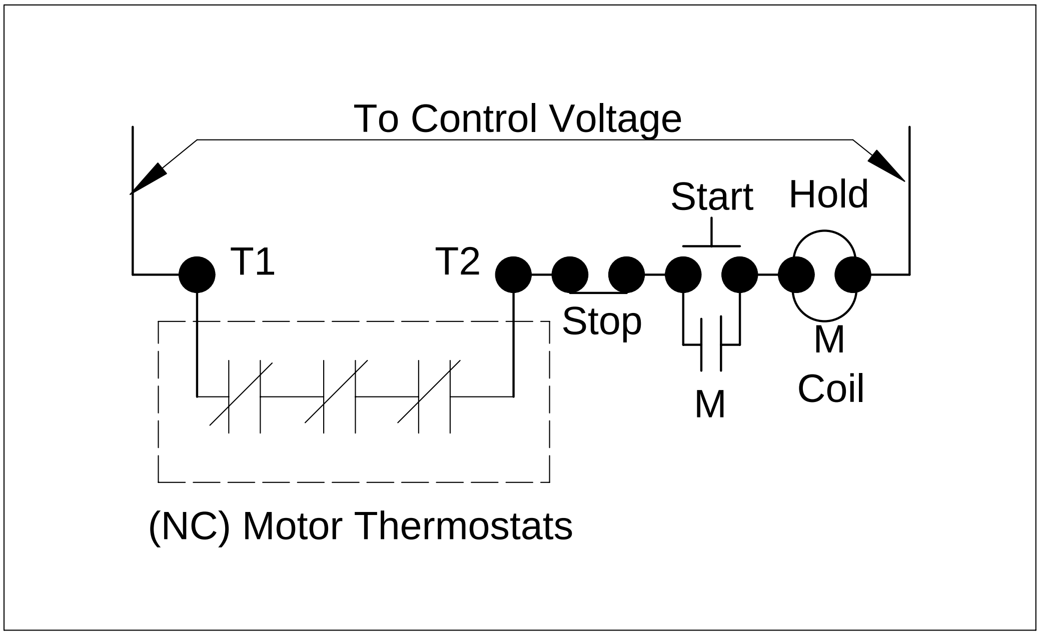
F11A	type (F11 nc)
12005	response temperature (120°C), tolerance (± 5K)
026D	date of manufacture (Feb.2006), country (D=Germany)

Representation office:

Microtherm GmbH
Täschenwaldstraße 3
Postfach 1208
D-75112 Pforzheim

Fon: +49 (0)7231 787-0
Fax : +49 (0)7231 787-155
E-Mail: mic-pforzheim@microtherm.de
Internet: www.microtherm.de

Typical Thermostat Control Schematic



ÆGIS SGR™
BEARING PROTECTION RING

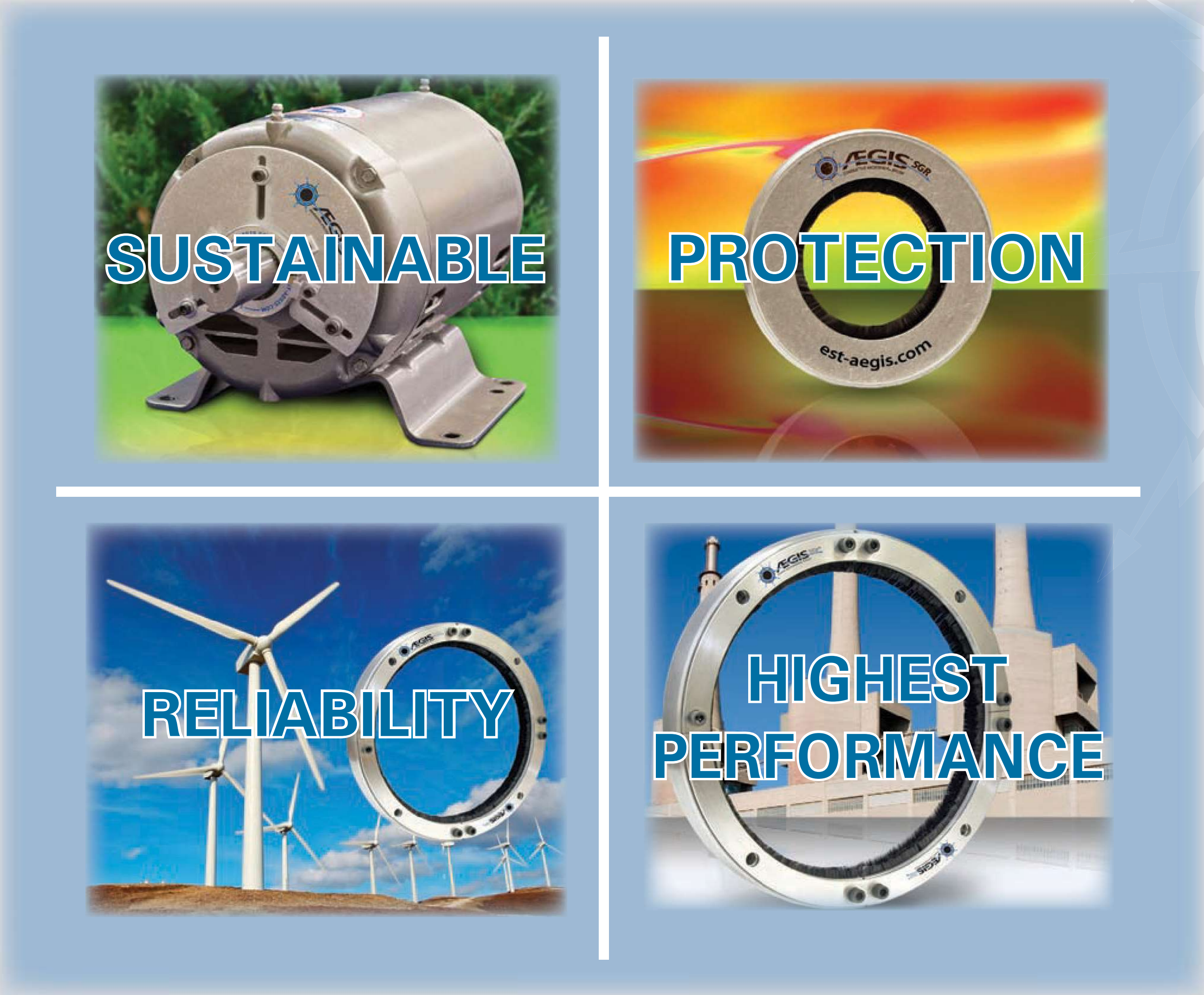
Sustainable Technology for True Inverter Duty Motors

WEG uses the standard SGR from the AEGIS catalog that is sized based on the motor min/max shaft diameter. They use the type with the mounting brackets which are designed to fit over the shaft shoulder on the motor end-shield.

Bearing Protection For Life!

2009

BEARING PROTECTION RING™



"The only bearing protection system guaranteed to eliminate harmful shaft currents preventing premature motor failure - for life."

Guarantee

Electro Static Technology guarantees any new motor up to 100hp/75kW will not fail from electrical bearing fluting damage for the life of the motor when the AEGIS SGR™ Bearing Protection Ring™ is installed in accordance with manufacturer's installation instructions. If electrically induced fluting damage occurs, Electro Static Technology will replace motor bearings. Guarantee is subject to the terms and conditions of the AEGIS SGR™ Guarantee Program.

For program details, visit: www.est-aegis.com

Don't let this happen to your bearings!

TABLE OF CONTENTS

Sustainable Motor Design - Prevent Bearing Failure

***AEGIS Bearing Protection Ring™*- protects motor bearings for life. Variable frequency drives (VFD) induce electrical voltages onto the shaft of AC and DC motors. With AEGIS SGR Bearing Protection Ring installed on the motor, you benefit from sustainability, system up-time, production improvement, and higher reliability.**

PROBLEM:

VFD Induced Shaft Voltages Damage Bearings

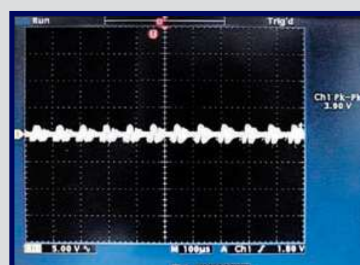
Shaft voltage reading with no protection

Variable frequency drives (VFD) on AC and DC motors induce harmful electrical voltages on the motor shaft. Once these voltages exceed the resistance of the bearing lubricant, they discharge through the motor's bearings causing fusion craters, severe pitting, fluting damage, excessive bearing noise and eventually bearing failure.

SOLUTION:

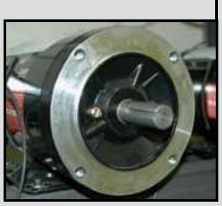
AEGIS SGR™ - Electrical Bearing Damage Protection

The new AEGIS SGR™ Bearing Protection Ring™ prevents electrical bearing damage by safely channeling harmful shaft voltages away from the bearings to ground. Using proprietary Electron Transport Technology™, the conductive micro fibers inside the AEGIS SGR™ provide the path of least resistance and dramatically extend motor life.



Shaft voltage reading with AEGIS SGR

VFD



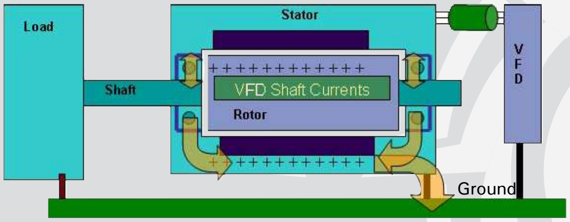
No bearing protection

AEGIS SGR™ Bearing Protection Ring™

About Shaft Voltages and Bearing Currents

VFD Induced Shaft Voltages - All Motors

Damaging voltages are induced on the shafts of AC and DC motors controlled by variable frequency drives (VFD). The extremely high on/off switching speeds of the pulse width modulation (PWM), generated by the insulated gate bipolar transistors (IGBT), induce damaging voltages onto the motor shaft through parasitic capacitive coupling between the stator and rotor. This common mode shaft voltage seeks a path to ground, usually through the motor's bearings.



EDM Currents Damage Bearings

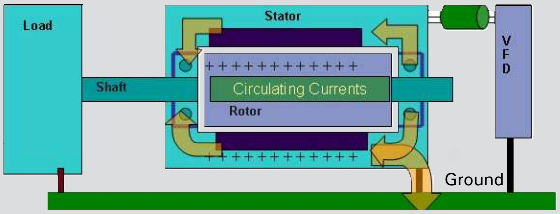
Bearing fluting, "washboard" pattern on bearing race

Electrical Damage in the Bearings (EDM) - Pitting, Fluting, Failure

Damaging currents arc through the dielectric oil film between the rolling elements and the bearing race. This is known as electrical discharge machining (EDM) effect. EDM causes fusion craters, severe pitting, and eventually bearing fluting (a washboard-like pattern in the bearing race) which results in premature bearing failure.

High Frequency Circulating Currents in Large AC and DC Motors

In addition to potential bearing failures in motors from VFD induced EDM currents, AC and DC motors above 100 hp (75 kW) may also experience bearing failures caused by high frequency circulating currents. VFD induced high frequency circulating currents are in the kilohertz or even megahertz range and circulate through the motor's bearings because of magnetic flux imbalances in the stator. This type of VFD induced current becomes the more dominant destructive current in higher hp/kW motors.



High Frequency Currents Damage Bearings

AEGIS SGR™ Bearing Protection Ring™ is the most effective solution to protect bearings in motors and attached equipment from EDM currents and VFD induced shaft voltages.

Technology Comparison

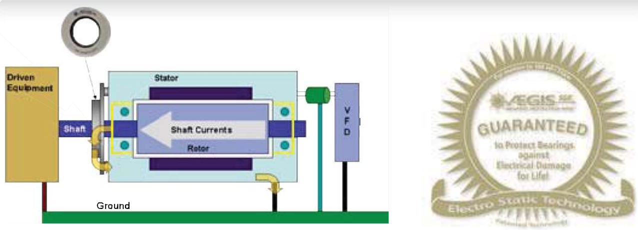
	AEGIS SGR™	Insulating sleeve	Ceramic/ Hybrid Bearing	Copper or Bronze Metal Brush	Carbon Block Brush	Conductive Grease
Protects Motor and Attached Equipment	Yes	No	No	No	No	No
Long-term Effectiveness	Yes	No	No	No	No	No
Easy to install	Yes	No	No	No	No	No
Contamination Proof	Yes	N/A	N/A	No	No	N/A
Low Lifetime Cost High return on Investment	Yes	No	No	No	No	No
Effective at any RPM	Yes	Yes	Yes	No	No	No
Maintenance Free Operation	Yes	Yes	Yes	No	No	No

Application Notes for AEGIS Bearing Protection Ring™

Improve System Reliability and Production with Sustainable Motor Design

Motors up to 100 HP (75 kW)

Any motor controlled by a variable frequency drive (VFD) requires bearing protection. Motors of 100 hp down to fractional hp motors will experience bearing failures when operated on a PWM drive. AEGIS SGR™ Bearing Protection Ring™ guarantees that bearings will not fail in these motors from fluting damage for the service life of the motor.



Install one AEGIS SGR™ Bearing Protection Ring™ on either the drive end or the non-drive end of the motor. The simplest installation is to slide the AEGIS SGR™ over the drive end and fasten it to the motor end bell with the easy to install mounting hardware included with each AEGIS SGR™

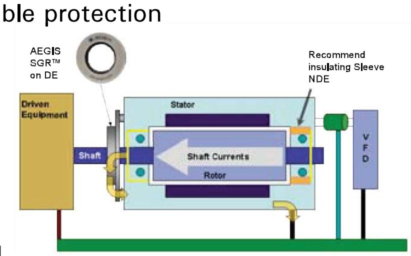
★ Recommend Colloidal Silver Shaft Coating PN CS015

Motors 100 HP to 1000 HP (75 kW to 750 kW)

Large motors above 100 hp may have VFD induced EDM currents as well as high frequency circulating currents when they are controlled by VFDs. To protect the bearings, insulate the bearing on one end and install an AEGIS SGR™ on the other end.

Insulation on one end (usually NDE) and AEGIS SGR™ on opposite end

- This method offers the most reliable protection
- Motor frame must be well grounded
- Non-Drive End: Bearing journal should be insulated or Insulated/ Ceramic Bearing installed to disrupt circulating currents
- Install AEGIS SGR™ Bearing Protection Ring™ on opposite end of insulation and Insulated/Ceramic Bearing (usually DE)
- Protects bearings in attached equipment (gear box, pillow block, encoder etc.)



★ Recommend Colloidal Silver Shaft Coating PN CS015

BEARING PROTECTION FACTS:

Bearing protection for motors and attached equipment: Only AEGIS SGR™ will protect both motor bearings and the bearings in attached equipment. VFD induced currents on the shaft can discharge through motor bearings or coupled equipment like gear boxes, pumps, fan bearings, pillow blocks, encoders, brake motors, etc. AEGIS SGR™ addresses the root of the problem and channels harmful currents to ground.

Maintenance free bearing protection for life: Hundreds of thousands of conductive micro fibers have virtually zero wear during operation, even at high RPM and high surface rates. Unlike carbon block brushes, there is no spring pressure on fibers. AEGIS SGR™ Bearing Protection Ring™ will last for the service life of the motor.

AEGIS SGR™ is effective in grease, oil, dirt or dust: Lab and field tested. The conductive micro fibers "sweep" away contaminants from the shaft surface and maintain a conductive path even when oil, grease, dirt or dust get on the shaft.

Operation in harsh environments where fibers are exposed to excessive debris: To prevent particles from damaging the fibers, install a slinger or O-ring against the AEGIS SGR™.

★ COLLOIDAL SILVER SHAFT COATING: NEW TECHNOLOGY

Improving the conductivity of the steel shaft surface enhances the shaft voltage discharge capability in AEGIS shaft grounding applications. Maintaining a highly conductive shaft surface is especially important in critical applications or in applications where the conductive shaft surface of steel could become compromised. Environmental elements could create a potential for decreased conductivity on the shaft of the motor.

Apply AEGIS CS015 Colloidal Silver Shaft Coating to any VFD driven motor shaft prior to installing AEGIS Bearing Protection Ring™.

BEARING PROTECTION FACTS:

AEGIS SGR™ Bearing Protection Ring™ current handling capability: AEGIS SGR™ is rated to discharge high frequency current. Variable frequency drives (VFD) induce high frequency EDM currents of up to 2 amps in 50 billionths of a second. AEGIS SGR™ protects the bearing by safely channeling the energy away from the motor bearings to ground.

AEGIS Bearing Protection Ring™ - the most reliable bearing protection: Production up-time and reliability improve when AEGIS SGR™ is installed. The patented ring of hundreds of thousands of conductive micro fibers provide protection for the service life of the motor. The fibers will always surround the shaft with a conductive path for destructive shaft currents while the motor is running.

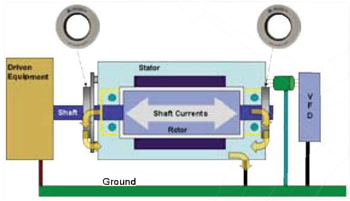
Vertical Motors: Insulate top bearing or shaft with non conductive coating. For bottom bearing, coat shaft with Colloidal Silver Shaft Coating and install AEGIS Bearing Protection Ring.

MOTORS WITH CERAMIC BEARINGS

Insulating both bearing journals or using ceramic coated bearings in the motor **does not prevent VFD induced currents** from discharging through the bearings on attached equipment and may present a voltage hazard.

Whenever ceramic bearings are used in a motor, *AEGIS SGR™ is required* to protect attached equipment and reduce potentially dangerous shaft voltages.

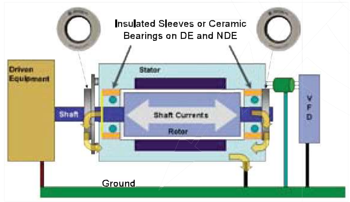
If insulation is not possible, the next best protection is to install AEGIS SGR™ on both ends of the motor



- Motor frame must be well grounded
- Install AEGIS SGR™ Bearing Protection Ring™ on drive and non-drive end to provide path of least resistance for circulating currents and to channel VFD currents to ground.
- Protects bearings in attached equipment
- **NOT SUITABLE FOR CYLINDRICAL ROLLER BEARING**

★ Coat shaft with Colloidal Silver Shaft Coating

Critical Applications: Insulate both ends and add AEGIS SGR™ Bearing Protection Ring™ on both ends



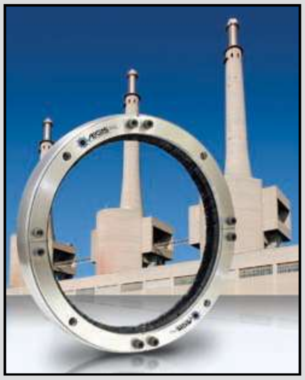
- Motor frame must be well grounded
- Drive and Non-Drive end: Bearing journals should be insulated or Insulated/Ceramic Bearing installed to disrupt circulating currents
- Install AEGIS SGR™ Bearing Protection Ring™ on drive and non-drive end to provide path of least resistance for shaft voltages and to channel VFD induced currents to ground.
- AEGIS SGR™ required to protect bearings in attached equipment (gear box, pillow block, encoder, etc.)

★ Coat shaft with Colloidal Silver Shaft Coating

Medium Voltage Motors
Large Motors and Generators over 1000 HP (750 kW)
Power Generators over 750kW

AEGIS iPRO™ Bearing Protection Ring™

Large motors and generators often have much higher induced shaft voltages and bearing currents which require a high current capable Bearing Protection Ring™. High frequency circulating currents induced by variable frequency drives (VFD) will cause bearing fluting and catastrophic failure in these motors. Generators experience current surges which can cause electrical arcing in bearings and equipment.



AEGIS iPRO™ High Current Bearing Protection Ring™

- One end of the motor should be insulated. Install AEGIS iPRO™ on opposite end of insulation to protect the non-insulated bearing.
- Install AEGIS iPRO™ on both ends of motor or generator if bearing cannot be insulated.

★ Coat shaft with Colloidal Silver Shaft Coating

Purpose of Application Notes: Application notes are intended as general guidance to assist with proper application of AEGIS SGR™ Bearing Protection Ring™ to protect motor bearings. All statements and technical information contained in the application notes are rendered in good faith. User must assume responsibility to determine suitability of the product for its intended use.

AEGIS SVP™ Shaft Voltage Probe

Conductive Microfiber Probe for use with Fluke 199C ScopeMeter

Measuring VFD Induced Shaft Voltages

For the first time you can easily and more accurately measure the voltage on a rotating shaft. The AEGIS SVP™ Shaft Voltage Probe's unique design of high density conductive microfibers ensures continuous contact with the rotating shaft. Used with the Fluke 199C ScopeMeter, you can determine if your motor is subject to potentially damaging bearing currents.

Catalog Number	Includes:
SVP-KIT-F199C	3 SVP tips, probe holder with two piece extension rod (fits 3/8″ magnetic base)
SVP-TIP-F199C	3 SVP tips

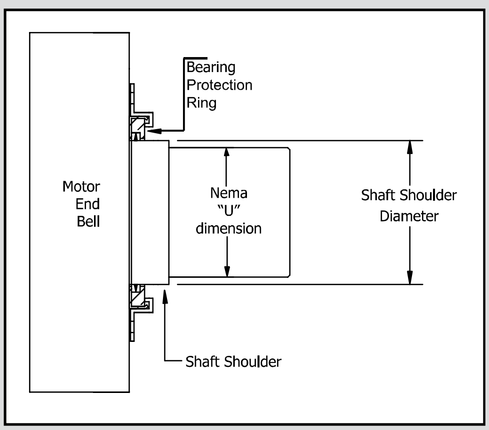
Selecting The Right Size Bearing Protection Ring For Your Motor

Front View


Side View


Back View

Mounting Options shown on page 8

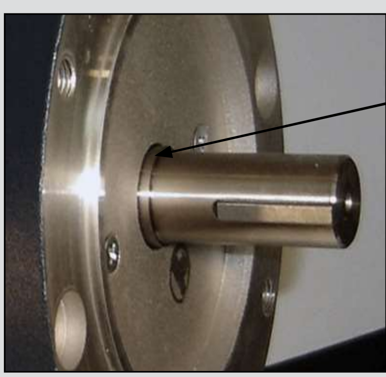


1. Measure shaft diameter at a point 0.125″ from motor end bell.
2. Refer to the part lists to locate the correct SGR part number.

   Note: If you have a slinger or a shaft shoulder that is less than 0.375″, you will need the NEMA/IEC kit. See page 13 for more information.

Example shaft measurement 0.425″

Catalog Number	Min.shaft diameter	Max.shaft diameter	Outside diameter	Thickness Max
SGR-6.9-1	0.311	0.355	1.60	0.295
SGR-8.0-1	0.356	0.395	1.60	0.295
SGR-9.0-1	0.396	0.435	1.60	0.295
SGR-10.1-1	0.436	0.480	1.60	0.295
SGR-11.2-1	0.481	0.520	1.60	0.295



Shaft shoulder: The SGR can be mounted to the shaft shoulder but the shoulder should be at least 0.375″ in length so that all of the fibers are in contact with the rotating shaft. Measure the diameter of the shaft shoulder then locate the correct SGR on the part lists.

AEGIS SGR™ Bearing Protection Ring™ Options


pg. 9

NEW PRODUCT!

Conductive Epoxy Mounting
Shaft diameters: 0.311″ to 6.02″
Solid and Split Ring
Quick and easy installation to metal motor frame
Conductive Epoxy Included


pg.10-11

Standard Mounting Brackets
Shaft diameters: 0.311″ to 6.02″
Ships with mounting brackets, 6-32 screws and washers
Quick and easy installation to most surfaces


pg. 10-11

Split Ring
Shaft diameter: 0.311″ to 6.02″
4 to 6 mounting brackets, M3 screws and washers
Installs without decoupling motor


pg. 10-11

Bolt Through Mounting
Shaft diameters: 0.311″ to 6.02″
M3 x 14 socket head cap screws and lock washers
2 mounting holes up to shaft size 3.895″
4 mounting holes for larger sizes


pg. 12

Press Fit Mounting
Shaft diameters: 0.311″ to 6.02″
Clean dry 0.004″ press fit
Custom sizes available


pg. 13

NEMA-IEC Mounting Kits
Shaft diameter: see chart for standard kits
Custom kits available for other shaft diameters
Clears any slinger, shaft shoulder or protrusion


pg. 14

WTG
Long term reliable performance
Maintenance free system
Solid and Split Ring configurations


pg. 14

iPRO
Long term reliable performance
Maintenance free system
Solid and Split Ring configurations
Available in sizes up to 30″ shaft diameter

Standard SGR™ - Conductive Epoxy Mounting

AEGIS SGR™ BEARING PROTECTION RING

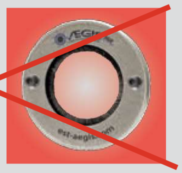
NEW PRODUCT!

Dimensions in inches

Solid SGR Catalog Number	Split SGR Catalog Number	Min.shaft diameter	Max.shaft diameter	Outside diameter	Thickness Max
SGR-6.9-0AW	SGR-6.9-0A4W	0.311	0.355	1.60	0.295
SGR-8.0-0AW	SGR-8.0-0A4W	0.356	0.395	1.60	0.295
SGR-9.0-0AW	SGR-9.0-0A4W	0.396	0.435	1.60	0.295
SGR-10.1-0AW	SGR-10.1-0A4W	0.436	0.480	1.60	0.295
SGR-11.2-0AW	SGR-11.2-0A4W	0.481	0.520	1.60	0.295
SGR-12.2-0AW	SGR-12.2-0A4W	0.521	0.560	1.60	0.295
SGR-13.2-0AW	SGR-13.2-0A4W	0.561	0.605	1.60	0.295
SGR-14.4-0AW	SGR-14.4-0A4W	0.606	0.645	1.60	0.295
SGR-15.4-0AW	SGR-15.4-0A4W	0.646	0.685	2.10	0.295
SGR-16.4-0AW	SGR-16.4-0A4W	0.686	0.730	2.10	0.295
SGR-17.6-0AW	SGR-17.6-0A4W	0.731	0.774	2.10	0.295
SGR-18.7-0AW	SGR-18.7-0A4W	0.775	0.815	2.10	0.295
SGR-19.7-0AW	SGR-19.7-0A4W	0.816	0.855	2.10	0.295
SGR-20.7-0AW	SGR-20.7-0A4W	0.856	0.895	2.10	0.295
SGR-21.7-0AW	SGR-21.7-0A4W	0.896	0.935	2.10	0.295
SGR-22.8-0AW	SGR-22.8-0A4W	0.936	0.980	2.10	0.295
SGR-23.9-0AW	SGR-23.9-0A4W	0.981	1.020	2.10	0.295
SGR-24.9-0AW	SGR-24.9-0A4W	1.021	1.060	2.10	0.295
SGR-25.9-0AW	SGR-25.9-0A4W	1.061	1.105	2.10	0.295
SGR-27.1-0AW	SGR-27.1-0A4W	1.106	1.145	2.10	0.295
SGR-28.1-0AW	SGR-28.1-0A4W	1.146	1.185	2.10	0.295
SGR-29.1-0AW	SGR-29.1-0A4W	1.186	1.230	2.10	0.295
SGR-30.3-0AW	SGR-30.3-0A4W	1.231	1.270	2.10	0.295
SGR-31.3-0AW	SGR-31.3-0A4W	1.271	1.310	2.10	0.295
SGR-32.3-0AW	SGR-32.3-0A4W	1.311	1.355	2.10	0.295
SGR-33.4-0AW	SGR-33.4-0A4W	1.356	1.395	2.10	0.295
SGR-34.4-0AW	SGR-34.4-0A4W	1.396	1.435	2.68	0.295
SGR-35.5-0AW	SGR-35.5-0A4W	1.436	1.480	2.68	0.295
SGR-36.6-0AW	SGR-36.6-0A4W	1.481	1.520	2.68	0.295
SGR-37.6-0AW	SGR-37.6-0A4W	1.521	1.560	2.68	0.295
SGR-38.6-0AW	SGR-38.6-0A4W	1.561	1.605	2.68	0.295
SGR-39.8-0AW	SGR-39.8-0A4W	1.606	1.645	2.68	0.295
SGR-40.8-0AW	SGR-40.8-0A4W	1.646	1.685	2.68	0.295
SGR-41.8-0AW	SGR-41.8-0A4W	1.686	1.730	2.68	0.295
SGR-43.0-0AW	SGR-43.0-0A4W	1.731	1.770	2.68	0.295
SGR-44.0-0AW	SGR-44.0-0A4W	1.771	1.810	2.68	0.295
SGR-45.0-0AW	SGR-45.0-0A4W	1.811	1.855	2.68	0.295
SGR-46.1-0AW	SGR-46.1-0A4W	1.856	1.895	2.68	0.295
SGR-47.1-0AW	SGR-47.1-0A4W	1.896	1.935	2.68	0.295
SGR-48.2-0AW	SGR-48.2-0A4W	1.936	1.980	2.68	0.295
SGR-49.3-0AW	SGR-49.3-0A4W	1.981	2.020	2.68	0.295
SGR-50.3-0AW	SGR-50.3-0A4W	2.021	2.060	3.10	0.295
SGR-51.3-0AW	SGR-51.3-0A4W	2.061	2.105	3.10	0.295
SGR-52.5-0AW	SGR-52.5-0A4W	2.106	2.145	3.10	0.295
SGR-53.5-0AW	SGR-53.5-0A4W	2.146	2.185	3.10	0.295
SGR-54.5-0AW	SGR-54.5-0A4W	2.186	2.230	3.10	0.295
SGR-55.7-0AW	SGR-55.7-0A4W	2.231	2.270	3.10	0.295
SGR-56.7-0AW	SGR-56.7-0A4W	2.271	2.310	3.10	0.295
SGR-57.7-0AW	SGR-57.7-0A4W	2.311	2.355	3.10	0.295
SGR-58.8-0AW	SGR-58.8-0A4W	2.356	2.395	3.10	0.295
SGR-59.8-0AW	SGR-59.8-0A4W	2.396	2.435	3.60	0.295
SGR-60.9-0AW	SGR-60.9-0A4W	2.436	2.480	3.60	0.295
SGR-62.0-0AW	SGR-62.0-0A4W	2.481	2.520	3.60	0.295
SGR-63.0-0AW	SGR-63.0-0A4W	2.521	2.560	3.60	0.295
SGR-64.0-0AW	SGR-64.0-0A4W	2.561	2.605	3.60	0.295
SGR-65.2-0AW	SGR-65.2-0A4W	2.606	2.645	3.60	0.295
SGR-66.2-0AW	SGR-66.2-0A4W	2.646	2.685	3.60	0.295
SGR-67.2-0AW	SGR-67.2-0A4W	2.686	2.730	3.60	0.295
SGR-68.4-0AW	SGR-68.4-0A4W	2.731	2.770	3.60	0.295
SGR-69.4-0AW	SGR-69.4-0A4W	2.771	2.810	3.60	0.295
SGR-70.4-0AW	SGR-70.4-0A4W	2.811	2.855	3.60	0.295
SGR-71.5-0AW	SGR-71.5-0A4W	2.856	2.895	3.60	0.295
SGR-72.5-0AW	SGR-72.5-0A4W	2.896	2.935	4.10	0.295
SGR-73.6-0AW	SGR-73.6-0A4W	2.936	2.980	4.10	0.295
SGR-74.7-0AW	SGR-74.7-0A4W	2.981	3.020	4.10	0.295
SGR-75.7-0AW	SGR-75.7-0A4W	3.021	3.060	4.10	0.295
SGR-76.7-0AW	SGR-76.7-0A4W	3.061	3.105	4.10	0.295
SGR-77.9-0AW	SGR-77.9-0A4W	3.106	3.145	4.10	0.295
SGR-78.9-0AW	SGR-78.9-0A4W	3.146	3.185	4.10	0.295
SGR-79.9-0AW	SGR-79.9-0A4W	3.186	3.230	4.10	0.295
SGR-81.1-0AW	SGR-81.1-0A4W	3.231	3.270	4.10	0.295
SGR-82.1-0AW	SGR-82.1-0A4W	3.271	3.310	4.10	0.295
SGR-83.1-0AW	SGR-83.1-0A4W	3.311	3.355	4.10	0.295
SGR-84.2-0AW	SGR-84.2-0A4W	3.356	3.395	4.10	0.295
SGR-85.2-0AW	SGR-85.2-0A4W	3.396	3.435	4.60	0.295
SGR-86.3-0AW	SGR-86.3-0A4W	3.436	3.480	4.60	0.295
SGR-87.4-0AW	SGR-87.4-0A4W	3.481	3.520	4.60	0.295
SGR-88.4-0AW	SGR-88.4-0A4W	3.521	3.560	4.60	0.295
SGR-89.4-0AW	SGR-89.4-0A4W	3.561	3.605	4.60	0.295
SGR-90.6-0AW	SGR-90.6-0A4W	3.606	3.645	4.60	0.295
SGR-91.6-0AW	SGR-91.6-0A4W	3.646	3.685	4.60	0.295
SGR-92.6-0AW	SGR-92.6-0A4W	3.686	3.730	4.60	0.295
SGR-93.8-0AW	SGR-93.8-0A4W	3.731	3.770	4.60	0.295
SGR-94.8-0AW	SGR-94.8-0A4W	3.771	3.810	4.60	0.295
SGR-95.8-0AW	SGR-95.8-0A4W	3.811	3.855	4.60	0.295
SGR-96.9-0AW	SGR-96.9-0A4W	3.856	3.895	4.60	0.295
SGR-97.9-0AW	SGR-97.9-0A4W	3.896	3.935	5.10	0.295
SGR-99.0-0AW	SGR-99.0-0A4W	3.936	3.980	5.10	0.295
SGR-100.1-0AW	SGR-100.1-0A4W	3.981	4.020	5.10	0.295
SGR-101.1-0AW	SGR-101.1-0A4W	4.021	4.060	5.10	0.295
SGR-102.1-0AW	SGR-102.1-0A4W	4.061	4.105	5.10	0.295
SGR-103.3-0AW	SGR-103.3-0A4W	4.106	4.145	5.10	0.295
SGR-104.3-0AW	SGR-104.3-0A4W	4.146	4.185	5.10	0.295
SGR-105.3-0AW	SGR-105.3-0A4W	4.186	4.230	5.10	0.295
SGR-106.5-0AW	SGR-106.5-0A4W	4.231	4.270	5.10	0.295
SGR-107.5-0AW	SGR-107.5-0A4W	4.271	4.310	5.10	0.295
SGR-108.5-0AW	SGR-108.5-0A4W	4.311	4.355	5.10	0.295
SGR-109.6-0AW	SGR-109.6-0A4W	4.356	4.395	5.10	0.295
SGR-110.6-0AW	SGR-110.6-0A4W	4.396	4.435	5.60	0.295
SGR-111.7-0AW	SGR-111.7-0A4W	4.436	4.480	5.60	0.295
SGR-112.8-0AW	SGR-112.8-0A4W	4.481	4.520	5.60	0.295
SGR-113.8-0AW	SGR-113.8-0A4W	4.521	4.560	5.60	0.295
SGR-114.8-0AW	SGR-114.8-0A4W	4.561	4.605	5.60	0.295
SGR-116.0-0AW	SGR-116.0-0A4W	4.606	4.645	5.60	0.295
SGR-117.0-0AW	SGR-117.0-0A4W	4.646	4.685	5.60	0.295
SGR-118.0-0AW	SGR-118.0-0A4W	4.686	4.730	5.60	0.295
SGR-119.2-0AW	SGR-119.2-0A4W	4.731	4.770	5.60	0.295
SGR-120.2-0AW	SGR-120.2-0A4W	4.771	4.810	5.60	0.295
SGR-121.2-0AW	SGR-121.2-0A4W	4.811	4.855	5.60	0.295
SGR-122.3-0AW	SGR-122.3-0A4W	4.856	4.895	5.60	0.295
SGR-123.3-0AW	SGR-123.3-0A4W	4.896	4.935	6.10	0.295
SGR-124.4-0AW	SGR-124.4-0A4W	4.936	4.980	6.10	0.295
SGR-125.5-0AW	SGR-125.5-0A4W	4.981	5.020	6.10	0.295
SGR-126.5-0AW	SGR-126.5-0A4W	5.021	5.060	6.10	0.295
SGR-127.5-0AW	SGR-127.5-0A4W	5.061	5.105	6.10	0.295
SGR-128.7-0AW	SGR-128.7-0A4W	5.106	5.145	6.10	0.295
SGR-129.7-0AW	SGR-129.7-0A4W	5.146	5.185	6.10	0.295
SGR-130.7-0AW	SGR-130.7-0A4W	5.186	5.230	6.10	0.295
SGR-131.9-0AW	SGR-131.9-0A4W	5.231	5.270	6.10	0.295
SGR-132.9-0AW	SGR-132.9-0A4W	5.271	5.310	6.10	0.295
SGR-133.9-0AW	SGR-133.9-0A4W	5.311	5.355	6.10	0.295
SGR-135.0-0AW	SGR-135.0-0A4W	5.356	5.395	6.10	0.295
SGR-136.0-0AW	SGR-136.0-0A4W	5.396	5.435	6.60	0.295
SGR-137.1-0AW	SGR-137.1-0A4W	5.436	5.480	6.60	0.295
SGR-138.2-0AW	SGR-138.2-0A4W	5.481	5.520	6.60	0.295
SGR-139.2-0AW	SGR-139.2-0A4W	5.521	5.560	6.60	0.295
SGR-140.2-0AW	SGR-140.2-0A4W	5.561	5.605	6.60	0.295
SGR-141.4-0AW	SGR-141.4-0A4W	5.606	5.645	6.60	0.295
SGR-142.4-0AW	SGR-142.4-0A4W	5.646	5.685	6.60	0.295
SGR-143.4-0AW	SGR-143.4-0A4W	5.686	5.730	6.60	0.295
SGR-144.6-0AW	SGR-144.6-0A4W	5.731	5.770	6.60	0.295
SGR-145.6-0AW	SGR-145.6-0A4W	5.771	5.810	6.60	0.295
SGR-146.6-0AW	SGR-146.6-0A4W	5.811	5.855	6.60	0.295
SGR-147.7-0AW	SGR-147.7-0A4W	5.856	5.895	6.60	0.295
SGR-148.7-0AW	SGR-148.7-0A4W	5.896	5.935	7.10	0.295
SGR-149.8-0AW	SGR-149.8-0A4W	5.936	5.980	7.10	0.295
SGR-150.9-0AW	SGR-150.9-0A4W	5.981	6.020	7.10	0.295

Conductive Epoxy Included

Parts List



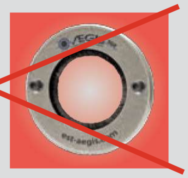
Dimensions in inches

Standard SGR Catalog Number	Split Ring* Catalog Number	Bolt Through* Catalog Number	Min. shaft diameter	Max. shaft diameter	Outside diameter	Thickness Max
SGR-6.9-1	SGR-6.9-2A4	SGR-6.9-3	0.311	0.355	1.60	0.295
SGR-8.0-1	SGR-8.0-2A4	SGR-8.0-3	0.356	0.395	1.60	0.295
SGR-9.0-1	SGR-9.0-2A4	SGR-9.0-3	0.396	0.435	1.60	0.295
SGR-10.1-1	SGR-10.1-2A4	SGR-10.1-3	0.436	0.480	1.60	0.295
SGR-11.2-1	SGR-11.2-2A4	SGR-11.2-3	0.481	0.520	1.60	0.295
SGR-12.2-1	SGR-12.2-2A4	SGR-12.2-3	0.521	0.560	1.60	0.295
SGR-13.2-1	SGR-13.2-2A4	SGR-13.2-3	0.561	0.605	1.60	0.295
SGR-14.4-1	SGR-14.4-2A4	SGR-14.4-3	0.606	0.645	1.60	0.295
SGR-15.4-1	SGR-15.4-2A4	SGR-15.4-3	0.646	0.685	2.10	0.295
SGR-16.4-1	SGR-16.4-2A4	SGR-16.4-3	0.686	0.730	2.10	0.295
SGR-17.6-1	SGR-17.6-2A4	SGR-17.6-3	0.731	0.774	2.10	0.295
SGR-18.7-1	SGR-18.7-2A4	SGR-18.7-3	0.775	0.815	2.10	0.295
SGR-19.7-1	SGR-19.7-2A4	SGR-19.7-3	0.816	0.855	2.10	0.295
SGR-20.7-1	SGR-20.7-2A4	SGR-20.7-3	0.856	0.895	2.10	0.295
SGR-21.7-1	SGR-21.7-2A4	SGR-21.7-3	0.896	0.935	2.10	0.295
SGR-22.8-1	SGR-22.8-2A4	SGR-22.8-3	0.936	0.980	2.10	0.295
SGR-23.9-1	SGR-23.9-2A4	SGR-23.9-3	0.981	1.020	2.10	0.295
SGR-24.9-1	SGR-24.9-2A4	SGR-24.9-3	1.021	1.060	2.10	0.295
SGR-25.9-1	SGR-25.9-2A4	SGR-25.9-3	1.061	1.105	2.10	0.295
SGR-27.1-1	SGR-27.1-2A4	SGR-27.1-3	1.106	1.145	2.10	0.295
SGR-28.1-1	SGR-28.1-2A4	SGR-28.1-3	1.146	1.185	2.10	0.295
SGR-29.1-1	SGR-29.1-2A4	SGR-29.1-3	1.186	1.230	2.10	0.295
SGR-30.3-1	SGR-30.3-2A4	SGR-30.3-3	1.231	1.270	2.10	0.295
SGR-31.3-1	SGR-31.3-2A4	SGR-31.3-3	1.271	1.310	2.10	0.295
SGR-32.3-1	SGR-32.3-2A4	SGR-32.3-3	1.311	1.355	2.10	0.295
SGR-33.4-1	SGR-33.4-2A4	SGR-33.4-3	1.356	1.395	2.10	0.295
SGR-34.4-1	SGR-34.4-2A4	SGR-34.4-3	1.396	1.435	2.68	0.295
SGR-35.5-1	SGR-35.5-2A4	SGR-35.5-3	1.436	1.480	2.68	0.295
SGR-36.6-1	SGR-36.6-2A4	SGR-36.6-3	1.481	1.520	2.68	0.295
SGR-37.6-1	SGR-37.6-2A4	SGR-37.6-3	1.521	1.560	2.68	0.295
SGR-38.6-1	SGR-38.6-2A4	SGR-38.6-3	1.561	1.605	2.68	0.295
SGR-39.8-1	SGR-39.8-2A4	SGR-39.8-3	1.606	1.645	2.68	0.295
SGR-40.8-1	SGR-40.8-2A4	SGR-40.8-3	1.646	1.685	2.68	0.295
SGR-41.8-1	SGR-41.8-2A4	SGR-41.8-3	1.686	1.730	2.68	0.295
SGR-43.0-1	SGR-43.0-2A4	SGR-43.0-3	1.731	1.770	2.68	0.295
SGR-44.0-1	SGR-44.0-2A4	SGR-44.0-3	1.771	1.810	2.68	0.295
SGR-45.0-1	SGR-45.0-2A4	SGR-45.0-3	1.811	1.855	2.68	0.295
SGR-46.1-1	SGR-46.1-2A4	SGR-46.1-3	1.856	1.895	2.68	0.295
SGR-47.1-1	SGR-47.1-2A4	SGR-47.1-3	1.896	1.935	2.68	0.295
SGR-48.2-1	SGR-48.2-2A4	SGR-48.2-3	1.936	1.980	2.68	0.295
SGR-49.3-1	SGR-49.3-2A4	SGR-49.3-3	1.981	2.020	2.68	0.295
SGR-50.3-1	SGR-50.3-2A4	SGR-50.3-3	2.021	2.060	3.10	0.295
SGR-51.3-1	SGR-51.3-2A4	SGR-51.3-3	2.061	2.105	3.10	0.295
SGR-52.5-1	SGR-52.5-2A4	SGR-52.5-3	2.106	2.145	3.10	0.295
SGR-53.5-1	SGR-53.5-2A4	SGR-53.5-3	2.146	2.185	3.10	0.295
SGR-54.5-1	SGR-54.5-2A4	SGR-54.5-3	2.186	2.230	3.10	0.295
SGR-55.7-1	SGR-55.7-2A4	SGR-55.7-3	2.231	2.270	3.10	0.295
SGR-56.7-1	SGR-56.7-2A4	SGR-56.7-3	2.271	2.310	3.10	0.295
SGR-57.7-1	SGR-57.7-2A4	SGR-57.7-3	2.311	2.355	3.10	0.295
SGR-58.8-1	SGR-58.8-2A4	SGR-58.8-3	2.356	2.395	3.10	0.295
SGR-59.8-1	SGR-59.8-2A4	SGR-59.8-3	2.396	2.435	3.60	0.295
SGR-60.9-1	SGR-60.9-2A4	SGR-60.9-3	2.436	2.480	3.60	0.295
SGR-62.0-1	SGR-62.0-2A4	SGR-62.0-3	2.481	2.520	3.60	0.295
SGR-63.0-1	SGR-63.0-2A4	SGR-63.0-3	2.521	2.560	3.60	0.295
SGR-64.0-1	SGR-64.0-2A4	SGR-64.0-3	2.561	2.605	3.60	0.295
SGR-65.2-1	SGR-65.2-2A4	SGR-65.2-3	2.606	2.645	3.60	0.295
SGR-66.2-1	SGR-66.2-2A4	SGR-66.2-3	2.646	2.685	3.60	0.295
SGR-67.2-1	SGR-67.2-2A4	SGR-67.2-3	2.686	2.730	3.60	0.295
SGR-68.4-1	SGR-68.4-2A4	SGR-68.4-3	2.731	2.770	3.60	0.295
SGR-69.4-1	SGR-69.4-2A4	SGR-69.4-3	2.771	2.810	3.60	0.295
SGR-70.4-1	SGR-70.4-2A4	SGR-70.4-3	2.811	2.855	3.60	0.295
SGR-71.5-1	SGR-71.5-2A4	SGR-71.5-3	2.856	2.895	3.60	0.295
SGR-72.5-1	SGR-72.5-2A4	SGR-72.5-3	2.896	2.935	4.10	0.295
SGR-73.6-1	SGR-73.6-2A4	SGR-73.6-3	2.936	2.980	4.10	0.295
SGR-74.7-1	SGR-74.7-2A4	SGR-74.7-3	2.981	3.020	4.10	0.295
SGR-75.7-1	SGR-75.7-2A4	SGR-75.7-3	3.021	3.060	4.10	0.295
SGR-76.7-1	SGR-76.7-2A4	SGR-76.7-3	3.061	3.105	4.10	0.295
SGR-77.9-1	SGR-77.9-2A4	SGR-77.9-3	3.106	3.145	4.10	0.295
SGR-78.9-1	SGR-78.9-2A4	SGR-78.9-3	3.146	3.185	4.10	0.295

*Custom Part - No Returns

Parts List



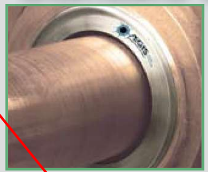


Dimensions in inches

Standard SGR Catalog Number	Split Ring* Catalog Number	Bolt Through* Catalog Number	Min. shaft diameter	Max. shaft diameter	Outside diameter	Thickness Max
SGR-79.9-1	SGR-79.9-2A4	SGR-79.9-3	3.186	3.230	4.10	0.295
SGR-81.1-1	SGR-81.1-2A4	SGR-81.1-3	3.231	3.270	4.10	0.295
SGR-82.1-1	SGR-82.1-2A4	SGR-82.1-3	3.271	3.310	4.10	0.295
SGR-83.1-1	SGR-83.1-2A4	SGR-83.1-3	3.311	3.355	4.10	0.295
SGR-84.2-1	SGR-84.2-2A4	SGR-84.2-3	3.356	3.395	4.10	0.295
SGR-85.2-1	SGR-85.2-2A4	SGR-85.2-3	3.396	3.435	4.60	0.295
SGR-86.3-1	SGR-86.3-2A4	SGR-86.3-3	3.436	3.480	4.60	0.295
SGR-87.4-1	SGR-87.4-2A4	SGR-87.4-3	3.481	3.520	4.60	0.295
SGR-88.4-1	SGR-88.4-2A4	SGR-88.4-3	3.521	3.560	4.60	0.295
SGR-89.4-1	SGR-89.4-2A4	SGR-89.4-3	3.561	3.605	4.60	0.295
SGR-90.6-1	SGR-90.6-2A4	SGR-90.6-3	3.606	3.645	4.60	0.295
SGR-91.6-1	SGR-91.6-2A4	SGR-91.6-3	3.646	3.685	4.60	0.295
SGR-92.6-1	SGR-92.6-2A4	SGR-92.6-3	3.686	3.730	4.60	0.295
SGR-93.8-1	SGR-93.8-2A4	SGR-93.8-3	3.731	3.770	4.60	0.295
SGR-94.8-1	SGR-94.8-2A4	SGR-94.8-3	3.771	3.810	4.60	0.295
SGR-95.8-1	SGR-95.8-2A4	SGR-95.8-3	3.811	3.855	4.60	0.295
SGR-96.9-1	SGR-96.9-2A4	SGR-96.9-3	3.856	3.895	4.60	0.295
SGR-97.9-1	SGR-97.9-2A4	SGR-97.9-3	3.896	3.935	5.10	0.295
SGR-99.0-1	SGR-99.0-2A4	SGR-99.0-3	3.936	3.980	5.10	0.295
SGR-100.1-1	SGR-100.1-2A4	SGR-100.1-3	3.981	4.020	5.10	0.295
SGR-101.1-1	SGR-101.1-2A4	SGR-101.1-3	4.021	4.060	5.10	0.295
SGR-102.1-1	SGR-102.1-2A4	SGR-102.1-3	4.061	4.105	5.10	0.295
SGR-103.3-1	SGR-103.3-2A4	SGR-103.3-3	4.106	4.145	5.10	0.295
SGR-104.3-1	SGR-104.3-2A4	SGR-104.3-3	4.146	4.185	5.10	0.295
SGR-105.3-1	SGR-105.3-2A4	SGR-105.3-3	4.186	4.230	5.10	0.295
SGR-106.5-1	SGR-106.5-2A4	SGR-106.5-3	4.231	4.270	5.10	0.295
SGR-107.5-1	SGR-107.5-2A4	SGR-107.5-3	4.271	4.310	5.10	0.295
SGR-108.5-1	SGR-108.5-2A4	SGR-108.5-3	4.311	4.355	5.10	0.295
SGR-109.6-1	SGR-109.6-2A4	SGR-109.6-3	4.356	4.395	5.10	0.295
SGR-110.6-1	SGR-110.6-2A4	SGR-110.6-3	4.396	4.435	5.60	0.295
SGR-111.7-1	SGR-111.7-2A4	SGR-111.7-3	4.436	4.480	5.60	0.295
SGR-112.8-1	SGR-112.8-2A4	SGR-112.8-3	4.481	4.520	5.60	0.295
SGR-113.8-1	SGR-113.8-2A4	SGR-113.8-3	4.521	4.560	5.60	0.295
SGR-114.8-1	SGR-114.8-2A4	SGR-114.8-3	4.561	4.605	5.60	0.295
SGR-116.0-1	SGR-116.0-2A4	SGR-116.0-3	4.606	4.645	5.60	0.295
SGR-117.0-1	SGR-117.0-2A4	SGR-117.0-3	4.646	4.685	5.60	0.295
SGR-118.0-1	SGR-118.0-2A4	SGR-118.0-3	4.686	4.730	5.60	0.295
SGR-119.2-1	SGR-119.2-2A4	SGR-119.2-3	4.731	4.770	5.60	0.295
SGR-120.2-1	SGR-120.2-2A4	SGR-120.2-3	4.771	4.810	5.60	0.295
SGR-121.2-1	SGR-121.2-2A4	SGR-121.2-3	4.811	4.855	5.60	0.295
SGR-122.3-1	SGR-122.3-2A4	SGR-122.3-3	4.856	4.895	5.60	0.295
SGR-123.3-1	SGR-123.3-2A4	SGR-123.3-3	4.896	4.935	6.10	0.295
SGR-124.4-1	SGR-124.4-2A4	SGR-124.4-3	4.936	4.980	6.10	0.295
SGR-125.5-1	SGR-125.5-2A4	SGR-125.5-3	4.981	5.020	6.10	0.295
SGR-126.5-1	SGR-126.5-2A4	SGR-126.5-3	5.021	5.060	6.10	0.295
SGR-127.5-1	SGR-127.5-2A4	SGR-127.5-3	5.061	5.105	6.10	0.295
SGR-128.7-1	SGR-128.7-2A4	SGR-128.7-3	5.106	5.145	6.10	0.295
SGR-129.7-1	SGR-129.7-2A4	SGR-129.7-3	5.146	5.185	6.10	0.295
SGR-130.7-1	SGR-130.7-2A4	SGR-130.7-3	5.186	5.230	6.10	0.295
SGR-131.9-1	SGR-131.9-2A4	SGR-131.9-3	5.231	5.270	6.10	0.295
SGR-132.9-1	SGR-132.9-2A4	SGR-132.9-3	5.271	5.310	6.10	0.295
SGR-133.9-1	SGR-133.9-2A4	SGR-133.9-3	5.311	5.355	6.10	0.295
SGR-135.0-1	SGR-135.0-2A4	SGR-135.0-3	5.356	5.395	6.10	0.295
SGR-136.0-1	SGR-136.0-2A4	SGR-136.0-3	5.396	5.435	6.60	0.295
SGR-137.1-1	SGR-137.1-2A4	SGR-137.1-3	5.436	5.480	6.60	0.295
SGR-138.2-1	SGR-138.2-2A4	SGR-138.2-3	5.481	5.520	6.60	0.295
SGR-139.2-1	SGR-139.2-2A4	SGR-139.2-3	5.521	5.560	6.60	0.295
SGR-140.2-1	SGR-140.2-2A4	SGR-140.2-3	5.561	5.605	6.60	0.295
SGR-141.4-1	SGR-141.4-2A4	SGR-141.4-3	5.606	5.645	6.60	0.295
SGR-142.4-1	SGR-142.4-2A4	SGR-142.4-3	5.646	5.685	6.60	0.295
SGR-143.4-1	SGR-143.4-2A4	SGR-143.4-3	5.686	5.730	6.60	0.295
SGR-144.6-1	SGR-144.6-2A4	SGR-144.6-3	5.731	5.770	6.60	0.295
SGR-145.6-1	SGR-145.6-2A4	SGR-145.6-3	5.771	5.810	6.60	0.295
SGR-146.6-1	SGR-146.6-2A4	SGR-146.6-3	5.811	5.855	6.60	0.295
SGR-147.7-1	SGR-147.7-2A4	SGR-147.7-3	5.856	5.895	6.60	0.295
SGR-148.7-1	SGR-148.7-2A4	SGR-148.7-3	5.896	5.935	7.10	0.295
SGR-149.8-1	SGR-149.8-2A4	SGR-149.8-3	5.936	5.980	7.10	0.295
SGR-150.9-1	SGR-150.9-2A4	SGR-150.9-3	5.981	6.020	7.10	0.295

*Custom Part - No Returns

Standard SGR™ - Press Fit Mounting*



Dimensions in inches

Catalog Number	Min.shaft diameter	Max.shaft diameter	SGR OD Tolerance +0/-0.001	Thickness Max	Bore Tolerance +0.001/-0
SGR-6.9-0A6	0.311	0.355	1.580	0.295	1.576
SGR-8.0-0A6	0.356	0.395	1.580	0.295	1.576
SGR-9.0-0A6	0.396	0.435	1.580	0.295	1.576
SGR-10.1-0A6	0.436	0.480	1.580	0.295	1.576
SGR-11.2-0A6	0.481	0.520	1.580	0.295	1.576
SGR-12.2-0A6	0.521	0.560	1.580	0.295	1.576
SGR-13.2-0A6	0.561	0.605	1.580	0.295	1.576
SGR-14.4-0A6	0.606	0.645	1.580	0.295	1.576
SGR-15.4-0A6	0.646	0.685	2.080	0.295	2.076
SGR-16.4-0A6	0.686	0.730	2.080	0.295	2.076
SGR-17.6-0A6	0.731	0.774	2.080	0.295	2.076
SGR-18.7-0A6	0.775	0.815	2.080	0.295	2.076
SGR-19.7-0A6	0.816	0.855	2.080	0.295	2.076
SGR-20.7-0A6	0.856	0.895	2.080	0.295	2.076
SGR-21.7-0A6	0.896	0.935	2.080	0.295	2.076
SGR-22.8-0A6	0.936	0.980	2.080	0.295	2.076
SGR-23.9-0A6	0.981	1.020	2.080	0.295	2.076
SGR-24.9-0A6	1.021	1.060	2.080	0.295	2.076
SGR-25.9-0A6	1.061	1.105	2.080	0.295	2.076
SGR-27.1-0A6	1.106	1.145	2.080	0.295	2.076
SGR-28.1-0A6	1.146	1.185	2.080	0.295	2.076
SGR-29.1-0A6	1.186	1.230	2.080	0.295	2.076
SGR-30.3-0A6	1.231	1.270	2.080	0.295	2.076
SGR-31.3-0A6	1.271	1.310	2.080	0.295	2.076
SGR-32.3-0A6	1.311	1.355	2.080	0.295	2.076
SGR-33.4-0A6	1.356	1.395	2.080	0.295	2.076
SGR-34.4-0A6	1.396	1.435	2.660	0.295	2.656
SGR-35.5-0A6	1.436	1.480	2.660	0.295	2.656
SGR-36.6-0A6	1.481	1.520	2.660	0.295	2.656
SGR-37.6-0A6	1.521	1.560	2.660	0.295	2.656
SGR-38.6-0A6	1.561	1.605	2.660	0.295	2.656
SGR-39.8-0A6	1.606	1.645	2.660	0.295	2.656
SGR-40.8-0A6	1.646	1.685	2.660	0.295	2.656
SGR-41.8-0A6	1.686	1.730	2.660	0.295	2.656
SGR-43.0-0A6	1.731	1.770	2.660	0.295	2.656
SGR-44.0-0A6	1.771	1.810	2.660	0.295	2.656
SGR-45.0-0A6	1.811	1.855	2.660	0.295	2.656
SGR-46.1-0A6	1.856	1.895	2.660	0.295	2.656
SGR-47.1-0A6	1.896	1.935	2.660	0.295	2.656
SGR-48.2-0A6	1.936	1.980	2.660	0.295	2.656
SGR-49.3-0A6	1.981	2.020	2.660	0.295	2.656
SGR-50.3-0A6	2.021	2.060	3.080	0.295	3.076
SGR-51.3-0A6	2.061	2.105	3.080	0.295	3.076
SGR-52.5-0A6	2.106	2.145	3.080	0.295	3.076
SGR-53.5-0A6	2.146	2.185	3.080	0.295	3.076
SGR-54.5-0A6	2.186	2.230	3.080	0.295	3.076
SGR-55.7-0A6	2.231	2.270	3.080	0.295	3.076
SGR-56.7-0A6	2.271	2.310	3.080	0.295	3.076
SGR-57.7-0A6	2.311	2.355	3.080	0.295	3.076
SGR-58.8-0A6	2.356	2.395	3.080	0.295	3.076
SGR-59.8-0A6	2.396	2.435	3.580	0.295	3.576
SGR-60.9-0A6	2.436	2.480	3.580	0.295	3.576
SGR-62.0-0A6	2.481	2.520	3.580	0.295	3.576
SGR-63.0-0A6	2.521	2.560	3.580	0.295	3.576
SGR-64.0-0A6	2.561	2.605	3.580	0.295	3.576
SGR-65.2-0A6	2.606	2.645	3.580	0.295	3.576
SGR-66.2-0A6	2.646	2.685	3.580	0.295	3.576
SGR-67.2-0A6	2.686	2.730	3.580	0.295	3.576
SGR-68.4-0A6	2.731	2.770	3.580	0.295	3.576
SGR-69.4-0A6	2.771	2.810	3.580	0.295	3.576
SGR-70.4-0A6	2.811	2.855	3.580	0.295	3.576
SGR-71.5-0A6	2.856	2.895	3.580	0.295	3.576
SGR-72.5-0A6	2.896	2.935	4.080	0.295	4.076
SGR-73.6-0A6	2.936	2.980	4.080	0.295	4.076
SGR-74.7-0A6	2.981	3.020	4.080	0.295	4.076
SGR-75.7-0A6	3.021	3.060	4.080	0.295	4.076
SGR-76.7-0A6	3.061	3.105	4.080	0.295	4.076
SGR-77.9-0A6	3.106	3.145	4.080	0.295	4.076
SGR-78.9-0A6	3.146	3.185	4.080	0.295	4.076
SGR-79.9-0A6	3.186	3.230	4.080	0.295	4.076
SGR-81.1-0A6	3.231	3.270	4.080	0.295	4.076
SGR-82.1-0A6	3.271	3.310	4.080	0.295	4.076
SGR-83.1-0A6	3.311	3.355	4.080	0.295	4.076
SGR-84.2-0A6	3.356	3.395	4.080	0.295	4.076
SGR-85.2-0A6	3.396	3.435	4.580	0.295	4.576
SGR-86.3-0A6	3.436	3.480	4.580	0.295	4.576
SGR-87.4-0A6	3.481	3.520	4.580	0.295	4.576
SGR-88.4-0A6	3.521	3.560	4.580	0.295	4.576
SGR-89.4-0A6	3.561	3.605	4.580	0.295	4.576
SGR-90.6-0A6	3.606	3.645	4.580	0.295	4.576
SGR-91.6-0A6	3.646	3.685	4.580	0.295	4.576
SGR-92.6-0A6	3.686	3.730	4.580	0.295	4.576
SGR-93.8-0A6	3.731	3.770	4.580	0.295	4.576
SGR-94.8-0A6	3.771	3.810	4.580	0.295	4.576
SGR-95.8-0A6	3.811	3.855	4.580	0.295	4.576
SGR-96.9-0A6	3.856	3.895	4.580	0.295	4.576
SGR-97.9-0A6	3.896	3.935	5.080	0.295	5.076
SGR-99.0-0A6	3.936	3.980	5.080	0.295	5.076
SGR-100.1-0A6	3.981	4.020	5.080	0.295	5.076
SGR-101.1-0A6	4.021	4.060	5.080	0.295	5.076
SGR-102.1-0A6	4.061	4.105	5.080	0.295	5.076
SGR-103.3-0A6	4.106	4.145	5.080	0.295	5.076
SGR-104.3-0A6	4.146	4.185	5.080	0.295	5.076
SGR-105.3-0A6	4.186	4.230	5.080	0.295	5.076
SGR-106.5-0A6	4.231	4.270	5.080	0.295	5.076
SGR-107.5-0A6	4.271	4.310	5.080	0.295	5.076
SGR-108.5-0A6	4.311	4.355	5.080	0.295	5.076
SGR-109.6-0A6	4.356	4.395	5.080	0.295	5.076
SGR-110.6-0A6	4.396	4.435	5.580	0.295	5.576
SGR-111.7-0A6	4.436	4.480	5.580	0.295	5.576
SGR-112.8-0A6	4.481	4.520	5.580	0.295	5.576
SGR-113.8-0A6	4.521	4.560	5.580	0.295	5.576
SGR-114.8-0A6	4.561	4.605	5.580	0.295	5.576
SGR-116.0-0A6	4.606	4.645	5.580	0.295	5.576
SGR-117.0-0A6	4.646	4.685	5.580	0.295	5.576
SGR-118.0-0A6	4.686	4.730	5.580	0.295	5.576
SGR-119.2-0A6	4.731	4.770	5.580	0.295	5.576
SGR-120.2-0A6	4.771	4.810	5.580	0.295	5.576
SGR-121.2-0A6	4.811	4.855	5.580	0.295	5.576
SGR-122.3-0A6	4.856	4.895	5.580	0.295	5.576
SGR-123.3-0A6	4.896	4.935	6.080	0.295	6.076
SGR-124.4-0A6	4.936	4.980	6.080	0.295	6.076
SGR-125.5-0A6	4.981	5.020	6.080	0.295	6.076
SGR-126.5-0A6	5.021	5.060	6.080	0.295	6.076
SGR-127.5-0A6	5.061	5.105	6.080	0.295	6.076
SGR-128.7-0A6	5.106	5.145	6.080	0.295	6.076
SGR-129.7-0A6	5.146	5.185	6.080	0.295	6.076
SGR-130.7-0A6	5.186	5.230	6.080	0.295	6.076
SGR-131.9-0A6	5.231	5.270	6.080	0.295	6.076
SGR-132.9-0A6	5.271	5.310	6.080	0.295	6.076
SGR-133.9-0A6	5.311	5.355	6.080	0.295	6.076
SGR-135.0-0A6	5.356	5.395	6.080	0.295	6.076
SGR-136.0-0A6	5.396	5.435	6.580	0.295	6.576
SGR-137.1-0A6	5.436	5.480	6.580	0.295	6.576
SGR-138.2-0A6	5.481	5.520	6.580	0.295	6.576
SGR-139.2-0A6	5.521	5.560	6.580	0.295	6.576
SGR-140.2-0A6	5.561	5.605	6.580	0.295	6.576
SGR-141.4-0A6	5.606	5.645	6.580	0.295	6.576
SGR-142.4-0A6	5.646	5.685	6.580	0.295	6.576
SGR-143.4-0A6	5.686	5.730	6.580	0.295	6.576
SGR-144.6-0A6	5.731	5.770	6.580	0.295	6.576
SGR-145.6-0A6	5.771	5.810	6.580	0.295	6.576
SGR-146.6-0A6	5.811	5.855	6.580	0.295	6.576
SGR-147.7-0A6	5.856	5.895	6.580	0.295	6.576
SGR-148.7-0A6	5.896	5.935	7.080	0.295	7.076
SGR-149.8-0A6	5.936	5.980	7.080	0.295	7.076
SGR-150.9-0A6	5.981	6.020	7.080	0.295	7.076

*Custom Part - No Returns

Bearing Protection Ring Kit for NEMA & IEC Motors

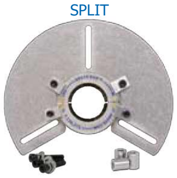
Kits include AEGIS SGR™ Bearing Protection Ring and all mounting hardware

NEMA/IEC Bearing Protection Ring™ Kit

SOLID

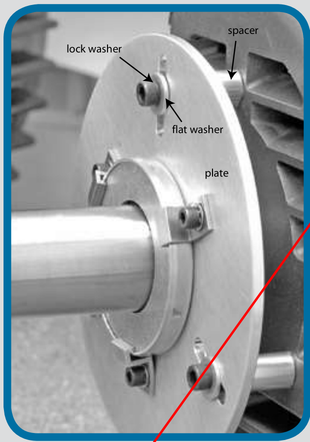
1 AEGIS SGR™
1 mounting plate
3 screws (inches or metric)
3 washers
3 lock washers
3 spacers*

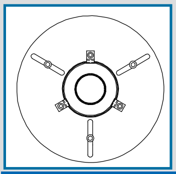
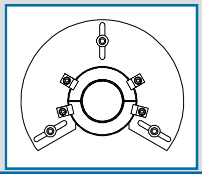
SPLIT



1 AEGIS Split Ring SGR™
1 split mounting plate
3 screws (inches or metric)
3 washers
3 lock washers
3 spacers*

* each kit includes 3 spacer lengths: 1/4", 1/2", and 1" for NEMA kits and 7mm, 17mm, and 27mm for IEC kits.



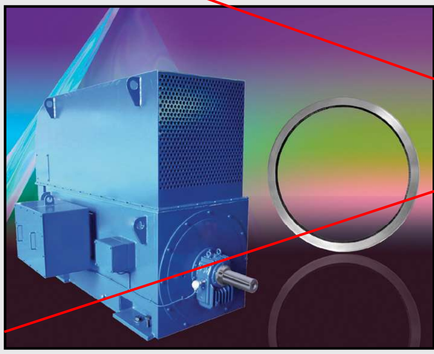
NEMA Motors Solid	NEMA Motors Split			
Catalog Number	**Catalog Number**	Motor shaft diameter "u"	NEMA Frame	Plate OD
SGR-0.625-NEMA	**SGR-0.625-NEMA-1A4**	0.625"	56	3.75"
SGR-0.875-NEMA	**SGR-0.875-NEMA-1A4**	0.875"	143T, 145T	5.60"
SGR-1.125-NEMA	**SGR-1.125-NEMA-1A4**	1.125"	182T, 184T	5.60"
SGR-1.375-NEMA	**SGR-1.375-NEMA-1A4**	1.375"	213T, 215T	5.60"
SGR-1.625-NEMA	**SGR-1.625-NEMA-1A4**	1.625"	254T, 256T	6.30"
SGR-1.875-NEMA	**SGR-1.875-NEMA-1A4**	1.875"	284T, 286T, 324TS, 326TS, 364TS, 365TS	6.30"
SGR-2.125-NEMA	**SGR-2.125-NEMA-1A4**	2.125"	324T, 326T, 404TS, 405TS	6.60"
SGR-2.375-NEMA	**SGR-2.375-NEMA-1A4**	2.375"	364T, 365T, 444TS, 445TS, 447TS, 449TS	6.60"
SGR-2.875-NEMA	**SGR-2.875-NEMA-1A4**	2.875"	404T, 405T,	7.30"
SGR-3.375-NEMA	**SGR-3.375-NEMA-1A4**	3.375"	444T, 445T, 447T, 449T	7.60"

IEC Motors Solid	IEC Motors Split			
Catalog Number	**Catalog Number**	IEC shaft diameter	IEC Frame	Plate OD
SGR-19-IEC	**SGR-19-IEC-2A4**	19mm	IEC 80 (2, 4, 6, 8 pole)	142mm
SGR-24-IEC	**SGR-24-IEC-2A4**	24mm	IEC 90S, 90L (2, 4, 6, 8 pole)	142mm
SGR-28-IEC	**SGR-28-IEC-2A4**	28mm	IEC 100L, 112M (2, 4, 6, 8 pole)	142mm
SGR-38-IEC	**SGR-38-IEC-2A4**	38mm	IEC 132S, 132M (2, 4, 6, 8 pole)	160mm
SGR-42-IEC	**SGR-42-IEC-2A4**	42mm	IEC 160M, 160L (2, 4, 6, 8 pole)	160mm
SGR-48-IEC	**SGR-48-IEC-2A4**	48mm	IEC 180M, 180L (2, 4, 6, 8 pole)	160mm
SGR-55-IEC	**SGR-55-IEC-2A4**	55mm	IEC 200L (2, 4, 6, 8 pole); IEC 225S, 225M (2 pole)	168mm
SGR-60-IEC	**SGR-60-IEC-2A4**	60mm	IEC 225S, 225M (4, 6, 8 pole) ; IEC 250M (2 pole)	168mm
SGR-65-IEC	**SGR-65-IEC-2A4**	65mm	IEC 250M (4, 6, 8 pole); IEC 280M, 280S, 315S, 315M, 315L (2 pole)	185mm
SGR-75-IEC	**SGR-75-IEC-2A4**	75mm	IEC 280S, 280M (4, 6, 8 pole); IEC 355M, 355L (2 pole)	193mm
SGR-80-IEC	**SGR-80-IEC-2A4**	80mm	IEC 315S, 315M, 315L (4, 6, 8 pole)	193mm
SGR-95-IEC	**SGR-95-IEC-2A4**	95mm	IEC 335L, 335M, 355L, 355M (4, 6, 8, 10 pole)	211mm

Custom Kits available for shaft diameters not shown above

- Easy to order and install for any NEMA or IEC frame size
- Clears any slinger, shaft shoulder or protrusion
- Adjustable slots adapt to most end bells
- Rigid mounting plate ensures alignment
- Split Ring kit allows for installation without decoupling equipment

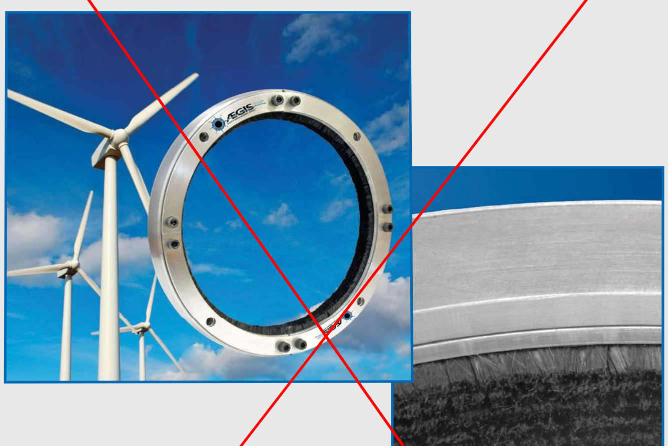
Custom Applications



AEGIS SGR™ Bearing Protection Ring™ for Large Shaft Diameters

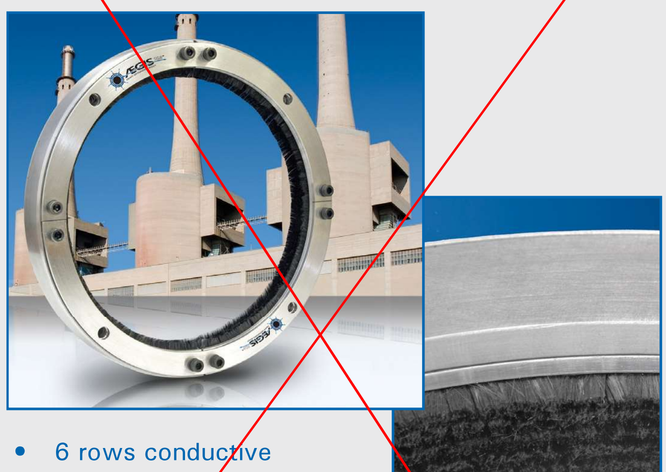
- For shaft diameters greater than 6″ (152.4mm)
- Long term reliable performance
- Maintenance free system
- Available in solid or split ring design

AEGIS WTG™ Wind Turbine Bearing Protection



- 6 rows conductive microfiber
- High current capable
- AEGIS WTG™ shaft current monitoring compatible
- Long term reliable performance
- Maintenance free system
- Up-tower retrofit capable split ring configuration

AEGIS iPRO™ High Current Bearing Protection for Large Motors and Generators



- 6 rows conductive microfiber
- High current capable
- AEGIS iPRO shaft current monitoring compatible
- Long term reliable performance
- Maintenance free system
- Available in sizes up to 30″ (762mm) shaft diameter

WARRANTY: Units are guaranteed for one year from date of purchase against defective materials and workmanship. Replacement will be made except for defects caused by abnormal use or mishandling. All statements and technical information contained herein, or presented by the manufacturer or his representative are rendered in good faith. User must assume responsibility to determine suitability of the product for intended use. The manufacturer shall not be liable for any injury, loss or damage, direct or consequential arising out of the use, or attempt to use the product.

Patent Numbers: 7,136,271: 7,193,836: and other patents pending

Engineering Specification:

All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber shaft grounding ring (AEGIS SGR) to discharge shaft currents to ground.
Recommended part: AEGIS SGR™ Bearing Protection Ring

AEGIS SGR™ BEARING PROTECTION RING™

CONSULTING - SPECIFYING engineer 2009 PRODUCT OF THE YEAR Finalist

Plant Engineering PRODUCT of the YEAR 2007 Winner

2007 FROST & SULLIVAN
North American Motors & Drives
Product Value Leadership of the Year Award

2007 design news GOLDEN MOUSETRAP Finalist

CONSULTING - SPECIFYING engineer A Perfect 10
2006 Product of the Year Silver Winner

Catalog No. 2009-1

Electro Static Technology™
An ITW Company
31 Winterbrook Road
Mechanic Falls, Maine 04256 USA
Tel.: 866-738-1857
Fax: 207-998-5143
www.est-aegis.com

Low Voltage Motors - Technical Bulletin - LVTB 04052024-1

Topic:	Insulated Bearings and Brackets
Issue Date:	April 5, 2024
Issued by	Dale Basso
Distribution List:	LV AEs, Inside Sales, Outside sales Service & Warranty

Preface: Shaft currents have become an increasing issue with modern Variable Frequency Drives and Higher switching frequencies? This creates a need to protect bearings from electrical damage.

The Basics:

Practical experience and international standards show that bearing insulation is an effective solution to prevent bearing damages due to electric currents flowing through the bearings. These currents can be caused by electromagnetic unbalances, by electrostatic effects, or by the high frequency common mode voltage from frequency converters. Bearing insulation can be made in different effective ways, as shown in IEC 60034-25 – Clause 8.4.2 (Figure 1), as well as NEMA ICS 7.2-2021 -5.2.10.

There are three components of shaft/bearing currents

- **Stator to Frame capacitive currents**
  - Higher frequencies caused by switching
  - Standard ground is not the desire return path to the drive
  - May take path through bearings, shaft and driven load
  - Best solution excellent low impedance return path back to the VFD (VFD Cable & Ground straps)

- **Stator to Rotor capacitive currents**
  - Created in rotor looking for path to source (VFD)
  - Path of least resistance may be:
    - Through driven equipment bearings
    - Through motor bearings
    - Best solution is motor drive end shaft ground brush plus Excellent Low impedance return path to VFD

- **Motor circulating currents -** Typically motors above 400T Frames (>100HP)
  - Caused by asymmetry in Magnetic field axially along the rotor
  - Typically, low frequencies on Sine wave- Higher frequencies on VFD
  - Best solution – Insulated ODE bearing (or bearing housing) and DE Shaft Ground brush plus Excellent low impedance return path to VFD

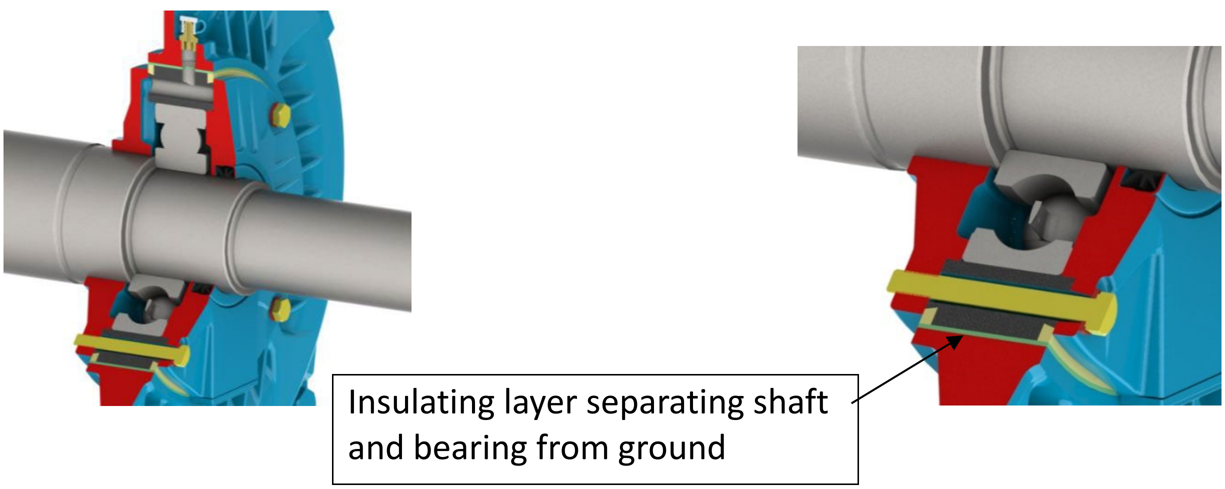
What is the difference between an insulated bearing housing and an insulated bearing?

Both provide the same benefit, as referenced in IEC 60034-25 and EASA AR100. That is to provide a layer of insulation to break the High frequency capacitive current across the bearing.

The effectiveness is measured in Ohms at high frequency not DC. According to IEC 60034-25 and EASA AR100 standards; in order to assure effective protection against bearing currents, the bearing impedance should be ≥ 100 Ω at 1 MHz.

- Popular **ceramic coated Insulated bearings** exceed 50-100 Ohms @1MHZ

- **WEG Insulated End Bracket** – 100+ Ohms @1MHZ
  The advantage of the Insulated bearing housing is that it is more effective than the ceramic coated bearings at a comparable cost, and allows future bearing replacements to utilize standard readily available bearings which cost less than the special insulated bearings.



- **Ceramic Ball bearings** – >200 Ohms @1MHz

BEST PRACTICES FOR VARIABLE FREQUENCY DRIVE (VFD) APPLICATIONS

VFD-induced shaft voltage can exist in every VFD driven motor application. It is not specific to the air movement industry, nor is it specific to any particular manufacturer's motors, drives or equipment. However, shaft voltage only becomes a problem when it leads to bearing current and consequential damage to the motor bearings.

NOTICE!

Risk of serious machine damage!
Appropriate measures must be implemented by the installation contractor to limit the shaft induced voltage to 1V – 2V as per IEEE 112.

Figure 1 Bearing damage caused by EDM

Frequency converters (also known as variable frequency drives or VFD's) can induce a voltage on the shafts of drive motors and stages due to the high switching frequencies used in these drives. Shaft voltage can become a problem when it reaches a high enough level to discharge across the bearings, causing electrical discharge machining (EDM) and creating small grooves called fluting which can lead to premature bearing failure. The potential for this induced shaft voltage exists in every VFD driven motor application and must be addressed on an installation specific basis.

VFD induced voltage is a phenomenon that is somewhat rare and unpredictable. As additional protection, Aerzen USA offers options for mitigating induced shaft currents such as grounding rings and isolated motor non drive end bearings. Even with these options installed, there is no guarantee that this phenomenon will be entirely eliminated. Damage to the motor bearings from shaft / bearing currents is not covered by warranty from Aerzen, the motor manufacturer or VFD manufacturer.

GENERAL RECOMMENDATIONS:

Motors up to and including 100HP (75kW) – Low Voltage

For induction motors either foot mounted, c-face or d-flange mounted motors with single row radial ball bearings on both ends of the motors

- Install one AEGIS SGR Bearing Protection Ring on either the drive end or the non-drive end of the motor to discharge capacitive induced shaft voltage.

Motors Greater than 100HP (75kW)

For horizontally mounted motors with single row radial ball bearings on both ends of the motor:

- Non-Drive End (Opposite Drive End): Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive End: Install one AEGIS Bearing Protection Ring.

Motors in Hazardous Areas

Grounding rings are permitted. Consult Aerzen USA or your motor supplier for specific recommendations.

AERZEN	**Aerzen USA Corporation** 108 Independence Way, Coatesville, PA 19320 Tel: (610) 380-0244 Fax: (610) 380-0278 website www.aerzen.com/en-us	**VFD SETTINGS** **Date**: **5-Sep-24** **Revision #**: **-**

REFERENCE INFORMATION

Document No. BC-6-0239 rev "Q"

Sales Order No.	SO-24-00272	Equip. No.	blank	VFD Manufacturer	-
Wiring Diagram	-	Machine	blank	VFD Model No.	-

GENERAL DESIGN REQUIREMENTS

1. Parameter Settings and Nos. will be included only in the case of the VFD being provided by AERZEN USA, otherwise this area can be used by customer for reference information regarding settings & parameter nos.
2. The highest voltage increase rate is 1200 V / micro second.
3. Install filter, output reactor if e.g. the cabling exceeds i.e. >200', etc.
4. Minimum Frequency is set to protect the blower from insufficient gear lubrication. Additional safety features (i.e. motor over-temp. or high discharge temp.) may trigger a shutdown before minimum speed is reached.
5. When starting VFD, motor speed must reach Min. Frequency with in 3-5 seconds
6. Rate Ramp (Acceleration Time) between Min Frequency and Max. Frequency should be set to 1 Hz/s. Also, the Deceleration Time between Max. and Min. should be set to 1 Hz/s
7. When the a stop command is supplied, the Motor should be set to "Coast-to-Stop", and must not restart until the motor has come to a completed stop. A stop command could also be an emergency stop, fault, or power failure.
8. VFD should be set to a Constant Torque Mode (Note: All motors have a 1.0 service factor when used with a VFD)

PROJECT SPECIFIC PARAMETERS	SETTING	PARAMETER No.[1]
Horsepower (kilowatt)	125 HP (93 kW)	
Voltage	575	
Full Load Amps (Motor Over Current)	111	
Maximum Frequency	60	
Minimum Frequency	22	
Time to Minimum Speed	3 - 5 sec.	
Ramp Rate	1 Hz / sec.	

SECTION 6

Component Breakdown

Component	Material	Protection Method (Standard)	Quality Document (Standard)	Protection Method (Upgrade)	Quality Document (Upgrade)
Base/Silencer*	Carbon Steel	Painted Externally (Solvent Based)	QH-00408	SikaCor Zinc R	QH-00510
Belt Guard	Galvanized Sheet Metal	N/A	N/A	N/A	N/A
Belt Guard Supports	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Blower Stage	Cast Carbon Steel	Painted Externally (Water Based)	QH-00408	SikaCor Zinc R	QH-00510
Connecting Housing (DN50)	Cast Aluminum	N/A	N/A	N/A	N/A
Connecting Housing (DN80 - DN250)	Cast Iron	Powder Coated	QH-00552	SikaCor Zinc R	QH-00510
Fasteners - Bolts, Studs, Nuts	Carbon Steel	Zinc Coated	N/A	N/A	N/A
Flex Connector	Silicone	N/A	N/A	N/A	N/A
Hose Clamps	Carbon Steel	Zinc Coated	N/A	N/A	N/A
Inlet Filter/ Silencer Housing	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450
Inlet Hose	Reinforced Rubber	N/A	N/A	N/A	N/A
Inlet Silencer	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450
Motor Mounting Hardware	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Piping (Galvanized)	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Piping (Painted)	Carbon Steel	Painted Externally	QH-00408	SikaCor Zinc R	A-6-450
Pressure Safety/Vacuum Breaker Valves	Carbon Steel (Flange)	Painted Flange	QH-00408	N/A	N/A
Sound Enclosure - Base	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	QH-00510
Sound Enclosure	Galvanized Sheet Metal	Powder Coated	QH-00419	SikaCor Zinc R	QH-00510
Vent Silencer	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450

*If made in the USA, Protection Method goes from Painted Externally to Powder Coated (A-6-450)

General Painting Information

The machine castings are fettled, cleaned and primed; the primer used is specially developed for machinery parts and is particularly notable for its excellent bonding characteristic and elasticity. Its base is a quick drying synthetic resin binder possessing a high degree of water resistance. The proportion of pigment to binder is such to ensure the best protection for the machines.
Total dry Film Thickness: 70 µm (2.75 mil)

Surface Preparation	Sand blasting, mechanical cleaning to near white surfaces per SA 2,5 acc. to DIN ISO 8501 or SSPC10	
Primer	Alkyd Resin: RAL 6006	Manufacturer: Relius Coatings
Final Coat	Alkyd Resin: RAL 5001 (Blue)	Manufacturer: Relius Coatings (BASF) or Dr. Demuth GmbH

General Powder Coating Information

SP Polyester Powder Paint, RAL 5001, structure, glossy
Relius No.: I536-5401
Total dry film thickness: 80 - 110µm

General Upgraded Protection Information

Surface Preparation	Sa 2 ½
Priming Coat	SikaCorEG4 (80µm max)
Intermediate Coat	SikaCorEG1 (80µm max)
Finishing Coat	SikaCorEG5 (80µm max)

DIFFUSED AERATION SYSTEM

FINE BUBBLE DIFFUSER

AQUARIUS

Equipment Submittal

Fine Bubble Diffused Aeration System

For
Napanee, Ontario CA WWTP

Equipment Location:
Aqua-Nereda Basins 1-3

Purchaser:
Aqua-Aerobic Systems, Inc.
6306 N. Alpine Rd.
Loves Park, IL 61111
Ph.: 815-654-2501 / Fax: 815-654-8602
P.O.# 1076378

Aquarius Project Manager:
Jerry Truszynski
Ph #: 262-284-0102
Email: jtruszynski@aquariustechnologies.com

Aquarius Contract Number:
24-03140

September 24, 2024
R.0a

AQUARIUS Technologies LLC

Fine Bubble Flexible Membrane Disc Aeration System

Table of Contents

Section 1 – Equipment Data

Please see Section 1 in AASI Submittal for all warranty information

a. ~~Warranty~~

b. **Aeration System Data Sheets**

c. **Spare Parts / Special Tools List**

Project: Napanee, Ontario, CA
Project #: 24-03140

Fine Bubble Aeration Equipment Data Sheet

AGS Basins 1-3

Upper Dropleg

Material: 304L Stn Stl.

Qty	Size	Wall Thickness
6	6"	Sch 5S

Lower Dropleg

Material: PVC

Qty	Size	Wall Thickness
6	6"	Sch 40

Manifold

Material: PVC

Qty	Size	Wall Thickness
6	6"	Sch 40

Headers

Material: PVC
Size: 4.215" O.D.
Wall Thickness: SDR 24.5 (0.173")

Moisture Purge System

Type: Continuous
Material: EPDM/Polypropylene

Supports

Material: 304 Stn. Stl.

Location	Size
Dropleg	5/8" dia. Threaded Rod
Manifold	5/8" dia. Threaded Rod
Header	1/2" dia. Threaded Rod

Support Notes

Add struts to supports where shown on drawings

Anchors

Material: 304 Stn. Stl.
Type: Hilti HY-100 Adhesive

Location	Size
Dropleg	1/2" dia. Threaded Rod
Manifold	1/2" dia. Threaded Rod
Header	1/2" dia. Threaded Rod

Anchor Notes

*1/2" anchors for dropleg/manifold struts
*3/8" anchors for header struts

Project: **Napanee, Ontario, CA**
Project #: **24-03140**

Fine Bubble Aeration Equipment Data Sheet

AGS Basins 1-3

Diffuser

Type: 9" Membrane - Low Pressure
Material: EPDM
Orifice: 13/64" dia.

Aeration Grid Layout

Basin	# of Basins	Dropleg Dia.	Grids / Basin	Headers / Grid	Holders / Header	Holders / Grid	Installed Diffusers / Grid	Blank Diffusers / Grid	Total Diffusers This Grid Type
AGS Basins 1-3	3	6"	2	15	19	285	285	0	1710

Total Holders: 1,710
Total Diffusers: 1,710

Spare Parts / Special Tools List
(None required or recommended)

ITEM	PART #	QUANTITY

For spare and replacement parts contact:

Aquarius Technologies LLC
420 Technology Way, Suite D
Saukville, WI 53080
Ph: 262-268-1500
Fx: 262-268-1515

- Freight and all applicable sales taxes will be added to the total
- To place an order, the following information will be required:

A. Purchase order number followed up by a formal purchase order.
B. The bill to, ship to address.
C. If your purchase is tax exempt, please fax a copy of your tax exemption certificate to us at 262-268-1515.
If you are not tax exempt, please provide your sales tax rate.

Section 2 – Equipment Design

a. Material & Manufacturing Specifications

b. ~~Submittal Drawings S-1 thru S-7~~

Please see Section 7 in AASI Submittal for all drawing information

NAME: MATERIAL & MANUFACTURING SPECIFICATIONS	DATE: 05/2/2018
MATERIAL: 304, PVC	DOCUMENT #: SPEC-1

MEMBRANE DISC FINE BUBBLE AERATION SYSTEM

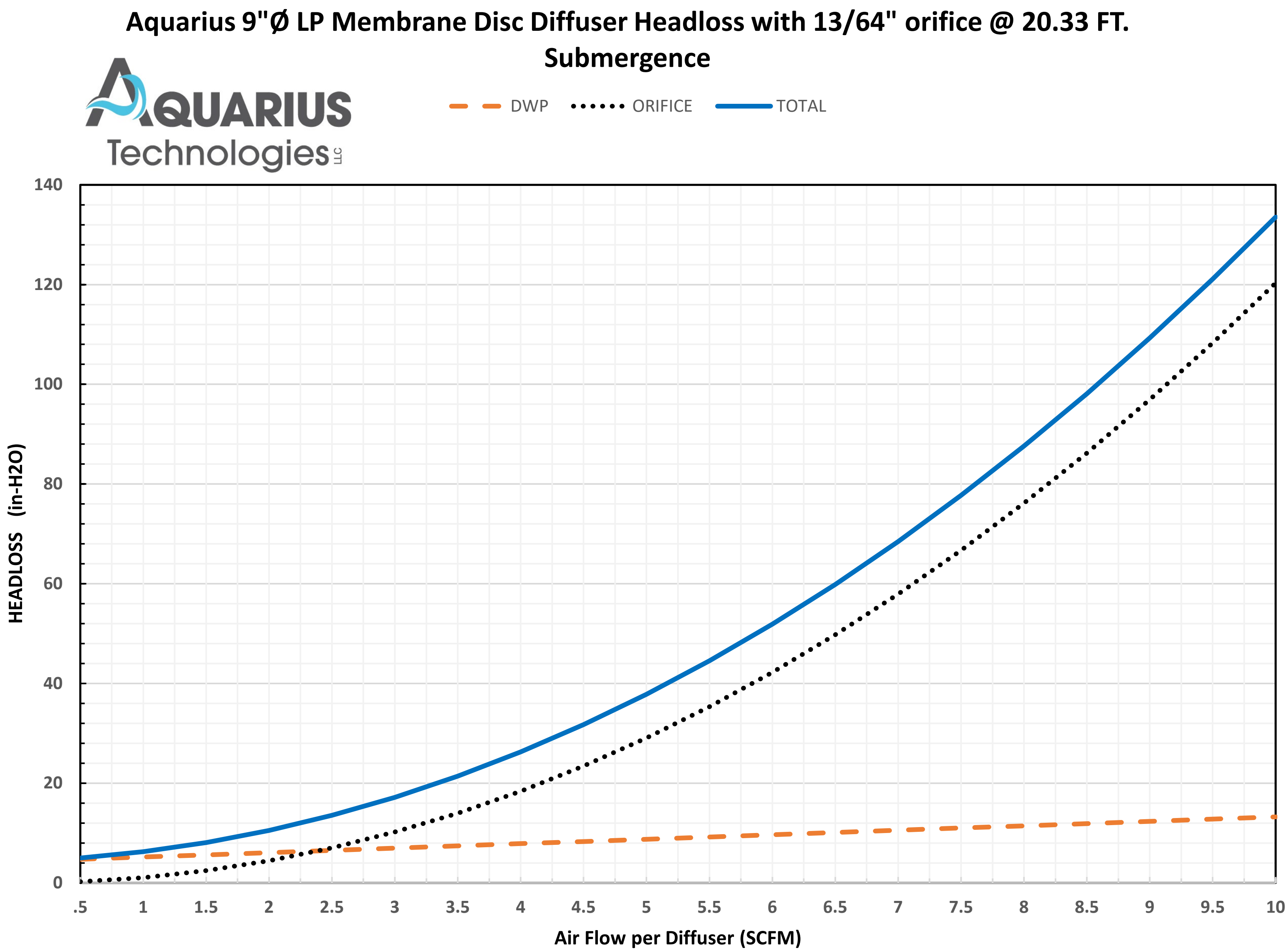
Component	Material Specification	Manufacturing Specification	Note
Dropleg - Upper	304L Stn. Stl. - ASTM A240	Pipe / Tube - ASTM A - 778 Fittings - ASTM A - 774 Cleaning - ASTM A - 380	
Supports	304 Stn. Stl. - ASTM A240 Threaded Rod - ASTM A276 Sheet / Plate - ASTM A240		"L" grade not required for non-welded parts "L" grade required for welded parts
Bolts, Nuts, Washers	18-8 Stn. Stl.		
Dropleg - Lower	PVC - ASTM D1784 Compound - 12454	Pipe - ASTM D1785 Fittings - ASTM D2466	
Manifold (6" & Larger Diameter)	PVC - ASTM D1784 Compound - 12454	Pipe - ASTM D1785 Fittings - ASTM D2466	
Manifold (4" Diameter)	PVC - ASTM D1784 Compound - 12454	Pipe - ASTM D3034 Fittings - ASTM D3034	Minimum 2% Titanium Dioxide
Header	PVC - ASTM D1784 Compound - 12454	Pipe - ASTM D3034 Fittings - ASTM D3034	Minimum 2% Titanium Dioxide
Diffuser Holder, Retainer Ring	PVC - ASTM D1784 Compound - 12454		Minimum 2% Titanium Dioxide
Union Joint	PVC - ASTM D1784 Compound - 12454	Pipe - ASTM D3034 Fittings - ASTM D3034	Minimum 2% Titanium Dioxide
PVC Solvent Glue	ASTM 2564	ASTM D2855	
Union Joint O-Ring	Natural Rubber / SBR		45 +/- Durometer Shore A
Diffuser Element	EPDM		

Section 3 – System Performance

a. **Low Pressure Membrane Disc Diffuser Headloss Curve**

b. **Performance Model / Headloss Calculations**

c. **Heat Transfer Calculations**


Aquarius 9"Ø LP Membrane Disc Diffuser Headloss with 13/64" orifice @ 20.33 FT. Submergence
DWP
ORIFICE
TOTAL
HEADLOSS (in-H2O)
0
20
40
60
80
100
120
140
.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
Air Flow per Diffuser (SCFM)

Low Pressure Membrane Disc Fine Bubble

Diffused Aeration System Design

for

Napanee, ON WWTP

Aqua-Nereda #171482

Consulting Engineer : Aqua-Aerobic

Aquarius Project Number 24-03140

August 29, 2024

Aeration System Design Parameters

Project Information

Project Name:	**Napanee, ON WWTP**
Aquarius Project Number:	**24-03140**
Tank or Process Label:	**Aqua-Nereda #171482**
Client Engineer:	**Aqua-Aerobic**
Number Design Conditions:	**3**
Total Number Process Trains:	**3**
Number Passes Per Process Train:	**1**
Diffuser Model:	**Low Pressure Membrane Disc Fine Bubble**

Tank Dimensions

	Dim	Common	
Pass Number			**1**
Length	ft	106.5	106.5
Width	ft	55.8	55.8
Water Depth	ft	21	21
Volume	ft3/tank		124796.7
Surface Area	ft2/tank		5942.7
Parallel Passes in each train			1
Number Taper Zones in pass			1
Train Volume	KCF/train	124.7967	
Train Surface Area	ft2/train	5942.7	

Design Conditions (Given)

Condition Label			**AOR**	**SOR**	**SCFM**
Number Trains in Operation			3	3	3
Design Safety Factor	%				
Diffuser submergence	ft	20.33	20.33	20.33	20.33
Plant Elevation	ft	256			
Plant Carbonaceous Loading	lb-CBOD5/d				
Plant Autotrophic Loading	lb-N/d				
Carbonaceous Oxidation Coefficient	O2/CBOD5				
Autotrophic Oxidation Coefficient	O2/N				
Carbonaceous Loading Rate	lb-CBOD5/d-KCF				
AOR	lb-O2/d		28620		
alpha			0.7	0.7	0.7
beta		0.95			
theta		1.024			
Water Temp.	deg.C		20	20	20
Operating D.O.	mg-O2/l		2	2	2
SOR	lb-O2/d			52329.6	
Air Rate	SCFM				6597
Design Conditions (Evaluated)					
C*sc	mg-O2/l		11.27	11.27	11.27
Ct	mg-O2/l		9.14	9.14	9.14
C20	mg-O2/l		9.14	9.14	9.14
Ambient Pressure	Psia	14.61			
AOR/SOR			0.535	0.535	0.535

Aeration System Layout

ITEM	Dimension	Common or Total	
GRID LAYOUT			
Pass Number			**1**
Zone			**1**
Grid Number			**1**
Zone Length	ft		106.50
Zone Width	ft		55.80
Zone Volume	ft3/zone/tank		124,797
Zone Surface Area	ft2/zone/tank		5,943
Parallel Passes in Each Train			1
Train Volume	KCF/train	124.7967	
Train Surface Area	ft2/train	5,943	
Mark with "X" if unaerated			
Orifice Diameter (13/64 is std.)	inch	**13/64**	
Design Fraction Avg. SOTR			100.0%
Number Grids/tank/zone			**2**
Grid Length	ft		53.3
Inlet Temp	deg.F	148	
Compression Factor		0.715	
Max Drop Velocity @ 3 SCFM/disc	fps	55	
Required Dropleg Diameter	**in**		**6**
Dropleg Velocity	ft/s		52.8
GRID DETAIL			
Dist. Parallel with Length (L) or Width (W) of tank?			W
Manifold at End (E) or Center (C) of distributors?			C
Dropleg at End (E) or Center (C) of Manifold?			E
Max Discs/dist			55
Min Discs/dist			14
Max Distributors/Grid			44
Min Distributors/Grid			13
Design Number Discs/Distributor			19
Design Number Distributors			15
Design Discs/Grid			285
Design Density			3.9%
Design At/Ad			25.43
Diffusers/Train		570	570
Distributor Spacing	ft		3.42
Disc Spacing	ft		3.02

Headloss Evaluation

Grid 1 with 285 diffusers

Operating Cond. - **SOR**
Inlet Air - 1088.6 SCFM @ 147.9 deg.F, 9.109 Psig total pressure
Manifold - Dropleg at end, 51.3 ft. long @ 6 inch diameter.
Distributors - Center feed, 15 lines each 54.3 ft. long, @ 4 inch diameter, parallel with tank width.

Node	Pipe I.D. [inch]	Appurt.	Pipe Length [feet]	Flow [SCFM]	Flow [CFM]	Velocity [ft/s]	Headloss [psi]	Total Pressure [psi]	Velocity Head [psi]	Gauge Pressure [psi]
Dropleg										
Nodes 1 to 4: Dropleg Headloss =0.068 psi.										
Manifold										
Nodes 5 to 30: Average Gauge Pressure = 8.988 Psig. Mean headloss to distributors = 0.0528 Psi										
Distributor										
Nodes 31 to 45: Average Gauge Pressure = 8.988 Psig. Mean headloss to diffusers = 0.0003 Psi										
Diffuser										
46	0.203	Orifice		3.8	2.7	202.3	6.620E-01	8.326	4.629E-01	7.863
47		DWP		3.8	2.7	0.0	2.783E-01	8.048	0.000E+00	8.048
48		Subm.		3.8	2.7	0.0	8.809E+00	-0.761	0.000E+00	-0.761

Summary

Required Total Pressure at Top of Dropleg = 9.87 Psig
Max. Gauge Pressure Differential [psi]: Manifold =0.01104, Distributor = 0.00006. TOTAL = 0.01109
(Diff. Orifice HL)/(Total Gauge Pressure Differential) = 59.669

Aeration Performance Table

CONDITION:	Dimension	Common	AOR	SOR	SCFM
OVERALL SUMMARY					
Total Number Diffusers in Plant		1710			
Total Number Grids in Plant		6			
Number Trains in Operation			3	3	3
Total Aerated Volume	ft3		374,390	374,390	374,390
Total AOR	lbs-O2/plant-d		28,620		
AOR/SOR			0.535	0.535	0.535
Total SOR	lbs-O2/plant-d		53,472	52,329	52,772
Total Air Rate	SCFM/plant		6,701	6,532	6,597
Diffuser Air Rate	SCFM/diff		3.92	3.82	3.86
SOTE			31.85%	31.97%	31.93%
Max Dropleg Pressure	Psig		9.91	9.87	9.89
Est. Blower Pressure	Psig		10.21	10.17	10.19
Est. Blower Efficiency		0.7			
Est. Blower Power	BHP		350.2	340.1	344.0
Est. Motor Load	KW		284.0	275.8	279.0
Est. SAE	lbs-O2/KWH		7.8	7.9	7.9
Oxygen Transfer Safety Factor		0.0%			
Pass 1, Zone 1 - Grid 1					
1 tank(s)/pass/train, 2 grid(s)/tank, 2 grid(s)/train, 6 grid(s) total, 6 inch dropleg.					
Sub-total Operating Volume	ft3/zone		374,390	374,390	374,390
Number Grids in Operation			6	6	6
Diffuser Floor Density		3.9%			
Number Diffusers in Operation			1,710	1,710	1,710
Diffuser Air Rate	SCFM/diff		3.919	3.820	3.858
Surface Mixing Rate	SCFM/ft2				
Sub-Total Air Rate	SCFM/zone		6,701	6,532	6,597
SOTE			31.85%	31.97%	31.93%
Sub-total SOR	lbs-O2/d-zone		53,472	52,329	52,772
SOTR	mg-O2/l-h		95.2	93.2	94.0
Diffuser Headloss	in-water		27.1	26.0	26.5
Dropleg Pressure	Psig		9.91	9.87	9.89

AQUARIUS Technologies LLC

Heat Transfer Calculations

Project: Napenee WWTP
Job #: 24-03140
Location: Napanee, ON, CA

Input Values	**No Cooling Loop Required!**		
Upper Dropleg Material	Stainless Steel		
Lower Dropleg Material	PVC		
Air Distributor Material	PVC		
Is There An Airmain?	No		
	Stainless Steel		
Are There Multiple Airmain Sections?	No		
PVC Distributor Wall Thickness	0.173	inches	
Air Flow	1675.00	SCFM	1117 SCFM * 1.5 Air Bump = 1675 SCFM
Wastewater Temperature	68.00	deg F	
Stainless Steel Dropleg Thickness	0.109	inches	
Dropleg Outer Diameter	6.625	inches	
Dropleg Length in Wastewater	18.33	feet	18.33 ft SS drop leg
Atmospheric Pressure	14.720	PSI	
Wastewater Velocity	1.00	ft/s	
Diffuser Submergence	20.33	feet	
Blower Discharge Temperature	228.00	deg F	
Number of Distributors per Grid	15		

Calculated Temperatures

Air Exiting Air Main Section	**228.00**	**Deg F**
Air Exiting Upper Dropleg	**191.32**	**Deg F**
Lower PVC Dropleg Wall (Air Side)	**166.94**	**Deg F**
Lower PVC Dropleg Wall (Water Side)	**70.49**	**Deg F**
Lower PVC Dropleg Mean Wall	**118.71**	**Deg F**
PVC Distributor Wall (Air Side)	**116.72**	**Deg F**
PVC Distributor Wall (Water Side)	**69.79**	**Deg F**
PVC Distributor Mean Wall	**93.25**	**Deg F**

Maximum Alllowable Mean Wall Temperatures are 130°F PVC and 170°F CPVC

Section 5 – General Supplier Cut Sheets

a. **Hilti HY-100 Adhesive Anchor System**

b. **JCM Clamp Coupling**

c. **Flexcap Diffuser (Continuous Purge)**

EVERYDAY SOLUTION FOR FAST-CURE CHEMICAL ANCHORING

HIT-HY 100 Adhesive Anchor

EVERYDAY SOLUTION FOR FAST-CURE CHEMICAL ANCHORING

Hybrid Adhesive HIT-HY 100

Hilti HIT-HY 100 is the everyday fast-cure mortar that provides the quality you've come to expect from Hilti at an economical price. HIT-HY 100 has approvals for cracked and un-cracked concrete and grout filled CMU, making HIT-HY 100 more versatile for rebar doweling and anchoring.

Take reliability, safety, and productivity to a new level with HIT-HY 100 and SafeSet technology by eliminating the manual hole cleaning step. With the TE-CD and TE-YD hollow bits and the VC 150 and VC 300 series vacuums, you can increase productivity up to 60% while achieving correct hole preparation and OSHA 1926.1153 Table 1 compliance.

APPLICATIONS AND ADVANTAGES

- Suitable for use in un-cracked concrete and cracked concrete with all anchor rods and rebar per ICC-ES approval (International Code Council — Evaluation Service)
- Suitable for use in grout-filled CMU for anchor rods per IAPMO-UES (IAPMO-UES (International Association of Plumbing and Mechanical Officials Uniform Evaluation Service)
- Anchoring light structural steel connections (e.g. steel columns, beams)
- Rebar doweling / connection of secondary post-installed rebar
- Easy and accurate dispensing with HDE 500-A22 battery dispenser
- SafeSet technology — automatic hole cleaning with TE-CD / TE-YD hollow drill bits and VC 150/300 vacuum

2015 IBC®
Compliant Anchor

HILTI

Technical data

Product	Hybrid Urethane Methacrylate
Base material temperature	14° F to 104° F (-10° C to 40° C)
Diameter range	3/8" to 1-1/4"
Package volume	• Volume of HIT-HY 100 11.1 fl oz/330 ml foil pack is 20.1 in³ • Volume of HIT-HY 100 16.9 fl oz/500 ml foil pack is 30.5 in³

Description	Qty of foil packs	Item number
HIT-HY 100 (11.1oz/330ml)	1	2078494
HIT-HY 100 Master Carton (11.1oz/330ml)	25	3510989
HIT-HY 100 Master Carton (11.1oz/330ml) + HDM 500	25	3510991
HIT-HY 100 Master Carton (16.9oz/500ml)	20	2078495
(2) HIT-HY 100 Master Cartons (16.9oz/500ml) + HDM 500	40	3511063
(2) HIT-HY 100 Master Cartons (16.9oz/500ml) + HDE 500 Kit	40	3511064
HY 100 TE 50 AVR SafeSet Pack	40	3582040

Accessories

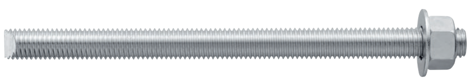
Description	Item number
HDM 500 Manual Dispenser	3498241
HDE 500-A22 Starter Package	3540270

PRODUCT DESCRIPTION

HIT-HY 100 with Threaded Rod, Rebar, and HIS-N/RN Inserts

Mortar system

Hilti HIT-HY 100 Cartridge



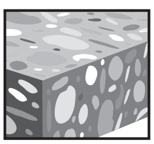
Threaded Rod
HAS
HIT-V

Rebar

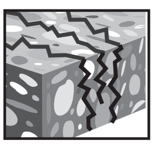
Hilti HIS-N

Features and Benefits

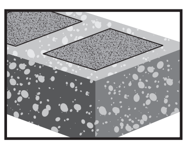
- No additional hole cleaning required after drilling when installed SafeSet™ hollow drill bit technology
- ICC-ES approved for cracked concrete and seismic service
- IAPMO approved for grout-filled concrete masonry
- Anchoring light structural steel connections (e.g. steel columns, beams)
- Anchoring secondary steel elements
- Rebar doweling and connecting secondary post-installed rebar
- Complete anchor system available, including HAS rods, HIT-V rods and HIS-N inserts
- Easy and accurate dispensing with battery dispenser



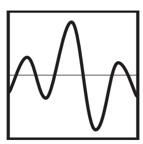
Uncracked concrete



Cracked concrete



Grout-filled concrete masonry



Seismic Design Categories A-F

SAFESET

SafeSet System with Hollow Drill Bit

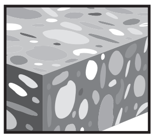
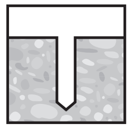
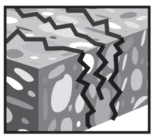
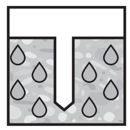
PROFIS Anchor design software

Approvals/Listings	
ICC-ES (International Code Council Evaluation Service)	ESR-3574 (for concrete)
IAPMO-UES (International Association of Plumbing and Mechanical Officials Uniform Evaluation Service)	ER-547 (for grout-filled CMU)
NSF/ANSI Std 61	Certification for use in potable water
City of Los Angeles	LABC Supplement in ESR-3574
U.S. Green Building Council	LEED® Credit 4.1-Low Emitting Materials
Department of Transportation	Contact Hilti for various states

Hilti HIT-HY 100 adhesive with Hilti HAS threaded rod

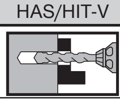
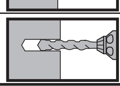
HAS HIT-V

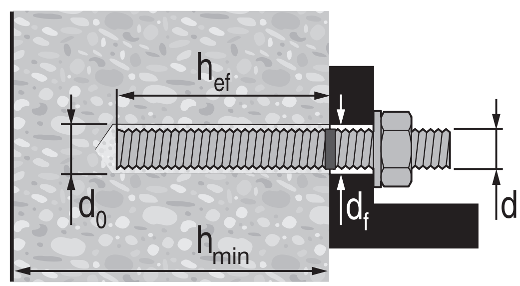
Hilti HAS / HIT-V threaded rod installation conditions

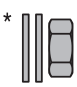
Permissible Base Materials					Permissible Drilling Method		
		Uncracked concrete		Dry Concrete			Hammer Drilling with Carbide Tipped Drill Bit
		Cracked concrete		Water Saturated Concrete			Hollow Drill Bit

Hilti HAS/HIT-V threaded rod installation specifications

Nominal Rod Diameter	Drill Bit Diameter	Embedment Depth Range	Maximum Installation Torque	Minimum Base Material Thickness
d in (mm)	d_0 in	h_{ef} in (mm)	T_{max} ft-lb (Nm)	h_{min} in (mm)
3/8 (9.5)	7/16	2-3/8 – 7-1/2 (60 – 191)	15 (20)	h_{ef} + 1-1/4 (h_{ef} + 30)
1/2 (12.7)	9/16	2-3/4 – 10 (70 – 254)	30 (41)	
5/8 (15.9)	3/4	3-1/8 – 12-1/2 (79 – 318)	60 (81)	h_{ef} + $2d_0$
3/4 (19.1)	7/8	3-1/2 – 15 (89 – 381)	100 (136)	
7/8 (22.2)	1	3-1/2 – 17-1/2 (89 – 445)	125 (169)	
1 (25.4)	1-1/8	4 – 20 (102 – 508)	150 (203)	
1-1/4 (31.8)	1-3/8	5 – 25 (127 – 635)	200 (271)	

d_f	HAS/HIT-V	3/8	1/2	5/8	3/4	7/8	1	1-1/4
$d_{f,1}$		1/2	5/8	13/16*	15/16*	1-1/8*	1-1/4*	1-1/2*
$d_{f,2}$		7/16	9/16	11/16	13/16	15/16	1-1/8*	1-3/8



*


* Use two washers

Table 20 — Hilti HIT-HY 100 adhesive design strength with concrete / bond failure for threaded rod in uncracked concrete [1,2,3,4,5,6,7,8]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ϕN_n				Shear — ϕV_n			
		f'_c = 2500 psi (17.2 Mpa) lb (kN)	f'_c = 3000 psi (20.7 Mpa) lb (kN)	f'_c = 4000 psi (27.6 Mpa) lb (kN)	f'_c = 6000 psi (41.4 Mpa) lb (kN)	f'_c = 2500 psi (17.2 Mpa) lb (kN)	f'_c = 3000 psi (20.7 Mpa) lb (kN)	f'_c = 4000 psi (27.6 Mpa) lb (kN)	f'_c = 6000 psi (41.4 Mpa) lb (kN)
3/8	2-3/8 (60)	2,710 (12.1)	2,760 (12.3)	2,840 (12.6)	2,960 (13.2)	2,920 (13.0)	2,970 (13.2)	3,060 (13.6)	3,185 (14.2)
	3-3/8 (86)	3,850 (17.1)	3,920 (17.4)	4,035 (17.9)	4,205 (18.7)	8,295 (36.9)	8,445 (37.6)	8,695 (38.7)	9,055 (40.3)
	4-1/2 (114)	5,135 (22.8)	5,230 (23.3)	5,380 (23.9)	5,605 (24.9)	11,060 (49.2)	11,260 (50.1)	11,590 (51.6)	12,070 (53.7)
	7-1/2 (191)	8,555 (38.1)	8,715 (38.8)	8,970 (39.9)	9,340 (41.5)	18,430 (82.0)	18,770 (83.5)	19,320 (85.9)	20,120 (89.5)
1/2	2-3/4 (70)	3,555 (15.8)	3,895 (17.3)	4,385 (19.5)	4,565 (20.3)	7,660 (34.1)	8,395 (37.3)	9,445 (42.0)	9,835 (43.7)
	4-1/2 (114)	6,845 (30.4)	6,970 (31.0)	7,175 (31.9)	7,470 (33.2)	14,745 (65.6)	15,015 (66.8)	15,455 (68.7)	16,095 (71.6)
	6 (152)	9,130 (40.6)	9,295 (41.3)	9,565 (42.5)	9,965 (44.3)	19,660 (87.5)	20,020 (89.1)	20,605 (91.7)	21,460 (95.5)
	10 (254)	15,215 (67.7)	15,495 (68.9)	15,945 (70.9)	16,605 (73.9)	32,765 (145.7)	33,370 (148.4)	34,345 (152.8)	35,765 (159.1)
5/8	3-1/8 (79)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,485 (28.8)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	13,970 (62.1)
	5-5/8 (143)	10,405 (46.3)	10,895 (48.5)	11,210 (49.9)	11,675 (51.9)	22,415 (99.7)	23,465 (104.4)	24,150 (107.4)	25,145 (111.9)
	7-1/2 (191)	14,260 (63.4)	14,525 (64.6)	14,950 (66.5)	15,565 (69.2)	30,720 (136.6)	31,285 (139.2)	32,195 (143.2)	33,530 (149.1)
	12-1/2 (318)	23,770 (105.7)	24,210 (107.7)	24,915 (110.8)	25,945 (115.4)	51,200 (227.7)	52,140 (231.9)	53,660 (238.7)	55,880 (248.6)
3/4	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	6-3/4 (171)	13,680 (60.9)	14,985 (66.7)	16,145 (71.8)	16,815 (74.8)	29,460 (131.0)	32,275 (143.6)	34,775 (154.7)	36,210 (161.1)
	9 (229)	20,540 (91.4)	20,915 (93.0)	21,525 (95.7)	22,415 (99.7)	44,235 (196.8)	45,050 (200.4)	46,365 (206.2)	48,280 (214.8)
	15 (381)	34,230 (152.3)	34,860 (155.1)	35,875 (159.6)	37,360 (166.2)	73,725 (327.9)	75,080 (334.0)	77,275 (343.7)	80,470 (357.9)
7/8	3-1/2 (89)	5,105 (22.7)	5,595 (24.9)	6,460 (28.7)	7,910 (35.2)	11,000 (48.9)	12,050 (53.6)	13,915 (61.9)	17,040 (75.8)
	7-7/8 (200)	17,235 (76.7)	18,885 (84.0)	20,500 (91.2)	21,350 (95.0)	37,125 (165.1)	40,670 (180.9)	44,155 (196.4)	45,980 (204.5)
	10-1/2 (267)	26,080 (116.0)	26,560 (118.1)	27,335 (121.6)	28,465 (126.6)	56,170 (249.9)	57,200 (254.4)	58,870 (261.9)	61,305 (272.7)
	17-1/2 (445)	43,465 (193.3)	44,265 (196.9)	45,555 (202.6)	47,440 (211.0)	93,615 (416.4)	95,335 (424.1)	98,120 (436.5)	102,180 (454.5)
1	4 (102)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	9 (229)	21,060 (93.7)	23,070 (102.6)	24,465 (108.8)	25,475 (113.3)	45,360 (201.8)	49,690 (221.0)	52,690 (234.4)	54,870 (244.1)
	12 (305)	31,120 (138.4)	31,695 (141.0)	32,620 (145.1)	33,970 (151.1)	67,030 (298.2)	68,260 (303.6)	70,255 (312.5)	73,160 (325.4)
	20 (508)	51,870 (230.7)	52,820 (235.0)	54,365 (241.8)	56,615 (251.8)	111,715 (496.9)	113,770 (506.1)	117,090 (520.8)	121,935 (542.4)
1-1/4	5 (127)	8,720 (38.8)	9,555 (42.5)	11,030 (49.1)	12,140 (54.0)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
	11-1/4 (286)	25,025 (111.3)	25,490 (113.4)	26,230 (116.7)	27,315 (121.5)	63,395 (282.0)	64,880 (288.6)	66,770 (297.0)	69,535 (309.3)
	15 (381)	33,370 (148.4)	33,985 (151.2)	34,975 (155.6)	36,425 (162.0)	84,940 (377.8)	86,505 (384.8)	89,030 (396.0)	92,710 (412.4)
	25 (635)	55,615 (247.4)	56,640 (251.9)	58,290 (259.3)	60,705 (270.0)	141,570 (629.7)	144,175 (641.3)	148,380 (660.0)	154,520 (687.3)

1 See Section 3.1.8 (2017 PTG) for explanation on development of load values.
2 See Section 3.1.8.6 (2017 PTG) to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Load values are for a single anchor with no spacing, edge distance, or concrete thickness factors. Apply spacing, edge distance, and concrete thickness factors in tables 23-35 as necessary. Compare to the steel values in table 22. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above value by 0.92.
For temperature range C: Max. short term temperature = 210°F (99°C), max. long term temperature = 162°F (72°C) multiply above value by 0.71.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete conditions. For water saturated concrete multiply design strength (factored resistance) by 0.85.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8 (2017 PTG).
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.

Table 21 — Hilti HIT-HY 100 adhesive design strength with concrete / bond failure for threaded rod in cracked concrete [1,2,3,4,5,6,7,8,9]

Nominal anchor diameter in.	Effective embedment in. (mm)	Tension — ϕN_n				Shear — ϕV_n			
		f'_c = 2500 psi (17.2 Mpa) lb (kN)	f'_c = 3000 psi (20.7 Mpa) lb (kN)	f'_c = 4000 psi (27.6 Mpa) lb (kN)	f'_c = 6000 psi (41.4 Mpa) lb (kN)	f'_c = 2500 psi (17.2 Mpa) lb (kN)	f'_c = 3000 psi (20.7 Mpa) lb (kN)	f'_c = 4000 psi (27.6 Mpa) lb (kN)	f'_c = 6000 psi (41.4 Mpa) lb (kN)
3/8	2-3/8 (60)	1,120 (5.0)	1,140 (5.1)	1,170 (5.2)	1,220 (5.4)	1,205 (5.4)	1,225 (5.4)	1,260 (5.6)	1,315 (5.8)
	3-3/8 (86)	1,590 (7.1)	1,620 (7.2)	1,665 (7.4)	1,735 (7.7)	3,425 (15.2)	3,485 (15.5)	3,590 (16.0)	3,735 (16.6)
	4-1/2 (114)	2,120 (9.4)	2,160 (9.6)	2,220 (9.9)	2,315 (10.3)	4,565 (20.3)	4,650 (20.7)	4,785 (21.3)	4,980 (22.2)
	7-1/2 (191)	3,530 (15.7)	3,595 (16.0)	3,700 (16.5)	3,855 (17.1)	7,610 (33.9)	7,750 (34.5)	7,975 (35.5)	8,305 (36.9)
1/2	2-3/4 (70)	1,880 (8.4)	1,915 (8.5)	1,970 (8.8)	2,055 (9.1)	4,050 (18.0)	4,125 (18.3)	4,245 (18.9)	4,425 (19.7)
	4-1/2 (114)	3,080 (13.7)	3,135 (13.9)	3,225 (14.3)	3,360 (14.9)	6,630 (29.5)	6,750 (30.0)	6,950 (30.9)	7,235 (32.2)
	6 (152)	4,105 (18.3)	4,180 (18.6)	4,300 (19.1)	4,480 (19.9)	8,840 (39.3)	9,005 (40.1)	9,265 (41.2)	9,650 (42.9)
	10 (254)	6,840 (30.4)	6,965 (31.0)	7,170 (31.9)	7,465 (33.2)	14,735 (65.5)	15,005 (66.7)	15,445 (68.7)	16,080 (71.5)
5/8	3-1/8 (79)	2,890 (12.9)	2,945 (13.1)	3,030 (13.5)	3,155 (14.0)	6,230 (27.7)	6,345 (28.2)	6,530 (29.0)	6,800 (30.2)
	5-5/8 (143)	5,205 (23.2)	5,300 (23.6)	5,455 (24.3)	5,680 (25.3)	11,210 (49.9)	11,415 (50.8)	11,750 (52.3)	12,235 (54.4)
	7-1/2 (191)	6,940 (30.9)	7,065 (31.4)	7,275 (32.4)	7,575 (33.7)	14,945 (66.5)	15,220 (67.7)	15,665 (69.7)	16,315 (72.6)
	12-1/2 (318)	11,565 (51.4)	11,780 (52.4)	12,125 (53.9)	12,625 (56.2)	24,910 (110.8)	25,370 (112.9)	26,110 (116.1)	27,190 (120.9)
3/4	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,355 (19.4)	4,535 (20.2)	7,790 (34.7)	8,535 (38.0)	9,380 (41.7)	9,765 (43.4)
	6-3/4 (171)	8,010 (35.6)	8,160 (36.3)	8,395 (37.3)	8,745 (38.9)	17,255 (76.8)	17,575 (78.2)	18,085 (80.4)	18,835 (83.8)
	9 (229)	10,680 (47.5)	10,880 (48.4)	11,195 (49.8)	11,660 (51.9)	23,010 (102.4)	23,430 (104.2)	24,115 (107.3)	25,115 (111.7)
	15 (381)	17,805 (79.2)	18,130 (80.6)	18,660 (83.0)	19,435 (86.5)	38,345 (170.6)	39,055 (173.7)	40,190 (178.8)	41,855 (186.2)
7/8	3-1/2 (89)	3,620 (16.1)	3,965 (17.6)	4,575 (20.4)	5,325 (23.7)	7,790 (34.7)	8,535 (38.0)	9,855 (43.8)	11,470 (51.0)
	7-7/8 (200)	10,975 (48.8)	11,175 (49.7)	11,505 (51.2)	11,980 (53.3)	23,640 (105.2)	24,075 (107.1)	24,775 (110.2)	25,800 (114.8)
	10-1/2 (267)	14,635 (65.1)	14,905 (66.3)	15,340 (68.2)	15,975 (71.1)	31,520 (140.2)	32,100 (142.8)	33,035 (146.9)	34,405 (153.0)
	17-1/2 (445)	24,390 (108.5)	24,840 (110.5)	25,565 (113.7)	26,620 (118.4)	52,530 (233.7)	53,500 (238.0)	55,060 (244.9)	57,340 (255.1)
1	4 (102)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
	9 (229)	14,520 (64.6)	14,785 (65.8)	15,220 (67.7)	15,845 (70.5)	31,270 (139.1)	31,845 (141.7)	32,775 (145.8)	34,135 (151.8)
	12 (305)	19,360 (86.1)	19,715 (87.7)	20,290 (90.3)	21,130 (94.0)	41,695 (185.5)	42,460 (188.9)	43,700 (194.4)	45,510 (202.4)
	(508)	32,265 (143.5)	32,860 (146.2)	33,815 (150.4)	35,215 (156.6)	69,490 (309.1)	70,770 (314.8)	72,835 (324.0)	75,850 (337.4)

1 See Section 3.1.8 (2017 PTG) for explanation on development of load values.
2 See Section 3.1.8.6 (2017 PTG) to convert design strength value to ASD value.
3 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
4 Load values are for a single anchor with no spacing, edge distance, or concrete thickness factors. Apply spacing, edge distance, and concrete thickness factors in tables 23-35 as necessary. Compare to the steel values in table 22. The lesser of the values is to be used for the design.
5 Data is for temperature range A: Max. short term temperature = 130°F (55°C), max. long term temperature = 110°F (43°C).
For temperature range B: Max. short term temperature = 176°F (80°C), max. long term temperature = 110°F (43°C) multiply above value by 0.92.
For temperature range C: Max. short term temperature = 210°F (99°C), max. long term temperature = 162°F (72°C) multiply above value by 0.71.
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
6 Tabular values are for dry concrete conditions. For water saturated concrete multiply design strength (factored resistance) by 0.85.
7 Tabular values are for short term loads only. For sustained loads including overhead use, see Section 3.1.8.8 (2017 PTG).
8 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows:
For sand-lightweight, λ_a = 0.51. For all-lightweight, λ_a = 0.45.
9 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values in tension and shear by α_{seis} = 0.75

MATERIAL SPECIFICATIONS

Material specifications for Hilti HAS threaded rods, Hilti HIT-Z anchor rods, and Hilti HIS-N inserts are listed in section 3.2.8 (PTG Vol 2 Ed. 17).

Table 65 — Material properties for cured HIT-HY 100 adhesive

Compressive Strength ASTM C579	> 50 MPa	> 7252 psi
Flexural Strength ASTM C 580	> 20 MPa	> 2900 psi
Modulus of Elasticity ASTM C 307	> 3500 MPa	> 5.07 x 10^5 psi
Water Asorption ASTM D 570	< 2%	
Electrical Resistance DIN/VDE 0303T3	~ 2 x 10^{11} OHM/cm	~ 5.1 x 10^{11} OHM/in.

For material specifications for anchor rods and inserts, please refer to section 3.2.8 of the Hilti North American Technical Guide Volume 2: Anchor Fastening Technical Guide

Table 67 — Gel Time [1,2]

Base material temperature		HIT-HY 100
°F	°C	
14	-10	3 h
23	-4	40 min
32	1	20 min
41	6	8 min
51	11	8 min
69	21	5 min
87	31	2 min

Table 68 — Full Cure Time [1,2]

Base material temperature		HIT-HY 100
°F	°C	
14	-10	12 h
23	-4	4 h
32	1	2 h
41	6	60 min
51	11	60 min
69	21	30 min
87	31	30 min

1 Product temperatures must be maintained above 41°F (5°C) prior to installation.
2 Gel times and full cure times are approximate.

Table 66 — Resistance of HIT- HY 100 to chemicals

Chemical		Behavior
Sulphuric acid	conc.	-
	30%	•
	10%	+
Hydrochloric acid	conc.	•
	10%	+
Nitric acid	conc.	-
	10%	•
Phosphoric acid	conc.	+
	10%	+
Acetic acid	conc.	•
	10%	+
Formic acid	conc.	-
	10%	•
Lactic acid	conc.	+
	10%	+
Citric acid	10%	+
Sodium Hydroxide (Caustic soda)	40%	•
	20%	+
	5%	+
Amonia	conc.	•
	5%	+
Soda solution	10%	+
Common salt solution	10%	+
Chlorinated lime solution	10%	+
Sodium hypochlorite	2%	+
Hydrogen peroxide	10%	+
Carbolic acid solution	10%	-
Ethanol		-
Sea water		+
Glycol		+
Acetone		-
Carbon tetrachloride		-
Tolune		+
Petrol/Gasoline		•
Machine Oil		•
Diesel oil		•

Key: - non resistant + resistant • limited resistance

INSTALLATION INSTRUCTIONS

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com (US), or www.hilti.ca (Canada). Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

In the US:
Hilti, Inc. (U.S.)
7250 Dallas Parkway, Suite 1000, Dallas, TX 75024
Customer Service: 1-800-879-8000
en español: 1-800-879-5000
Fax: 1-800-879-7000

www.hilti.com

In Canada:
Hilti (Canada) Corporation
2360 Meadowpine Blvd.
Mississauga, Ontario, L5N 6S2
Customer Service: 1-800-363-4458
Fax: 1-800-363-4459

www.hilti.ca

Certified Quality and Environmental Systems
SQS
ISO 9001 / ISO 14001*
Reg. No. 12455-02
*14001 US only

The data contained in this literature was current as of the date of publication. Updates and changes may be made based on later testing. If verification is needed that the data is still current, please contact the Hilti Technical Support Specialists at 1-800-879-8000. All published load values contained in this literature represent the results of testing by Hilti or test organizations. Local base materials were used. Because of variations in materials, on-site testing is necessary to determine performance at any specific site. Laser beams represented by red lines in this publication. Printed in the United States

DBS • 04/18

JCM Industries, Inc.

Fittings & Fabrications
for Repair - Connection - Branching
All Types and Sizes of Pipe

JCM Industries, Inc.
P.O. Box 1220 - Nash, TX 75569-1220
Office: 903-832-2581, Fax: 903-838-6260
www.jcmindustries.com

Call Toll Free: 800-527-8482
Fax Toll Free: 800-874-9524
Email: sales@jcmindustries.com

JCM 161 Fabricated Lug All Stainless Steel Clamps

The JCM 161 Fabricated Lug All Stainless Steel Clamp offers an economical solution to problems such as breaks, splits, cracks, holes in all types of pipe. Available in standard sizes for cast iron, ductile iron, IPS PVC, C900 PVC, steel, asbestos cement and others. The 161 is a stainless steel clamp that offers all the benefits of stainless: corrosion resistance, lightweight, flexible yet strong. The JCM 161 is especially recommended for hot soil conditions and corrosive environments.

The full circumferential gasket provides a complete repair while the molded in stainless steel bridge plate provides the full stainless steel barrier to aggressive elements.

Strong Stainless Steel Studs -permanently attached to eliminate loose parts and nuts are treated to speed installation and prevent seizing.

Type 304 Stainless Steel Band - conforms to pipe irregularities, maintaining sealing pressure over the entire gasket.

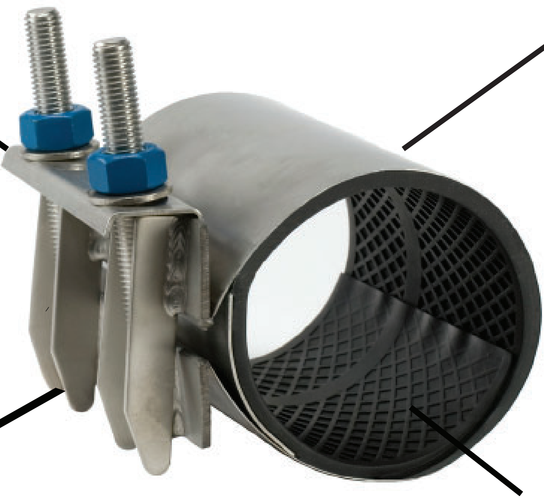


Image Reflects 7" Clamp Width

Positive Attachment of Band to Lugs - strong TIG welds eliminate mechanical weaknesses and prevents band separation. Thick stainless lifter bar plate prevents distortion or warping during tightening.

Thick Gridded Gasket - long tapered ends and recessed bridge plate assure even gasket pressure throughout range -without wrinkling or crimping. Compounded for use with water, salt solutions, mild acids and bases.

MATERIAL SPECIFICATIONS - JCM 161, 162, 163, 168 FABRICATED LUG ALL STAINLESS STEEL CLAMP COUPLINGS

Bolting Assembly:	18-8 Type 304 Stainless Steel
Band:	18-8 Type 304 Stainless Steel
Bolts And Nuts:	18-8 Type 304 Stainless Steel
Gasket: EPDM	~~Virgin Styrene Butadiene Rubber (SBR) - Compounded for use with water, salt solutions, mild acids and bases. Per ASTM D-2000 M4AA 607. Temperature range from -40° to 150°F (-40° to 65°C) constant, maximum intermittent 180°F (82°C). For applications on high temperatures or chemical pipelines, contact JCM Industries Technical Services.~~

Meets ANSI/AWWA C230 Stainless-Steel Full-Encirclement Repair and Service Connection Clamps as applicable.
JCM 100 Series Universal Clamp Couplings are ANSI/NSF Standard 61, Annex G and ANSI/NSF 372 Certified.

NSF
Certified to NSF/ANSI/CAN 61 & NSF/ANSI 372

JCM 161 Fabricated Lug Stainless Steel Universal Clamps

Image Reflects 7" Clamp Width

The JCM 161 Fabricated Lug All Stainless Steel Clamp offers an economical solution to problems such as breaks, splits, cracks, holes in all types of pipe. Available in standard sizes, the 161 is a stainless steel clamp that offers all the benefits of stainless: corrosion resistance, lightweight, flexible yet strong.

NOM PIPE SIZE (IN)	CLAMP O.D. RANGE (IN)	161 STAINLESS STEEL CLAMP	Clamp Width - *Approximate Weight*					
			7"	12"	15"	18"	24"	30"
		CLAMP NUMBER	*Lbs.#*	*Lbs.#*	*Lbs.#*	*Lbs.#*	*Lbs.#*	*Lbs.#*
2 - 2-1/2	2.35 - 2.63 2.70 - 3.13	0238 0275	•	•	•			
			5#	*8#*	*10#*			
3	3.46 - 3.70 3.73 - 4.13	0350 0400	•	•	•			
			6#	*9#*	*11#*			
4	4.45 - 4.75 4.74 - 5.14 4.95 - 5.35 5.22 - 5.62	0450 0480 0500 0525	•	•	•	•	•	•
			7#	*10#*	*12#*	*17#*	*20#*	*24#*
6	5.95 - 6.35 6.56 - 6.96 6.85 - 7.25 7.05 - 7.45 7.45 - 7.85	0600 0663 0690 0710 0745	•	•	•	•	•	•
			9#	*13#*	*17#*	*20#*	*26#*	*34#*
8	7.95 - 8.35 8.54 - 8.94 8.99 - 9.39 9.27 - 9.67 9.90 - 10.30	0800 0863 0905 0940 1000	•	•	•	•	•	•
			11#	*16#*	*21#*	*25#*	*32#*	*44#*
10	10.60 - 11.00 11.04 - 11.44 11.34 - 11.74 11.75 - 12.15 12.00 - 12.40	1075 1110 1140 1175 1200	•	•	•	•	•	•
			15#	*18#*	*24#*	*30#*	*36#*	*50#*
12	12.60 - 13.02 13.10 - 13.50 13.40 - 13.80 13.70 - 14.10 14.00 - 14.40	1275 1320 1340 1370 1400	•	•	•	•	•	•
			17#	*20#*	*27#*	*34#*	*40#*	*56#*
		Number of Bolts	**2**	**3**	**4**	**4**	**6**	**8**

HOW TO ORDER

1. Determine O.D. of pipe.
2. Select proper clamp O.D. range and width.
3. Determine Model Number. Model 161 for standard clamp.
4. Specify clamp number.

Example: To fit Cast Iron pipe, 6.90 O.D. with 6" width, order: 161-0690-6

Clamp width should be equal to or greater than the pipe diameter for higher working pressures.
Not recommended for use for joining plain end pressure pipe.
Other ranges and widths available upon request.
Note: Clamps do not prevent lateral movement of pipe. Applications in which the pipe may move out of the clamp, proper anchorage of the pipe must be provided.

Available Options Upon Request
Models 161-162

- Pipe sizes and ranges not listed
- Conductive Buttons
- Specialty Gaskets
- Tapped Outlets
- Other Sizes and Ranges

Certified to NSF/ANSI/CAN 61 & NSF/ANSI 372

Flexcap Diffuser™

The First Diffuser Engineered For Extended Life
Without Plugging, Without Blow-Off,
Without Maintenance. We Guarantee It!

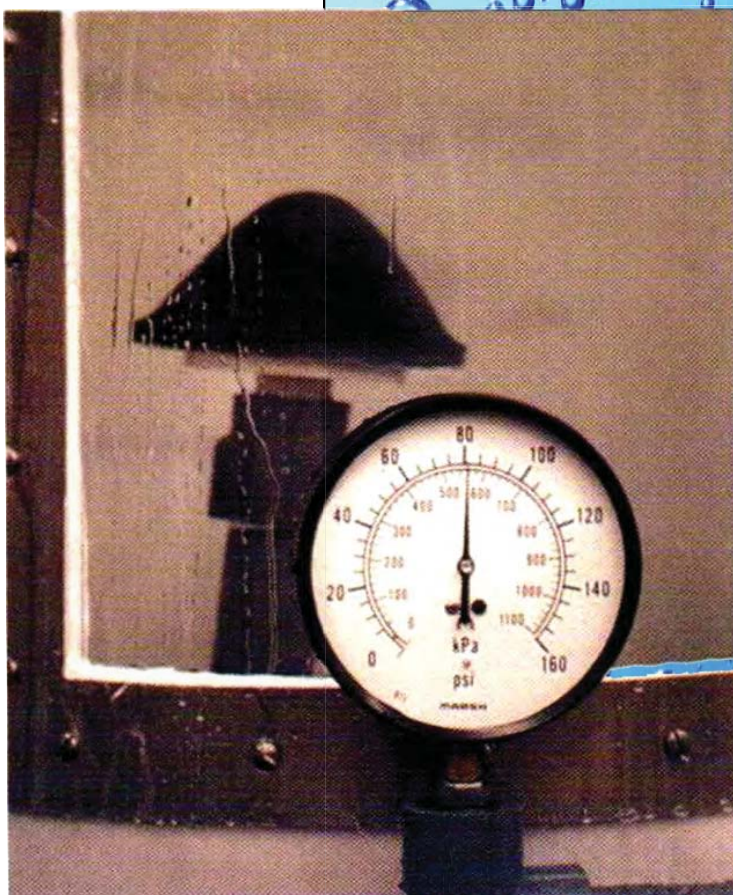
Design Breakthrough Makes Available The Most Reliable Coarse Bubble Diffuser Ever Built

At Mooers Products, our experience with coarse bubble diffusers goes back to the 1970's...we've seen hundreds of installations with more diffusers than we can count. And repeatedly, we've seen operators experiencing plugging and blow-off problems.

Mooers Offers A Better Engineered Diffuser, Designed For Longevity! The Proof Is In Our Performance.

We haven't heard of any performance problems since the Flex-cap'"Diffuser was introduced. Meanwhile, ordinary diaphragm diffusers still have the same old problems: plugging, brittleness, periodic maintenance and eventual blow-off. The Flexcap Diffuser was engineered from the cap down to the threads to eliminate those problems. The result: the first true extended-life diffuser available.

And It Works!



It works twice as long as any other diaphragm diffuser available today. It will not plug. It will not blow-off. It even resists brittleness. And it's virtually maintenance free.

This may seem hard to believe after all the promises and claims you have heard about diffusers. But we have so much confidence in the Flexcap Diffuser that we guarantee it.

80 PSI And It Didn't Blow

Sudden bursts of extreme air pressure, debris or brittleness over time cause ordinary diffusers to blow their caps. The Flexcap Diffuser won't blow its cap, not even when the pressure reaches 80PSI or more. Debris can't plug it and even calcium carbonate build up is eliminated. (Test results are available so you can see for yourself.)

If brittleness does set in, this cap is designed to hug the base even tighter. No other diffuser can make these claims. We know. We've used and tested them all.

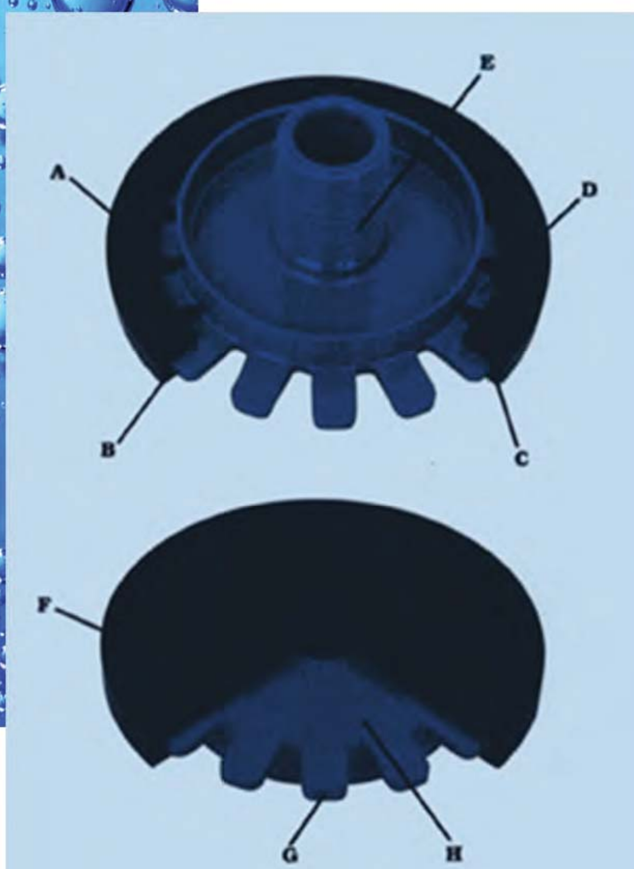
Check Valve Action Keeps Debris Out Of System

The smooth top on the base keeps debris from clinging and settling. This feature along with the greater flexibility of the cap provides a tight leak proof seating surface. When the air supply stops, the larger diameter of the base and cap allows added pressure from the liquid above to close the cap more securely to the base. This combined check valve action minimizes the chance of any debris or water entering the diffuser.

On The Outside It Works Like A Diffuser

The Flexcap Diffuser can replace any diaphragm diffuser you are using. It meets all the requirements for aeration in municipal, commercial, residential and recreational property package wastewater treatment systems. And it works effective1y in existing or new installations.
The Flexcap Diffuser uses a uniquely engineered cap and base that is deceptively simple in appearance, but it has been designed to work where other diffusers have failed

Bottom distribution ring design with air holes spaced on outside of the base form a uniform bubble distribution over the entire diameter of diffuser providing excellent oxygen transfer. It works whether the installation is flat or at an angle as severe as 15 degrees.



A. Air holes on underside of diffuser combine with self wiping action to keep diffuser from plugging.
B. Pockets reinforce locking lips to prevent walk off.
C. Pockets actually agitate back and forth during aeration, to wipe away debris and prevent plugging.
D. Cap placement on base allows movement . . . cap can't be forced off even during extreme contraction.
E. Uniform thread design makes replacement easy in existing or new installation.
F. Cap material specially formulated to retain flexibility longer.
G. Multiple fingers are extra-long and uniform to accept direct stress. This holds cap on even under extreme pressure, shifting and vibration.
H. Smooth top keeps debris from clinging and settling on base. Provides clean, even seating surface when air is shut off.

On The Inside No Other Diffuser Can Match It

On the outside the Flexcap looks like every other diaphragm diffuser. But inside, is what makes the difference. Take a closer look. It's enough to change your mind about diaphragm diffusers.

What It Doesn't Do Is What Every Operator Wants

No Plugging

- Underside orifice design prevents debris from settling inside the diffuser.
- Controlled velocity through air holes provides a positive flushing action.
- Dissimilar materials forming the orifice cause a flexing at the air holes that "wipes" the surface free of debris.

No Blow-Off

- Multiple fingers provide a blow-proof locking action by transferring stress to the outer tips. This action forces the cap tightly onto the diffuser.
- Pockets used to reinforce cap also reinforce locking lip to minimize movement and prevent cap from walking off disc plate.

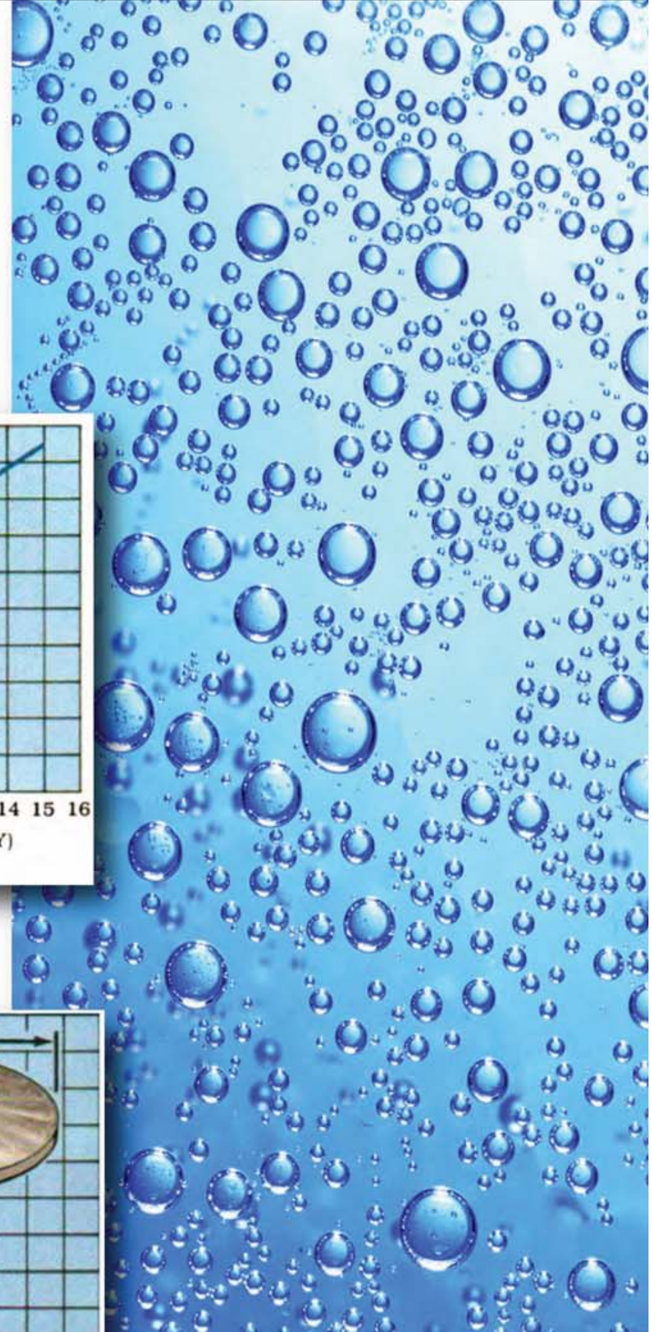
Minimizes Effect of Brittleness

- Unique cap and base design actually locks the cap tighter onto the base if brittleness does occur.
- Even before it hits the water, the cap is more flexible than other diffusers through the use of lower durometer cap material.

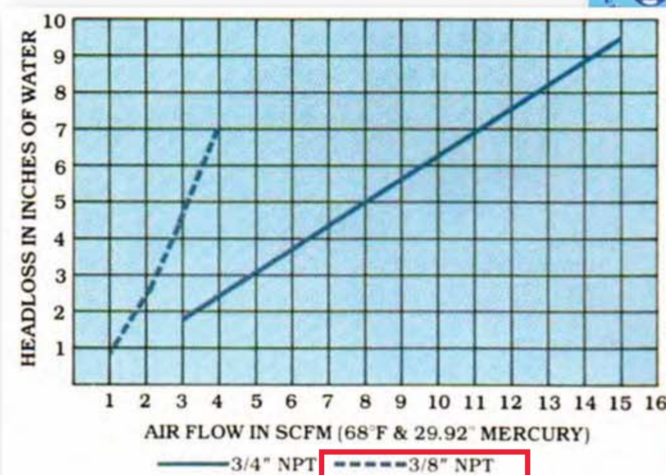
No Maintenance

Because the Flexcap Diffuser doesn't plug, won't blow-off and isn't as susceptible to failure due to brittleness, it is virtually maintenance free. No other diffuser can match this performance. Years of experience have proven how reliable the Flexcap Diffuser is ... You can find out how to solve your problems with a phone call. Check the facts on the back cover; then call for a demonstration.

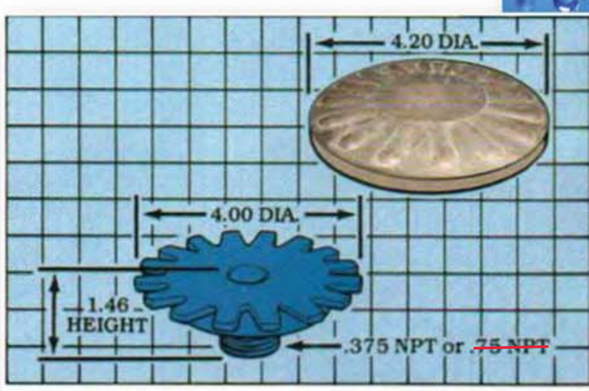
Figure It Out For Yourself...
The Flexcap™ Diffuser Can Save You Labor, Time and Money



Head Loss Characteristics



Dimensions And Specifications



SPECIFICATIONS
EPDM CAP
POLYPROPYLENE BASE
TOTAL HEIGHT 1.625 IN.
Other Technical Data available upon request.

3/8" NPT used for continuous purge

MOOERS PRODUCTS INC. - 5554 North Navajo Avenue • Milwaukee, WI 53217 U.S.A. • 414-964-3002 Fax: 414-964-3510

Bulletin Number: MPI 100-3M/290
Printed in U.S.A.

INSTRUMENTATION

CONTROLLER

HACH SC4500

Controller
Part # 2620812-TAB

Hach SC4500

2620812 Tabulated Part Number Matrix				
Signal Output	**Power Requirements**	**Hazardous Area Classification***	**AASI #**	**Hach #**
Analog 5x 4-20mA	100-240 VAC, 50/60 Hz, 1 A	C1D2	2620812-A1C	LXV525.99P11551
		Non Classified	2620812-A1N	LXV525.99A11551
	18-28 VDC, 2.5 A	C1D2	2620812-A2C	LXV525.99Y11551
		Non Classified	2620812-A2N	LXV525.99Z11551
Ethernet IP	100-240 VAC, 50/60 Hz, 1 A	Non Classified	2620812-E1N	LXV525.99A1G551
	18-28 VDC, 2.5 A	Non Classified	2620812-E2N	LXV525.99Z1G551
Modbus TCP	100-240 VAC, 50/60 Hz, 1 A	Non Classified	2620812-M1N	LXV525.99A15551
	18-28 VDC, 2.5 A	Non Classified	2620812-M2N	LXV525.99Z15551

Specifications:

- Dimensions: ½ DIN - 144 x 144 x 192 mm (5.7x 5.7 x 7.6 in.)
- Weight: 3.7 lbs. (1.68kg) w/o modules.
- Display: 3.5-inch TFT color display with capacitive touchpad.
- Operating Temperature: -20 to 60°C (-4 to 140°F); 0 to 95% relative humidity, non-condensing.
- Storage Temperature: -20 to 70°C (-4 to 158°F); 0 to 95% relative humidity, non-condensing.
- Enclosure: UL50E type 4X, IEC/EN 60529–IP 66, NEMA 250 type 4X. Enclosure with corrosion-resistant finish, polycarbonate, aluminum (powder coated), stainless steel.
- Mounting Configurations: Wall, Pole, or Panel Mounting.
- Control: Linear, PID
- Relays: Two SPDT (Form C) contacts:
  - AC controller
    - Maximum switching voltage: 100 - 240 VAC
    - Maximum switching current: 5 A Resistive/1 A Pilot Duty
    - Maximum switching power: 1200 VA Resistive/360 VA Pilot Duty
  - DC controller
    - Maximum switching voltage: 30 VAC or 42 VDC
    - Maximum switching current: 4 A Resistive/1 A Pilot Duty
    - Maximum switching power: 125 W Resistive/28 W Pilot Duty

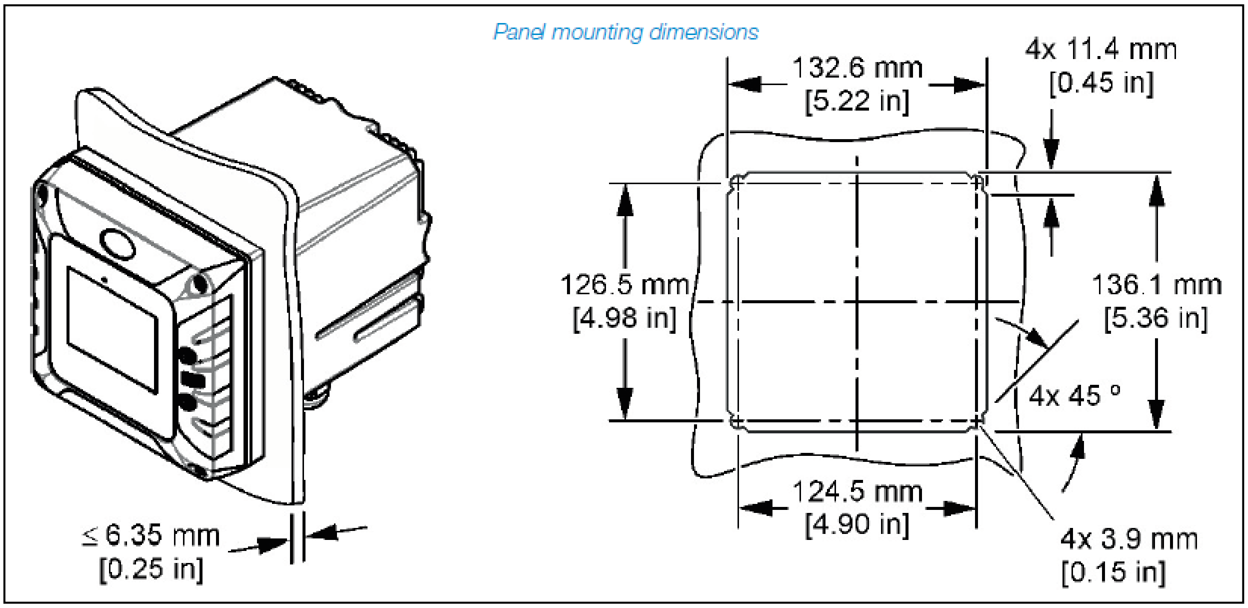
Hach SC4500

- Electrical Certifications:
    - CE. ETL certified to UL and CSA safety standards (with all sensor types), FCC, ISED, KC, RCM, EAC, UKCA, SABS, C (Morocco).
- Hazardous Area Certifications (*see tabulated part number matrix for applicable):
    - Class 1, Division 2, Group A, B, C, D, T4, Zone 2, Group IIC hazardous locations to UL and CSA safety standards by ETL (with appropriately rated Class 1, Division 2 or Zone 2 sensors).
        - Canadian Electrical Code does not allow the optional Zone 2, Group IIC marking.
- Inputs: Two digital
- Compatible Instruments / Software Version (Release Year)
  *Hardware Version 1 of instrument is not supported:
    - Amtax sc / V2.30 (2018) or higher
    - A-ISE sc / V1.02 or higher
    - AN-ISE sc / V1.08 (2013) or higher
    - N-ISE sc / V1.02 or higher
    - Nitratax clear sc, Nitratax eco sc, Nitratax plus sc / V3.13 (2013) or higher
    - Phosphax sc / V2.30 (2018) or higher
    - Phosphax sc LR/MR/HR / V1.01 (2018) or higher
    - TSS sc / V41.73 (2013) or higher
    - Solitax sc / V2.20 (2013) or higher
    - TU5300sc, TU5400sc / V1.34 (2017) or higher
    - SS7 sc (in Bypass) / V1.06 (2006) or higher
    - Ultraturb sc / V3.06 (2017) or higher
    - 1720E / V2.10 (2006) or higher
    - Sonatax sc / V1.15 (2016) or higher
    - CL17sc / V2.7 (2019) or higher
    - CL10sc / V1.14 (2013) or higher
    - 9184sc, 9185sc, 9187sc* / V2.03 (2013) or higher
    - Uvas plus sc / V3.01 (2017) or higher
    - LDO 2 sc* / V1.22 (2013) or higher
    - 3798sc* / V2.03 (2013) or higher
    - 3700sc + Inductive Conductive Digital Gateway 6120800 / V3.00 (2017) or higher
    - 3422sc, Analog 3400 + Contacting Cond. Digital Gateway 6120700 / V3.00 or higher
    - pHD sc*, pHD-S sc / V3.10 (2016) or higher
    - 1200-S sc* / V2.04 (2013) or higher
    - pHD analog + Digital Gateway 6120500 / V3.00 (2017) or higher
    - RC and PC analog sensor + Digital Gateway for conventional analog pH and ORP sensors 6120600 / V3.00 (2017) or higher
    - 8362sc* / V3.00 (2017) or higher

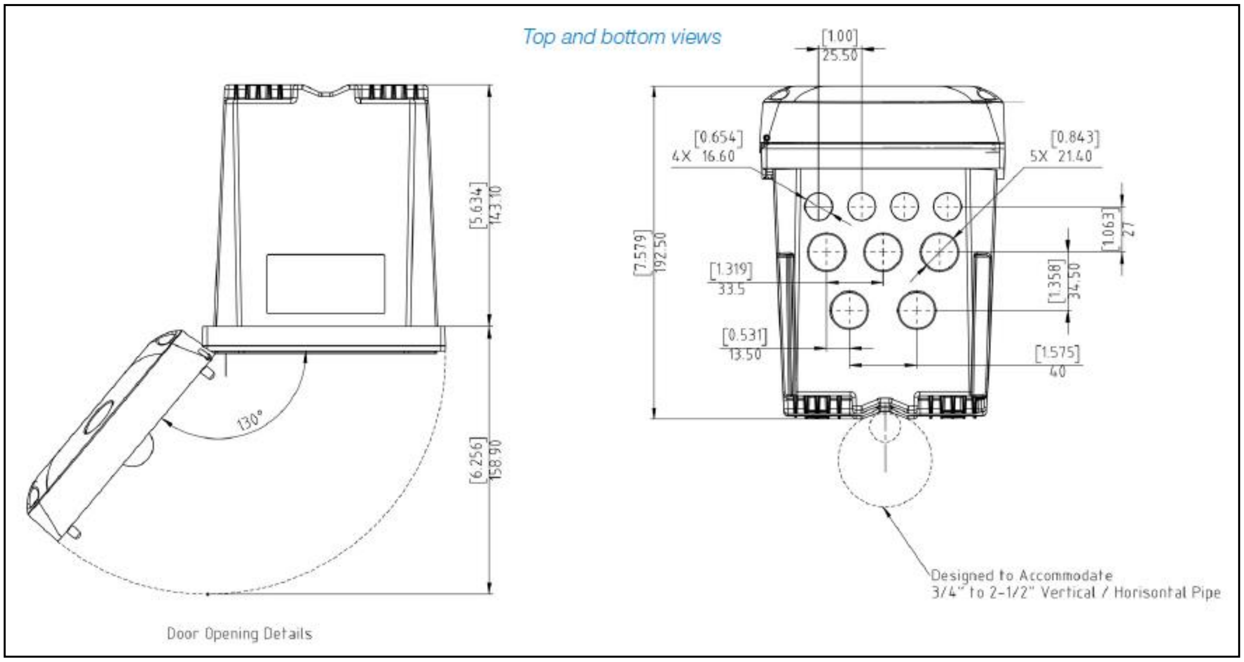
Controller

Part # 2620812-TAB

Hach SC4500

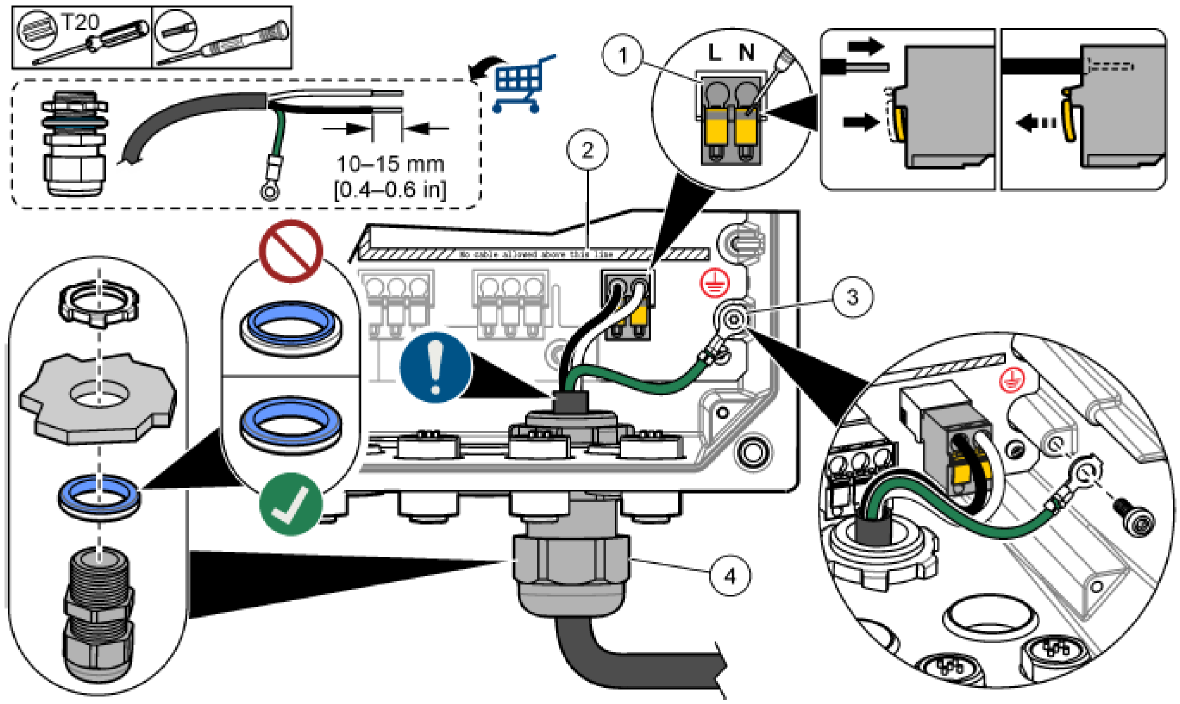


Panel mounting dimensions



Top and bottom views

Hach SC4500



1 AC and DC power terminal	**3** Protective earth ground
2 Cables limit: do not put cables above the line.	**4** Conduit hub (or strain relief fitting for power cord)

Table 2 Wiring information—AC power

Terminal	Description	Color—North America	Color—EU
L	Hot (Line 1)	Black	Brown
N	Neutral (N)	White	Blue
⏚	Protective earth ground	Green	Green with yellow stripe

Table 3 Wiring information—DC power

Terminal	Description	Color—North America	Color—EU
L	+24 VDC	Red	Red
N	24 VDC return	Black	Black
⏚	Protective earth ground	Green	Green with yellow stripe

Sun Shield **Part # 2620816**

Hach SC4500, LXZ524.99.00005

This assembly covers the face of the SC4500, protecting it from the sun. The transparent door can be opened for operating the controller. It is UV absorbent and protects the controller from harmful UV rays. Includes sunroof to further protect the controller.

<u>Dimension:</u>

5.66” x 5.66” x 7.13” (144mm x 144mm x 181mm)

HORIBA

Controller **Part # 2621102-1**

Horiba HC-200NH

Process Specifications:
Compatible Sensor: AM-2000
Measurement Range NH4-N: 0-1000 mg/L
Resolution 0-10 mg/L: 0.01mg/L
Resolution 10-999 mg/L: 0.1 mg/L
Repeatability: 3% +/- 1 digit of measured value or 0.2 mg/L +/- 1 digit (with standard solution)
Measurement Range Temperature: 0-40°C, 0.1°C resolution

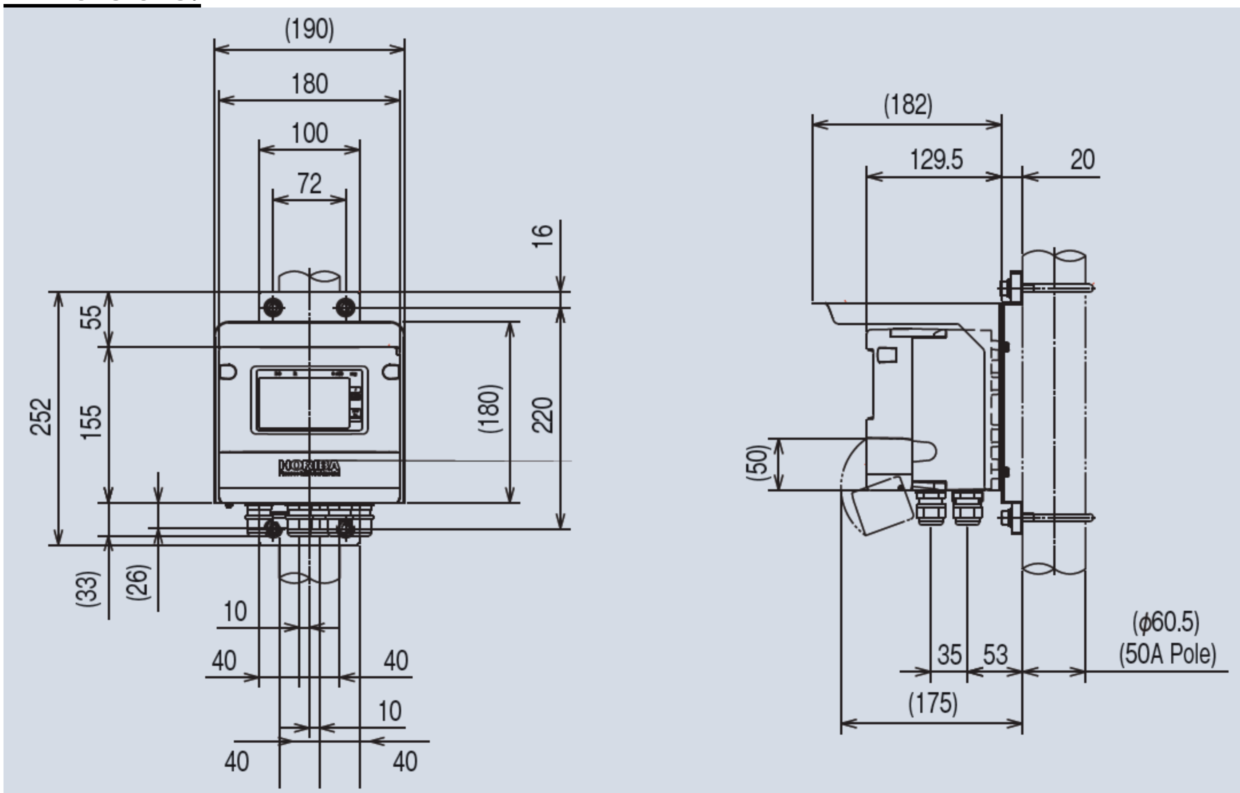
Electrical Specifications:
Power: 100…240VAC
Frequency: 50/60 Hz
Consumption: 28 VA Max
Outputs: (3) 4-20 mA
Compliance: CE

Mechanical Specifications:
Transmitter Operating Temperature Range: -20-55℃ (-4 to 131°F)
Weight: 4.5 kg w/ Hood (10 lb)
Enclosure Construction: Coated Aluminum alloy
Hood and Bracket: 304SS
Protection Rating: IP65

Controller **Part # 2621102-1**

Horiba HC-200NH

Dimensions:



DISSOLVED OXYGEN – D.O. PROBE

Sensor **Part # 2616326**

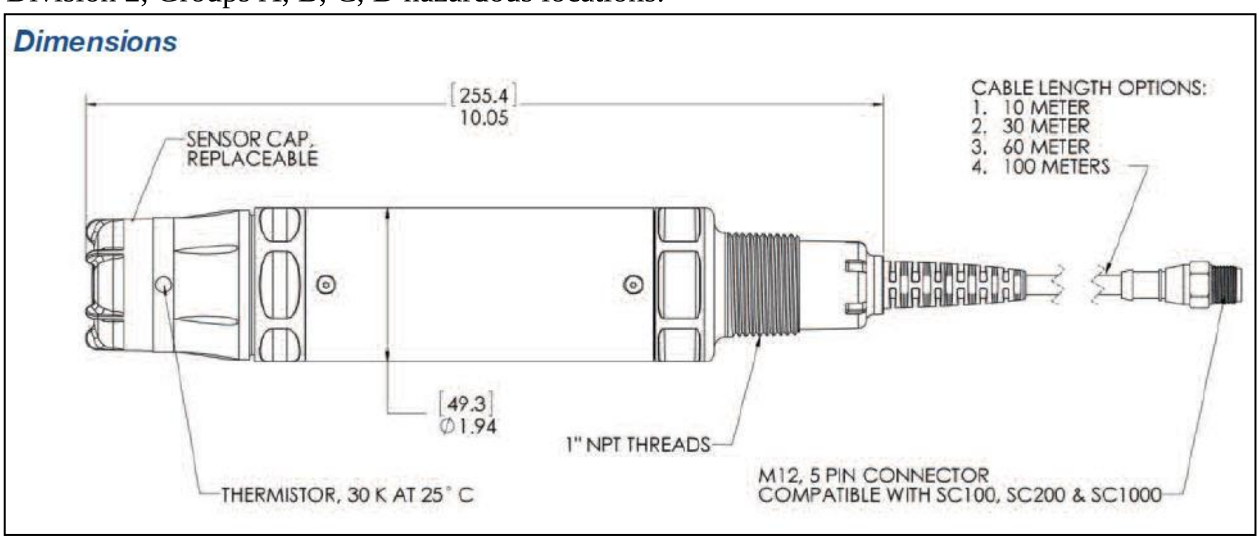
Hach Model 9020000, Dissolved Oxygen, LDO, C1D2

Specifications:

- **Measuring Range:** 0 to 20.0 ppm (mg/L), 0 to 200% saturation
- **Accuracy:**
  - Measurement:
    - ±0.05 ppm below 1ppm
    - ±0.1 ppm below 5 ppm
    - ±0.2 ppm above 5 ppm
  - Temperature: ±0.2°C (±0.4°F)
- **Repeatability:** ±0.1 ppm (mg/L)
- **Response time at 20°C:**
  - To 90% in less than 40 seconds
  - To 95% in less than 60 seconds
- **Resolution:** 0.01 ppm (mg/L), ±0.1% saturation
- **Operating Temperature:** 32 to 122°F (0 to 50°C)
- **Flow Rate:** None required
- **Probe Immersion Depth and Pressure Limits:** 111.5 ft (34m), 50 psi (345 kPa)
- **Transmission Distance:** 3280 ft (1000m) maximum
- **Sensor Cable (ingegral):** 33 ft (10m) terminated with quick-disconnect plug
- **Wetted Materials:**
  - Probe body: Noryl®, 316 stainless steel, CPVC, Polyurethane, Viton, and Acrylic
  - Sensor Cap: Acrylic
- **Weight:** 2.2 lbs (0.1 kg)

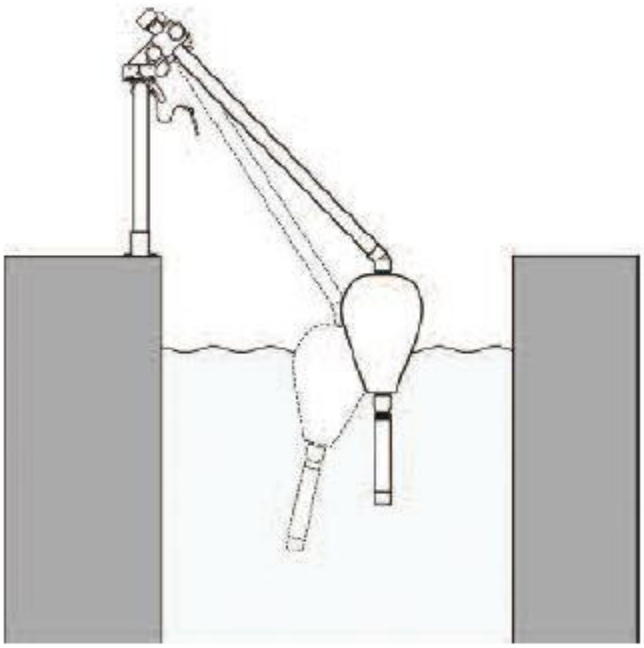
Dissolved oxygen probe shall be a continuous-reading probe that utilizes luminescent sensor technology.

Note: Sensor cable provided with Connector Safety Lock (Cat. No. 6139900) for use in Class 1, Division 2, Groups A, B, C, D hazardous locations.

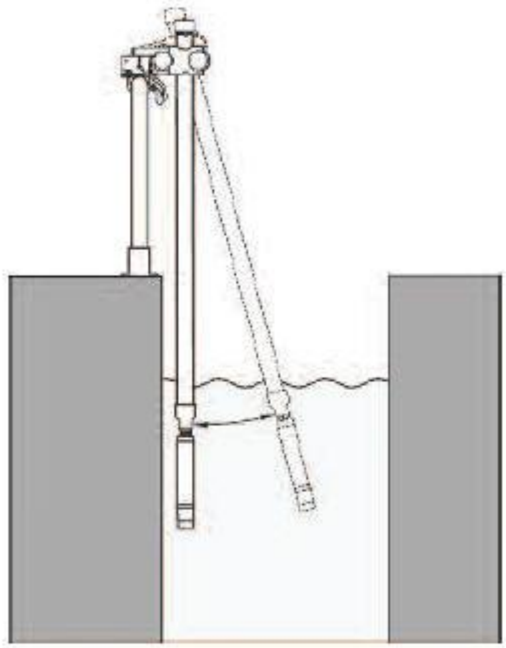


Hach Model 9020000, Dissolved Oxygen, LDO, C1D2

Installation / Mounting



Float Mount Kit



Pole Mount Kit

OXIDATION-REDUCTION POTENTIAL
ORP PROBE

ORP Sensor

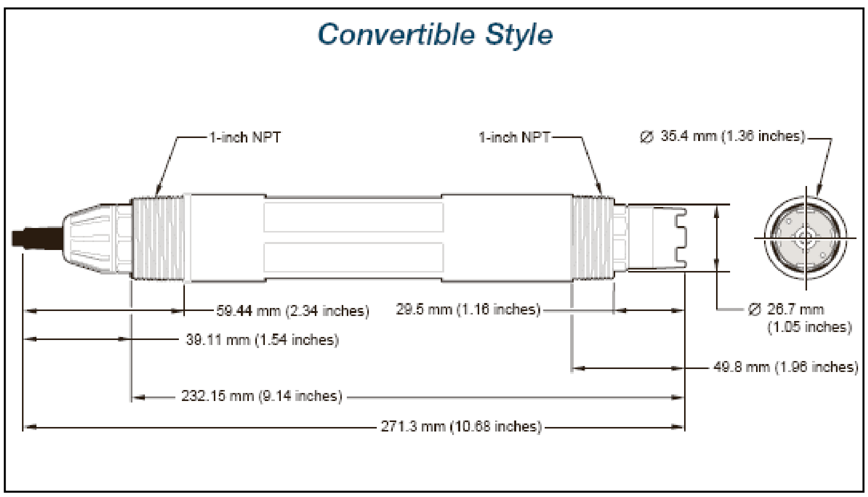
Part # 2613269

ORP (Redox) Sensor

Specifications:

- Measuring Range: -1500 to +1500mV
- Sensitivity: ±0.5 mV
- Stability: 2 mV per 24 hours, non-cumulative
- Operating Temperature:
  Digital Sensor: -5 to 105°C (23 to 221°F)
- Flow Rate: 3 m (10 ft) per second, maximum
- Pressure/Temperature Limits
  Digital: 6.9 bar at 70° C (100 psi at 158°F)
- Built-in Temperature Element
- NTC 300 ohm thermistor for analyzer temperature readout only – no automatic temperature compensation necessary for ORP measurement.
- Sensor Cable (integral)
  4 conductor cable with one shield and polyurethane jacket; rated to 105°C (221°F): 10 m (33 ft) standard length.

Dimensions

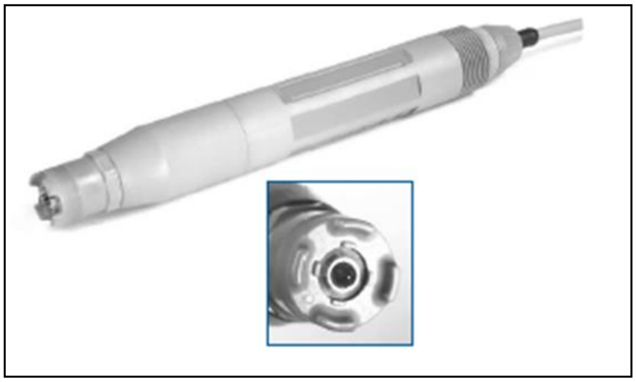


Ordering Information:

- Production Number DRD1P5
- Body Material: PEEK[1]
- Body Style: Convertible
- Electrode Material: Platinum
- Max Temp: 70°C (158°F)

pH PROBE

Hach – Differential pH Digital Sensor #DPD1P1



Features:

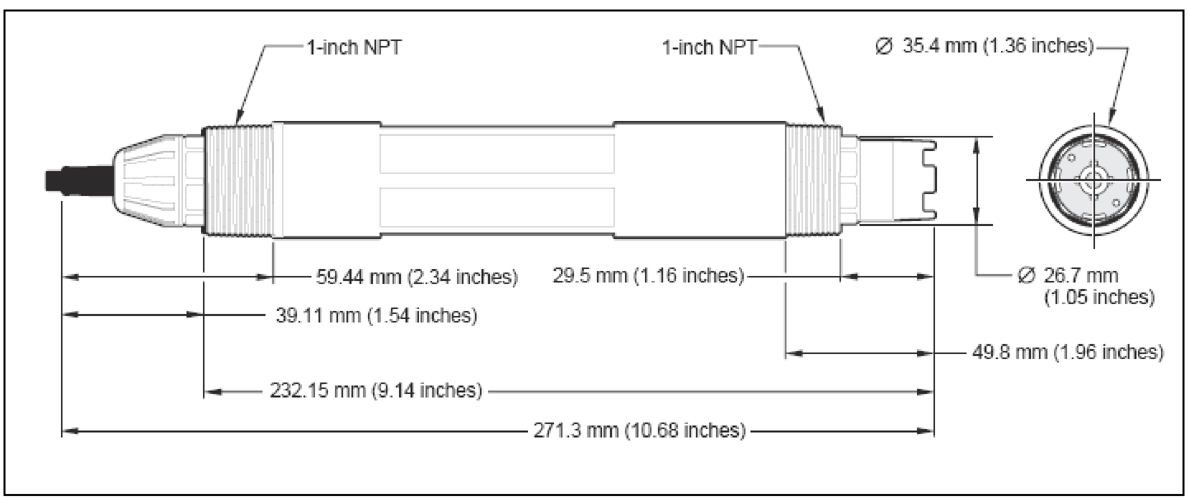
- **Built-in Temperature Element:** NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout
- **Integral Sensor Cable:** 4 and polyurethane jacket; 10 m (33 ft) standard length
- **Convertible Body Style:** for tee mounting or immersion mounting

Specifications:

- **Measuring Range:** -2 to 14 pH
- **Sensitivity:** +/- 0.01 pH
- **Stabilit**y: 0.03 pH per 24 hours, non-cumulative
- **Flow Velocity:** 3 m/s (9.8 ft./s) maximum
- **Operating Temperature:** -5 to 70 °C (23 to 158°F)
- **Pressure Limits:** 690 kPa at 70 °C (100 psi at 158 °F) maximum
- **Transmission Distance:** 100 m (328 ft) max
- **Sensor Cable (integral):** 10 m (33 ft.) standard
- **Wetted Materials:** PEEK, Kynar, Glass, Titanium, Viton

Note:

- The pH probe needs to be kept moist during use, transportation and storage.



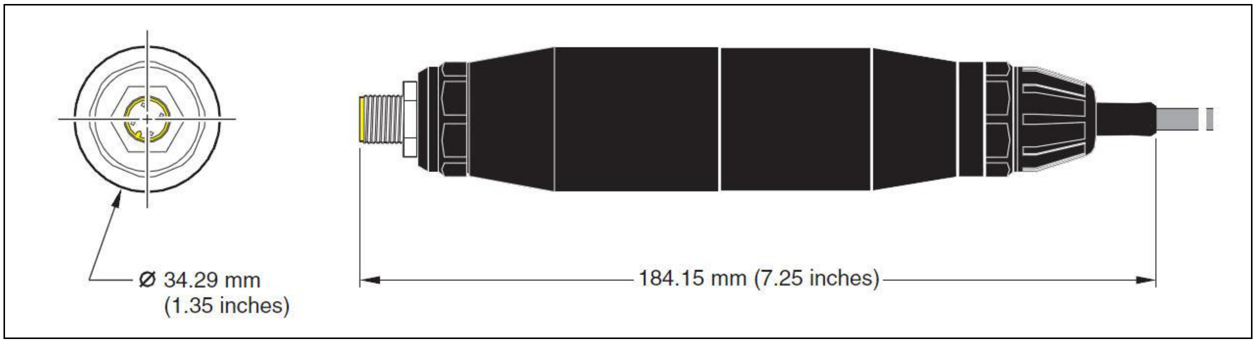
Digital Gateway **Part # 2617800**

Hach pHD, Digital Gateway, #6120500

Overview:

Digital gateway to convert analog differential pH/ORP sensors to digital output for connecting to sc digital controller.

- Differential electrode measurement technique
  This field proven technique uses three electrodes instead of the two normally used in conventional pH sensors. Process and reference electrodes measure the pH differentially with respect to a third ground electrode.
- Digital electronics modules
  Sensors are available with integral digital electronics or with a gateway module for high temperature (above 70°C) applications.
- Replaceable salt bridge / protector
  The unique, replaceable salt bridge holds an extraordinary volume of buffer to extend the working life of the sensor by protecting the reference electrode from harsh process conditions. The salt bridge simply threads onto the end of the sensor.
- Built-in encapsulated preamp
  Encapsulated construction protects the sensors built-in preamp from moisture and humidity, ensuring reliable sensor operation.
- Durable body materials



TOTAL SUSPENDED SOLIDS
TSS PROBE

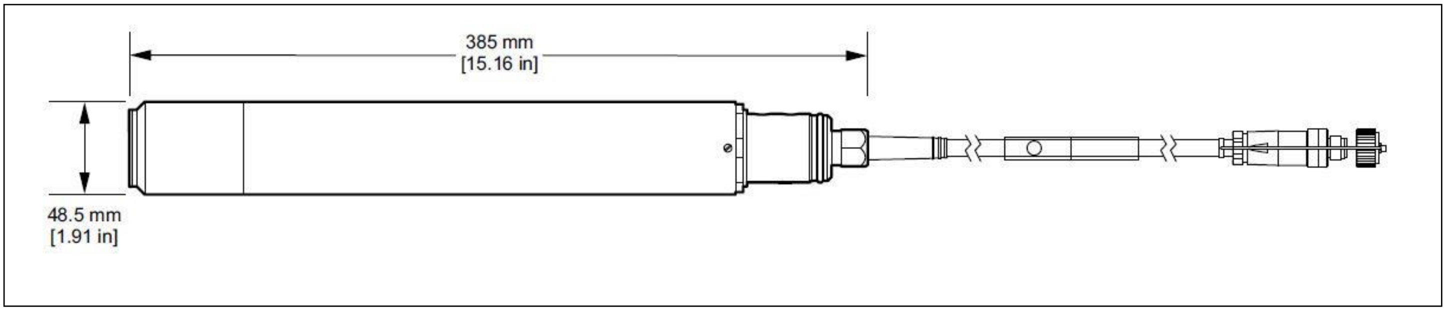
Probe

Part # 2618375

Hach TSS EX1 sc Total Suspended Solids, Tank-side mount

Model: Hach TSS EX1 sc
Connection: Tank-side mounting
Measurement Method: Combined multiple beam alternating light method with infrared diode system and beam focusing; 90° and 120° scattered light measurement, wavelength = 860 nm
Hazardous Locations: Class 1, Division 2 certified
Measuring Range: 0.001 to 500 g/L with SiO_2 standard solution
Measurement Accuracy: <5% of measured value ±0.01 FNU/NTU
Reproducibility: <4%
Response Time: 1 s < T90 < 300 s (adjustable)
Calibration: To be calibrated by customer on site
Zero Point: Permanently calibrated in the factory
Maximum Pressure: 145 psi [1000 kPa]
Flow Rate: 3 m/s maximum
Ambient Temperature: 32° to 122°F [0° to 50°C]
Weight: 7.2 lbs. [2.7 kg]
Cable Length: 30 ft. [9.1 m]

Dimensions:



Probe

Part # 2620914

Hach TSS EX1 sc Total Suspended Solids, Ball Valve Safety Mount

Model: Hach TSS EX1 sc

Material: 1.4460/1.4404 SS

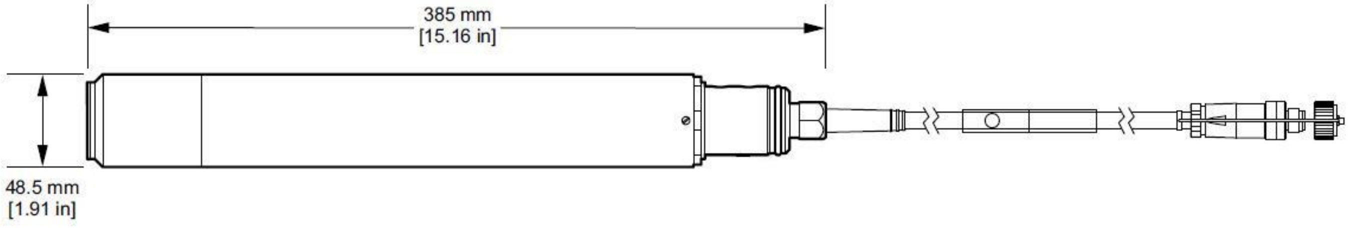
Connection: Ball Valve Safety Fitting

Length: 19.2 in [488 mm]

Measurement Method: Combined multiple beam alternating light method with infrared diode system and beam focusing; 90° and 120° scattered light measurement, wavelength = 860 nm

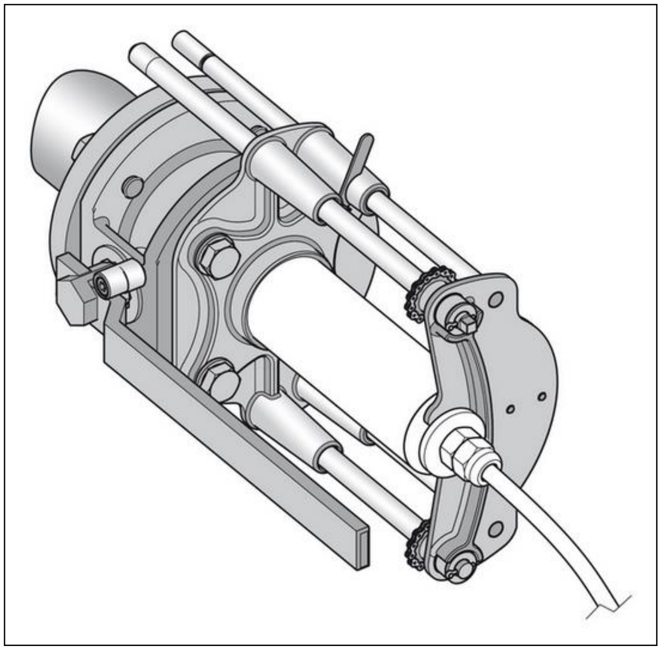
Hazardous Locations: Class 1, Division 2 certified
Measuring Range: 0.001 to 500 g/L with SiO_2 standard solution
Measurement Accuracy: <5% of measured value ±0.01 FNU/NTU
Reproducibility: <4%
Response Time: 1 s < T90 < 300 s (adjustable)
Calibration: To be calibrated by customer on site
Zero Point: Permanently calibrated in the factory
Maximum Pressure: 145 psi [1000 kPa]
Flow Rate: 3 m/s maximum
Ambient Temperature: 32° to 122°F [0° to 50°C]
Weight: 7.2 lbs. [2.7 kg]
Cable Length: 30 ft. [9.1 m]
Maximum Cable Length to Controller: 328 ft [100 m]

Dimensions:



Safety Armature Part # 2620915

Hach Safety Armature for TSS EX1 sc Inline Sensors



Model: LZY630.00.20000

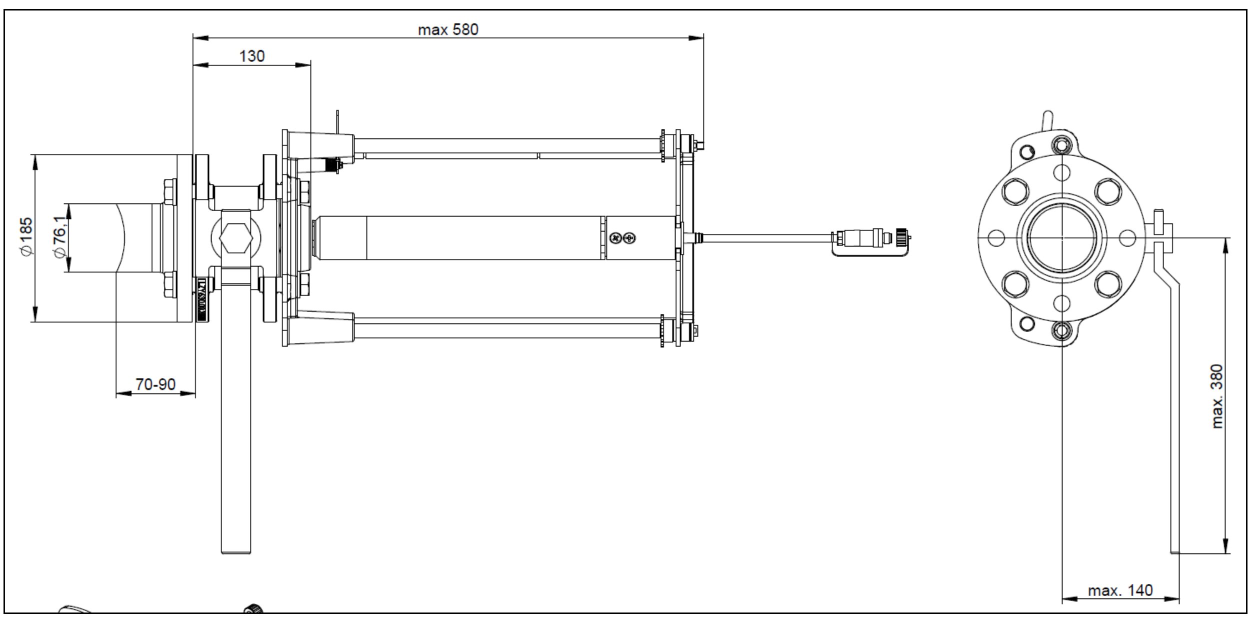
Material:

- Ball valve: SS 304/316
- Flange: SS 1.4571
- Piece of pipe: SS 1.4571

Connection: Pipe weld or Flange

Weight: 39.7 lbs. [18 kg]

Dimensions:



AUTOMATIC SAMPLING SYSTEM

Sample Filtration System Part # 2621065

Hach Filtrax, 115V/1/60Hz, 2m Hose

Specifications:

Power Supply: 115 VAC, 60Hz.
Enclosure Class: IP55 (outdoor installation)
Sample Flow: 900mL/h for up to three (3) instruments
Suction Head Space: 9 ft. (3m) maximum (filter module holder to controller)
Sample Delivery Head Space: 21 ft. (7m) maximum (control unit to analyzer)
Sample Delivery Hose: 2 meter (heated)
Suction Hose: 5 meter (heated)
Sample Temperature: 41 to 104°F (5 to 40°C)
Ambient Temperature: -4 to 104°F (-20 to 40°C)
Certification: CE, UL, CSA

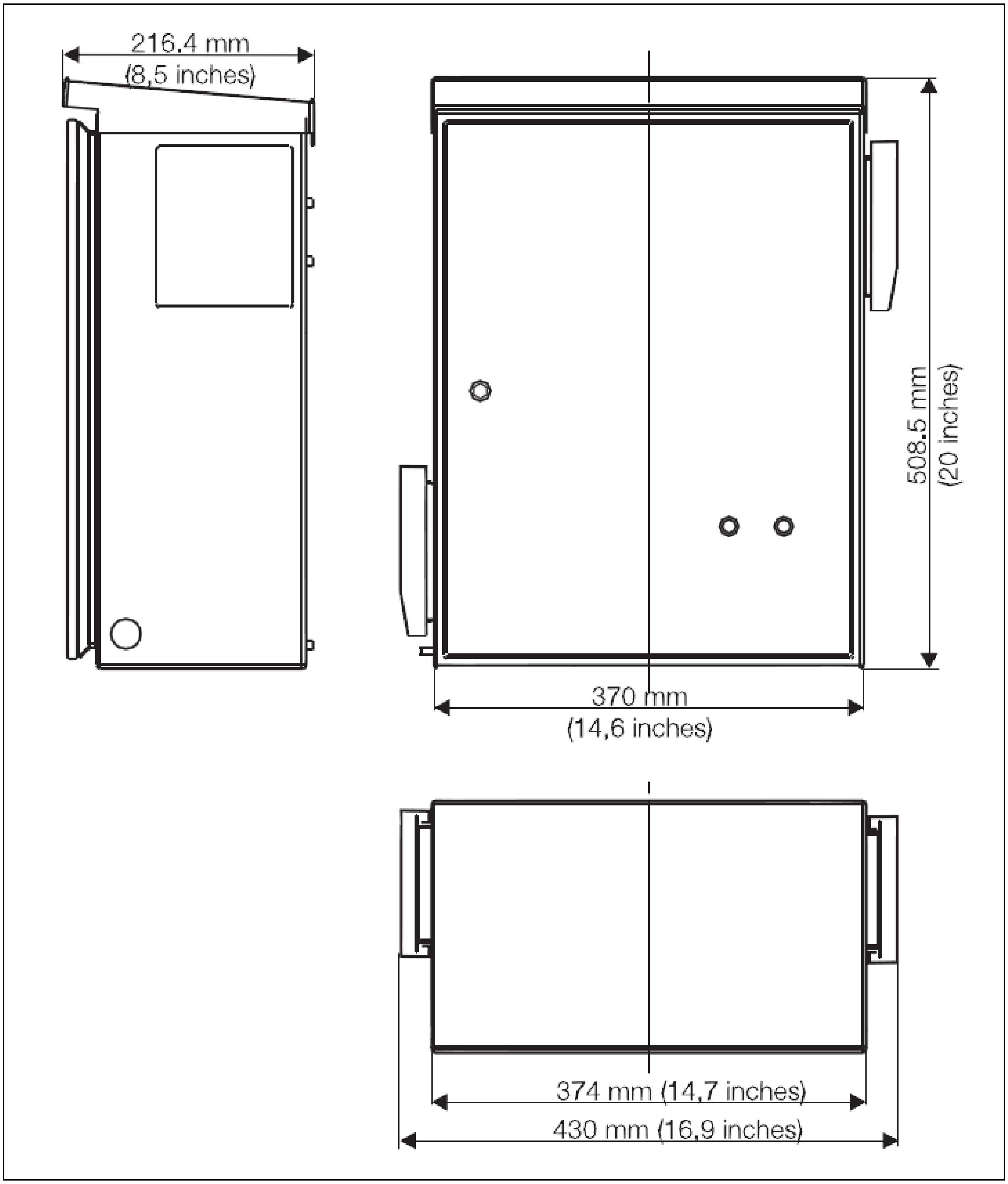
Hach Part No.: 5739200

Weight (control unit): 49 lb. (22 kg)
Weight (module holder): 20 lb. (9 kg)

Sample Filtration System Part # 2621065

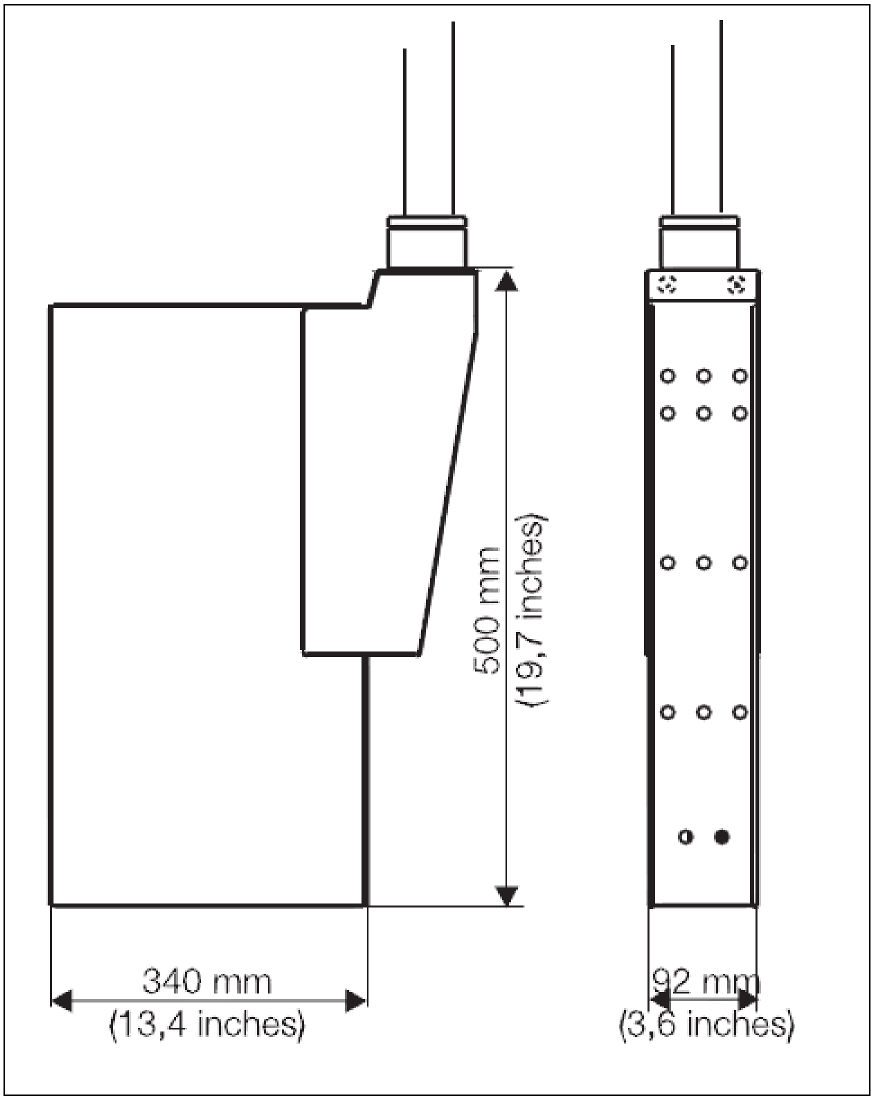
Hach Filtrax, 115V/1/60Hz, 2m Hose

Dimensions – Control Unit



Hach Filtrax, 115V/1/60Hz, 2m Hose

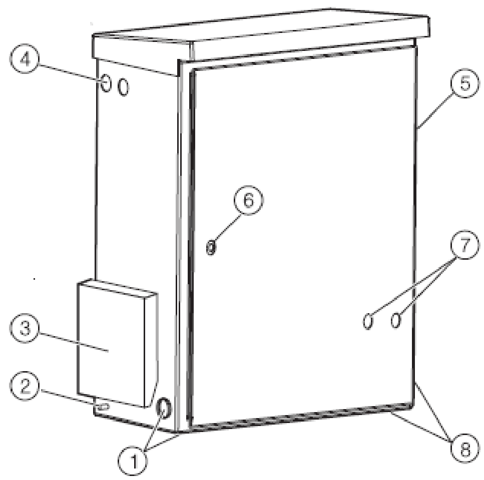
Dimensions – Module Holder



Hach Filtrax, 115V/1/60Hz, 2m Hose

2.5.1 Control unit

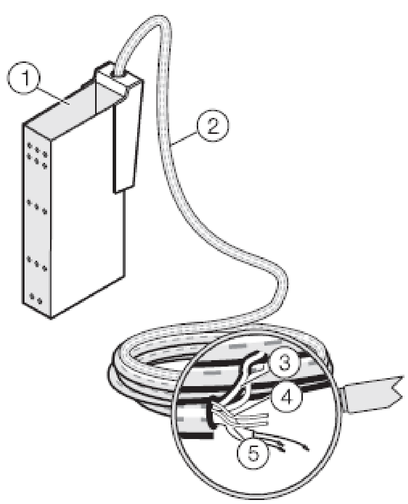
Fig. 2-3 Control unit



1. Suction tube connection (left or underneath on the left) (Blanking plugs and sealing ring for the unused opening)	**5.** Air filter cover (air outlet) **6.** Door lock
2. Connection for equipotential bonding	**7.** Green and red signal lamps
3. Air filter cover (air inlet) **4.** Cable gland for electrical connecting cable (2)	**8.** Sample tube connection (right or underneath on the right) (Blanking plugs and sealing ring for the unused opening)

2.5.2 Module carrier

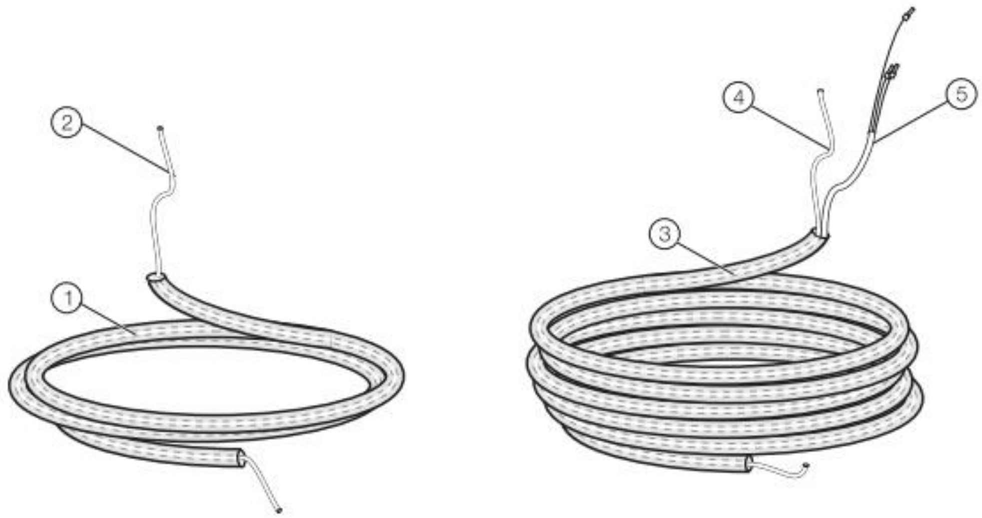
Fig. 2-4 Module carrier



1. Module carrier	**4.** Sample suction tube 3.2 mm OD (2)
2. Suction tube 5 m	**5.** Connecting cable for the tube heater
3. Air tube 6 mm OD (2)	

Hach Filtrax, 115V/1/60Hz, 2m Hose

Fig. 2-5 **Sample tubes**



1.	Sample tube 2 m, ∅ 23 mm (0.91 inch), not heated	**4.**	Sample pressure tube 3.2 mm OD
2.	Sample pressure tube 3.2 mm OD	**5.**	Connecting cable for the tube heater
3.	Sample tube 10 m, 20 m, 30 m, ∅ 23 mm (0.91 inch), heated		

AMMONIUM PROBE

Ammonia Probe Part # 2621103-1

Horiba AM-2000

Specifications:

Sample Condition:

Temperature: 0-40°C (32-104°F)

pH: 0-8.5

[Na+]: 0-100 times [NH4-N]

Maximum Depth: 10m (32.8')

Minimum Submergence: 100mm (4")

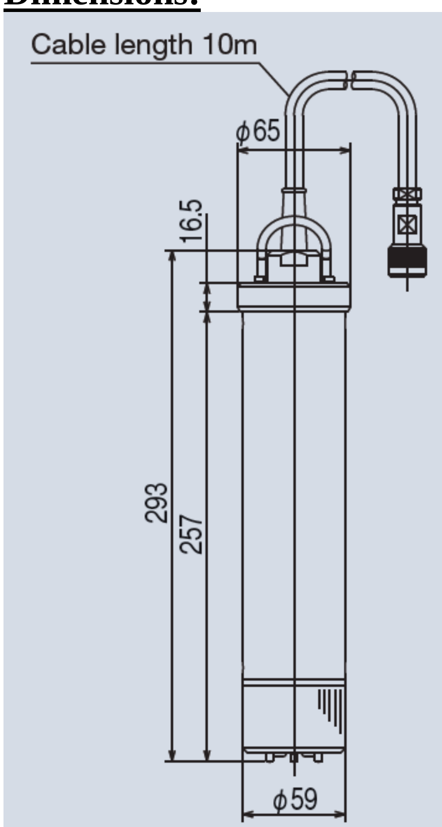
Wetted Materials: 316SS, FKM, PVC

Weight: 2.7 kg (including 10m cable) (6 lb)

Spare Parts:

AASI PN	Horiba Model	Description
2620399	7691	Ammonia ion sensor chip
2620400	7692	Potassium ion sensor chip
2620401	7211	Reference electrode chip
2620402	C-7211	Liquid junction tip
2620461-1	L-NH-1	1 mg/L standard (500mL)
2620461-10	L-NH-10	10 mg/L standard (500mL)

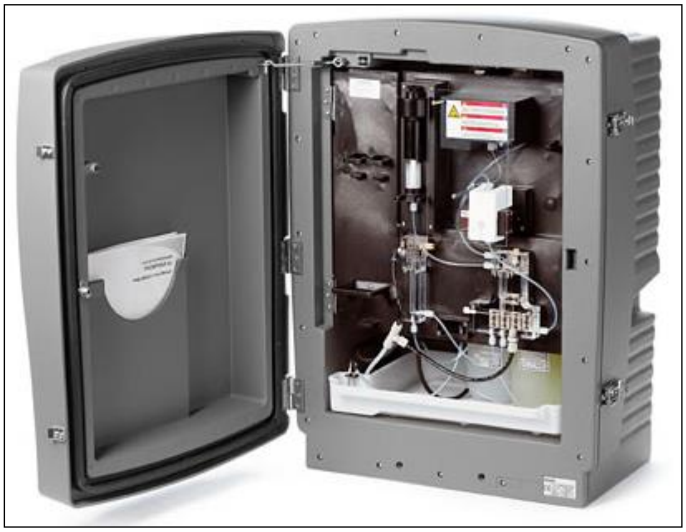
Dimensions:



PHOSPHATE ANALYZER

Phosphate Analyzer **Part # 2617392**

Hach Phosphax sc, Less Probe

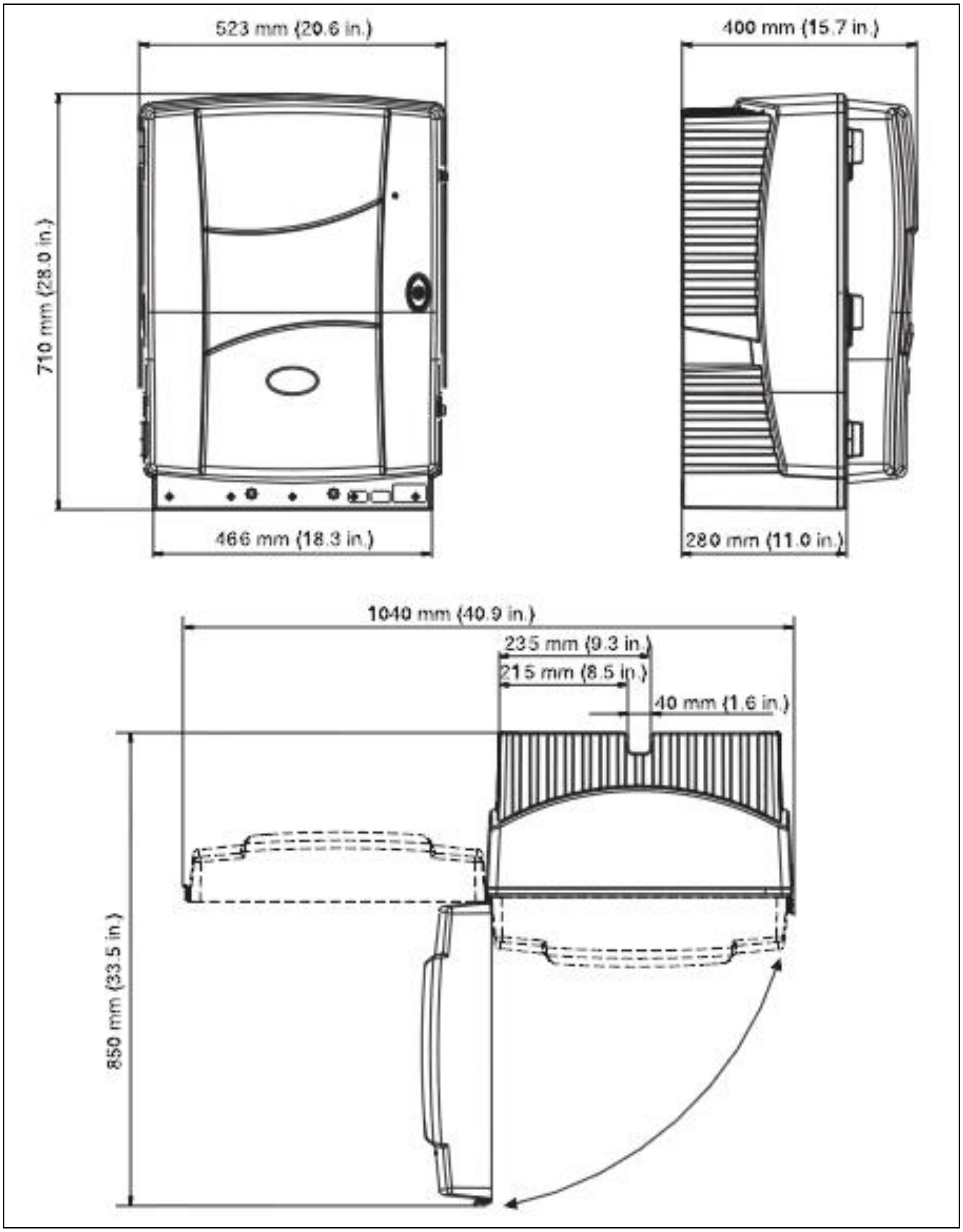


Specifications:

- **Measurement Method**: Photometric method using vanado-molydan
- **Range:** 0.05 to 15 mg/L
- **Accuracy:** 2% ±0.05 mg/L
- **Lower Detection Limit:** 0.05 mg/L
- **Reproducibility:** 2% ±0.05 mg/L
- **Response Time:** Less than 5 minutes, including sample preparation (T90)
- **Measurement Interval:** 5 to 120 minutes, adjustable
- **Flow:** 1 – 20 L/hr sample (free of suspended solids)
- **Number of Channels:** 1
- **Operating Conditions:**
  - Temperature: -20 to 45°C (-4 to 113°F)
  - Humidity: 95% relative humidity, non-condensing
- **Sample Conditions:**
  - Temperature: 4 to 40°C (39 to 104°F)
  - pH: 5 to 9
- **Storage Conditions:**
  - Temperature: -20 to 50°C (-4 to 122°F)
  - Humidity: 95% relative humidity, non-condensing
- **Power Supply:** connected to sc1000 / sc200
- **Data Transmission:** with data cable on sc1000 / sc200
- **Enclosure Material:** ASA/PC UV-resistant housing
- **Enclosure Rating:** IP55
- **Cable Length:** 2m (6.6 ft)
- **Weight:** 35 kg (77 lbs)

Hach Phosphax sc, Less Probe

Dimensions



TRANSDUCER

Level Transducer **Part # 2968870**

Keller Levelrat Submersible Level Transducer

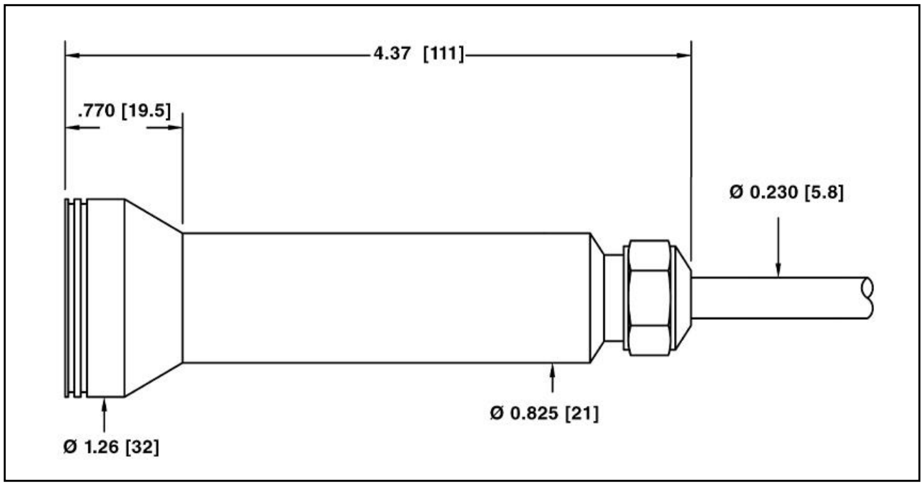
Design Features:

- Manufacturer: Keller America
- Connection: 1/2" NPT Conduit
- Wetted Materials: 316LSS
- Cable Material: Polyurethane
- Output Current: 4-20 mA
- Accuracy: 1%
- Operating Temperature Range: 14° to 140°F (-10° to 60°C)
- Excitation: 11-32 VDC
- Protection: IP68
- Lightning Protection
- Intrinsically safe for C1D1 locations

Configurations:

Assembly P/N	Instrument P/N	Range	Cable Length	Ordering Number
2968870-05-050	2620976-05-050	0-5 PSI	50 ft	2123.01202.023211.13
2968870-10-050	2620976-10-050	0-10 PSI	50 ft	2123.01302.023211.13

Dimensions:



Electrical:

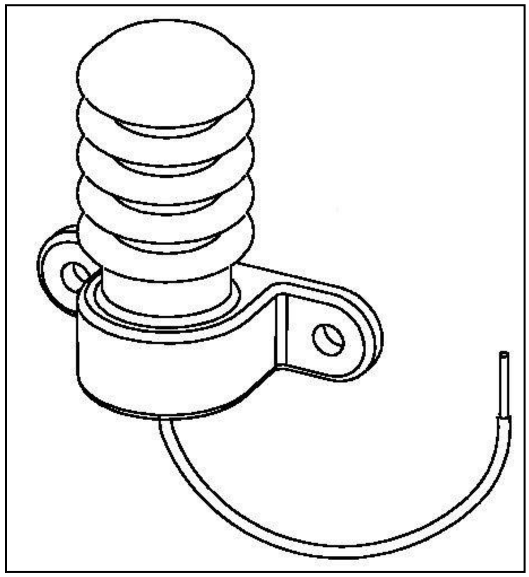
Output	Out / GND	VCC+	Shield
2-wire (mA)	Black	Red	Braided

Level Transducer **Part # 2968870**

Keller Levelrat Submersible Level Transducer

<u>Features</u>:

- Aqua Part Number: 2620977
- Keller America Part Number: 900001.0009



Bellows prevent moisture from entering and condensing in the vent tube of a submersible pressure transducer cable. It ensures reliable and accurate liquid level measurements while remaining a closed system. Mounting is located inside a junction box or control panel.

PRESSURE TRANSMITTER

Pressure Transmitter **Part # 2620949**

Rosemount 3051T, C1D2

Specifications:

- Model: 3051T Inline Pressure Transmitter
- Part Number: 3051TG1A2B21AM4Q4KB
- (G) Pressure Type: Gage
- (1) Pressure Upper Range Limit: 30 psi (2.1 bar)
- (A) Transmitter Output: 4-20 mA with Digital Signal Based on HART Protocol
- (2B) Process Connection Style: 1/2-14 NPT Female
- (2) Isolating Diaphragm / Process Connection Wetted Parts Material: 316L SST
- (1) Sensor Fill Fluid: Silicone
- (A) Housing Material | Conduit Entry Size: Aluminum | 1/2-14 NPT
- (M4) Display and Interface Options: LCD Display With Local Operator Interface
- (Q4) Calibration Certification: Calibration Certificate
- (KB) Product Certifications: Canada and USA Explosion-proof, Dust Ignition-proof, Intrinsically Safe, and Division 2

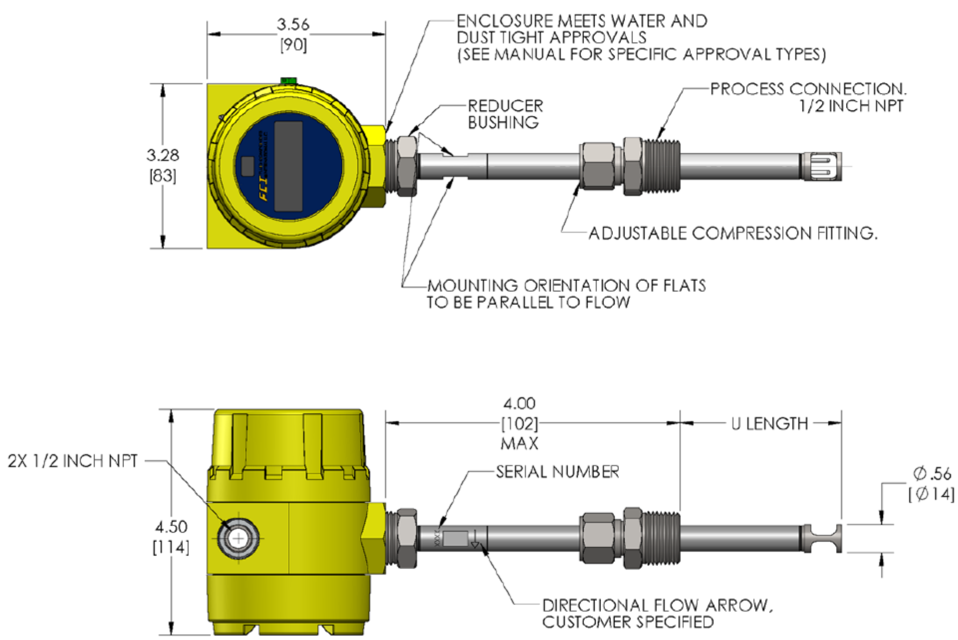
Name Tag / Calibration: 0-15 PSI

THERMAL DISPERSION FLOW METER

FCI ST51A Air Flow Meter

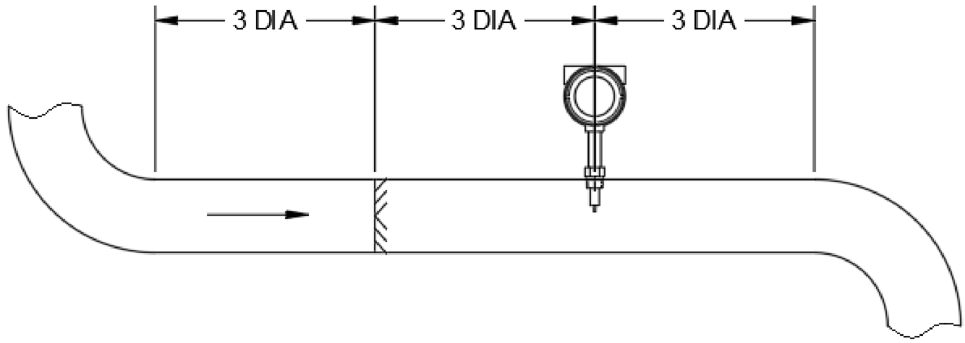
Specifications:

- Manufacturer: FCI
- Part Number: ST51A-4F22B6200
- Pipe Size/Schedule: 10" S10
- Flow Range: 543-2,173 SCFM
- Insertion Length: Max 12"
- Accuracy: +/- 1% reading +/- 0.5% full scale
- Repeatability: +/- 0.5% reading
- Turndown Ratio: 3:1 to 100:1
- Detection Method: Thermal Dispersion
- Maximum Pressure: 500 PSIG (3.44 MPa)
- Process Temperature Range: 0 to 350 °F (-18 to 177 °C)
- Process Connection: 1/2" NPT compression fitting
- Materials of Construction:
    - 316L SS Body
    - Hastelloy C22 Thermowell
    - 316 SS Compression Fitting
    - Aluminum Enclosure
- Enclosure Rating: NEMA 4X, IP66/IP67
- Ambient Temperature Range: 0-140 °F (-18-60 °C)
- Electrical Connection: Dual 1/2" NPT
- Input Power: 85-265 VDC
- Analog Output: Dual 4-20mA HART v7
- Communication Port: RS-232C for programming
- Digital Display: 2x16 character LCD

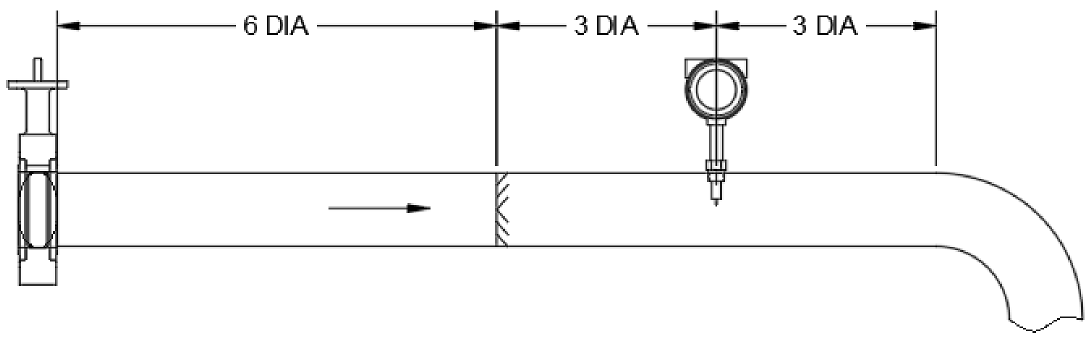


FCI ST51A Air Flow Meter

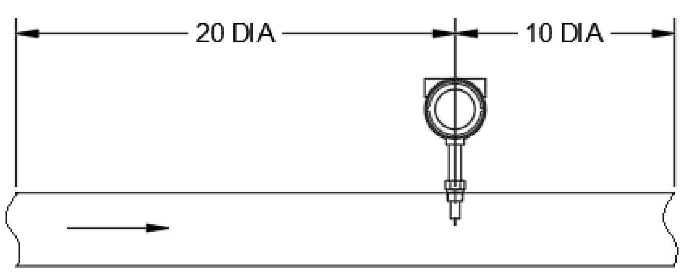
FLOWMETER WITH VIP VORTAB
(AFTER ELBOW)



FLOWMETER WITH VIP VORTAB
(AFTER BUTTERFLY VALVE)



FLOWMETER ONLY
(AFTER ANY FITTING OR VALVE)



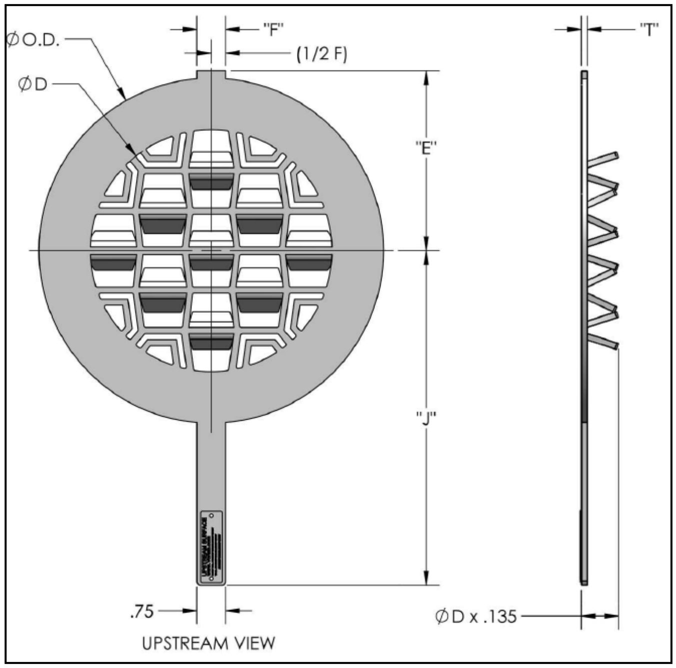
Flow Conditioner

Part # 2620686-TAB

FCI VIP Vortab A

Specifications:

- Mounting: Between flanges, ANSI B16.5
- Material: 316L SS
- Gaskets are required but **not** included with this part number.



Application and Installation:

Flow conditioners can be used to reduce the straight run requirement of thermal dispersion air flow meters.

The orientation of the handle must be parallel with the flow meter probe. Care should be taken to install the flow conditioner such that the elements are on the downstream side of the flanged connection.

Dimensions:

Nom. Pipe	AASI S10 PN	Ø D	AASI S40 PN	Ø D	T	Ø OD	J
2	2620686-020-10	2.16	2620686-020-40	2.07	0.048	3.62	5.63
2.5	2620686-025-10	2.64	2620686-025-40	2.47	0.06	4.12	6.13
3	2620686-030-10	3.26	2620686-030-40	3.07	0.07	5	7.13
4	2620686-040-10	4.26	2620686-040-40	4.03	0.12	6.19	8.13
6	2620686-060-10	6.36	2620686-060-40	6.07	0.12	8.5	9.25
8	2620686-080-10	8.33	2620686-080-40	7.98	0.12	10.62	9.88
10	2620686-100-10	10.42	2620686-100-40	10.02	0.12	12.75	11.63
12	2620686-120-10	12.39	2620686-120-40	12.00	0.12	15	13.13
14	2620686-140-10	13.62	2620686-140-40	13.25	0.12	16.25	14.38
16	2620686-160-10	15.62	2620686-160-40	15.25	0.188	18.5	15
18	2620686-180-10	17.62	2620686-180-40	17.25	0.188	21	16.25
20	2620686-200-10	19.56	2620686-200-40	19.25	0.188	23	17.88
22	2620686-220-10	21.56	2620686-220-40	21.25	0.25	27.25	19.25
24	2620686-240-10	23.50	2620686-240-40	23.25	0.25	27.25	22.8

FLOAT SWITCH

Float Switch   Part # 2611183

Anchor Scientific, Inc. ECO-FLOAT Model G

Features:
- Mercury Free
- Variety of Mounting Styles
- Variety of Circuit Configurations
- Installation Easy
- Differential in One Float
- Replaces Diaphragm and Mercury Switches

Description:

The Eco-Float is a mercury-free float switch for controlling liquid levels in a variety of applications. A snap-action switch is activated by a steel ball rolling back and forth within a switching tube in a plastic float housing. There is a minimum differential between "on" and "off" of approximately 3.5 inches (90mm). Greater differentials can be achieved when the pipe mounted or externally weighted mounting styles are used. Various lengths of cable and circuit configurations are available and in stock.

Applications:

The Eco-Float can be used in a variety of liquid level monitoring applications including sumps, sewage ejectors, septic tanks, vaults, lift stations and tanks. Eco-Floats are ruggedly constructed of corrosion resistant materials, enabling them to be used in a variety of different liquids. Some applications are subject to additional requirements described in the National Electric Code.

Specifications:
- Cable: Chloroprene jacketed with EPDM insulated conductors, type SOOW #18 AWG. 2-conductor cable 16/30 conductor stranding, .345 (8.8mm) nominal outside diameter rated for 600 volts, with a temperature limit = 90°C (194°F)
- Float Housing: Polypropylene, 3" O.D. X 4.25" long (76.2mm X 108mm)
- Electrical Ratings: 7A @ 115 VAC, 3.5A @ 230 VAC
- Temperature Limit: 140ºF (60ºC)
- Wiring Information: Black/White

Information:
- Part Number: GSI40NO-STOW
- Model: G
- Mounting Style: SI (internal weight)
- Cable Length: 40 ft. (12m)
- Circuit Configuration: NO (normally open)

CONCRETE SEALANT

Polyurethane Sealant Part # 2604138

Single Component Vulkem 116

Vulkem 116
An elastomeric sealant ideal for moving joints, with the ability to be subjected to stress and vibration as well as expansion and contraction. It exhibits excellent adhesion characteristics and is widely used in joints for vehicles, boats, log homes, and the railcar industry, where a waterproof environment is critical.

Product meets ASTM C920-98 and CAN/CGSB 19.13-M87. For additional health and safety information, read the current (SDS) safety data sheet carefully before using this product and observe all precautions for empty containers.

Packaging: The Vulkem 116 polyurethane sealant material is packaged in 10.1 oz. (300 ml) cartridges (tube size is 2" dia x 8.5" lg) for dispensing with standard conventional caulking gun or pneumatic / electric caulking guns. A case / cardboard box holds (30) 10.1 oz cartridges.

Storage Conditions: Vulkem 116 sealant material must be used within an 18-month period from the manufacturing date printed on each cartridge. Store sealant at a temperature of 40 to 100°F (4.4 - 37.7°C). Do not allow to freeze.

PHYSICAL PROPERETIES	
Hardness	40
100% Modulus	150
Elongation, Ultimate	200-300%
Tensile Strength	200-250 PSI
NSF Standard	No
USDA Approved	Approved
Cure Rate	48-72 Hours
Toxicity, Cured Strength	Non-Toxic
Stain / Color change	None
Sag Resistance	Non-sag in 1/2″ joint
Weight Loss, (24 hours-uncured)	Max. 10% @ 100 Degrees C (PASS)
PEEL STRENGTH	
Aluminum (mill finish)	15 PLI
Aluminum (anodized)	18 PLI
Steel	19 PLI
Glass	16 PLI
Tear Strength	70 PLI

Weathering Resistance: Excellent resistance to aging and weathering

- **Chemical Resistance:** Good resistance to water, diluted acids, and diluted alkaline. Avoid exposure to high levels of chlorine. (Maximum continuous level must not exceed 3 ppm of chlorine.) Bonds to most construction materials without a primer. Consult Technical Service for specific data.
- **Clean-up:** Uncured material can be removed with approved solvent. Cured material can only be removed mechanically.

Valve Schedule
AquaNereda®

Project Name: Napanee WPCP Upgrades
Project Location: Napanee, Ontario, Canada
Project ID: 704419A

Unless otherwise noted, electric valve actuators shall be supplied with a receptacle. The mating cord set is to be supplied by Aqua-Aerobic Systems, Inc. with each actuator. The electrical disconnect / junction boxes (provided by others) must be located within reach of the provided cord set.

AquaNereda®

QTY	Manuf.	Description / Location	Valve No.	Actuator Assembly	Drawing No.
3	Pratt Auma	24” Electric Knife Gate Influent	9704419A30355	9704419A30132	9704419A30124
3	Pratt Auma	18” Electric Knife Gate Sludge Decant	9704419A30356	9704419A30133	9704419A30125
3	Milliken	18” Manual Knife Gate Sludge Decant Isolation	9704419A30364	---	---
3	Pratt Auma	16” Electric Knife Gate Water Level Correction	9704419A30357	9704419A30137	9704419A30126
3	Milliken	16” Manual Knife Gate Water Level Correction	9704419A30365	---	---
3	ABZ Auma	4” Electric Butterfly Sludge Decant Air Supply	2617008	9704419A30136	9704419A30129
3	ABZ Auma	4” Electric Butterfly Sludge Decant Air Release	2617008	9704419A30136	9704419A30129
3	ABZ	4” Manual Butterfly Sludge Decant Air Throttle	2617000	---	---

Valve Schedule
AquaNereda®

Blower / Diffuser System

QTY	Manuf.	Description / Location	Valve No.	Actuator Assembly	Drawing No.
8	ABZ	8” Manual Butterfly Blower Isolation	2617002	---	---
3	ABZ Auma	6” Electric Butterfly Diffuser (Modulating)	2617009	9704419A30135	9704419A30128
3	ABZ	10” Manual Butterfly Diffuser Isolation	2617003	-	-

Sludge Buffer

QTY	Manuf.	Description / Location	Valve No.	Actuator Assembly	Drawing No.
2	Milliken Auma	18” Electric Butterfly Sludge Buffer Inlet	2615543	9704419A30134	9704419A30127

BUTTERFLY VALVE

MANUAL LEVER
BUTTERFLY VALVE

Valve **Part # 2617000**

Butterfly, 4", ABZ, Series 397, Lever Operated

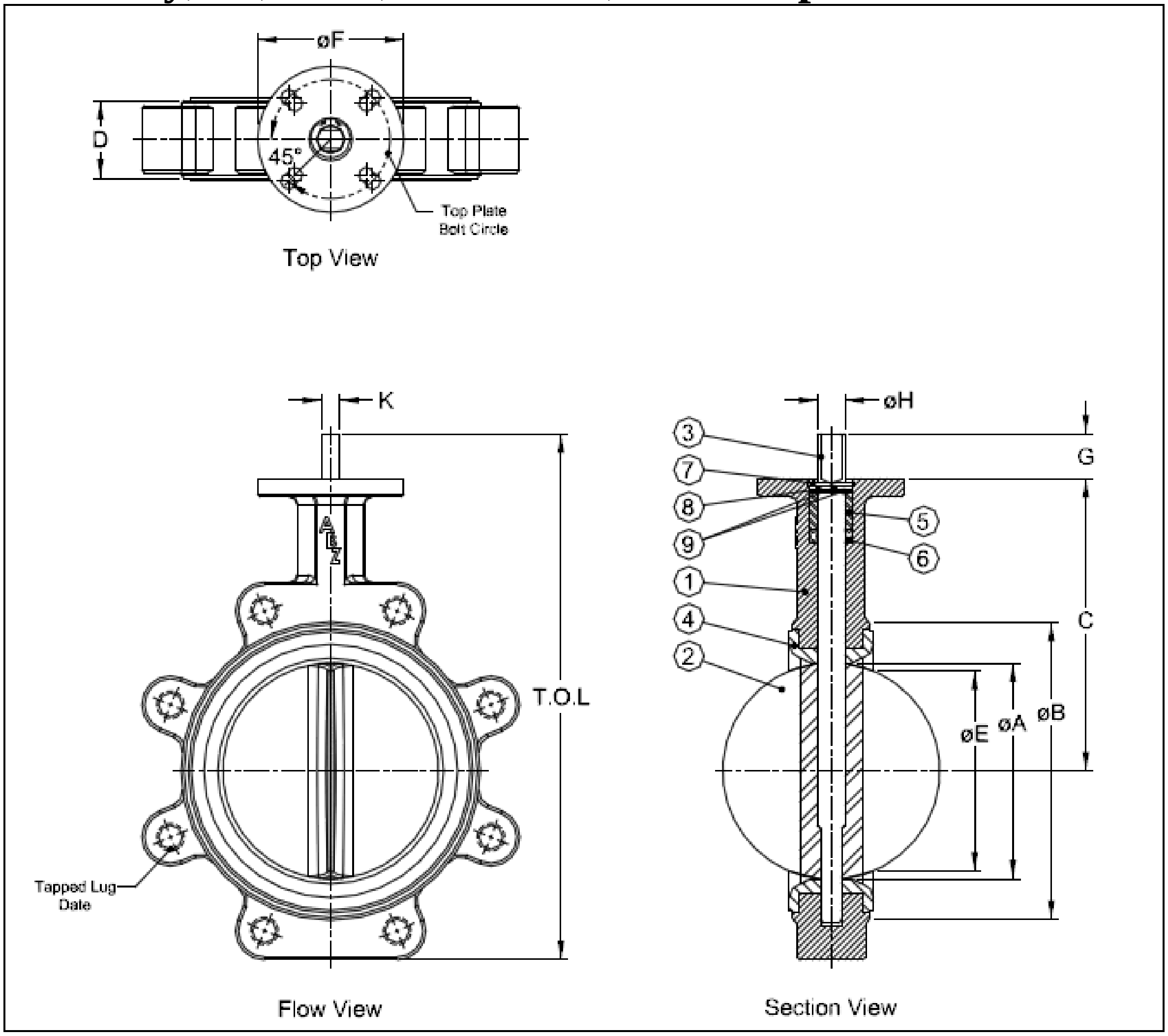
Features:

- Rated up to 200 PSI bi-directional and dead end service
- Stub shaft design with internal drive (stems removable and replaceable with no special tools).
- Designed in accordance with sections of API 609 Category A, ASME 16.1/16.5, ASME 16.34 and MSS SP67.
- Design tested in accordance with API 598.
- Molded Seat forms a seal against all standard ANSI 125/150 flanges. Gasketing requirements are eliminated.
- Viton seat rated for 350°F (176°C)

Materials of Construction:

Item No.	Name	Material
1	Lug Body	Ductile Iron
2	Disc	316 SS
3	Stem	416 SS
4	Seat	Viton
5	Bushing	Teflon – Graphite Impregnated
6	Seal	Buna
7	Body Clip	Carbon Steel
8	Stem Clip	Carbon Steel
9	Washer	Zinc Plated Steel

Butterfly, 4", ABZ, Series 397, Lever Operated



Dimensions in inches (mm):

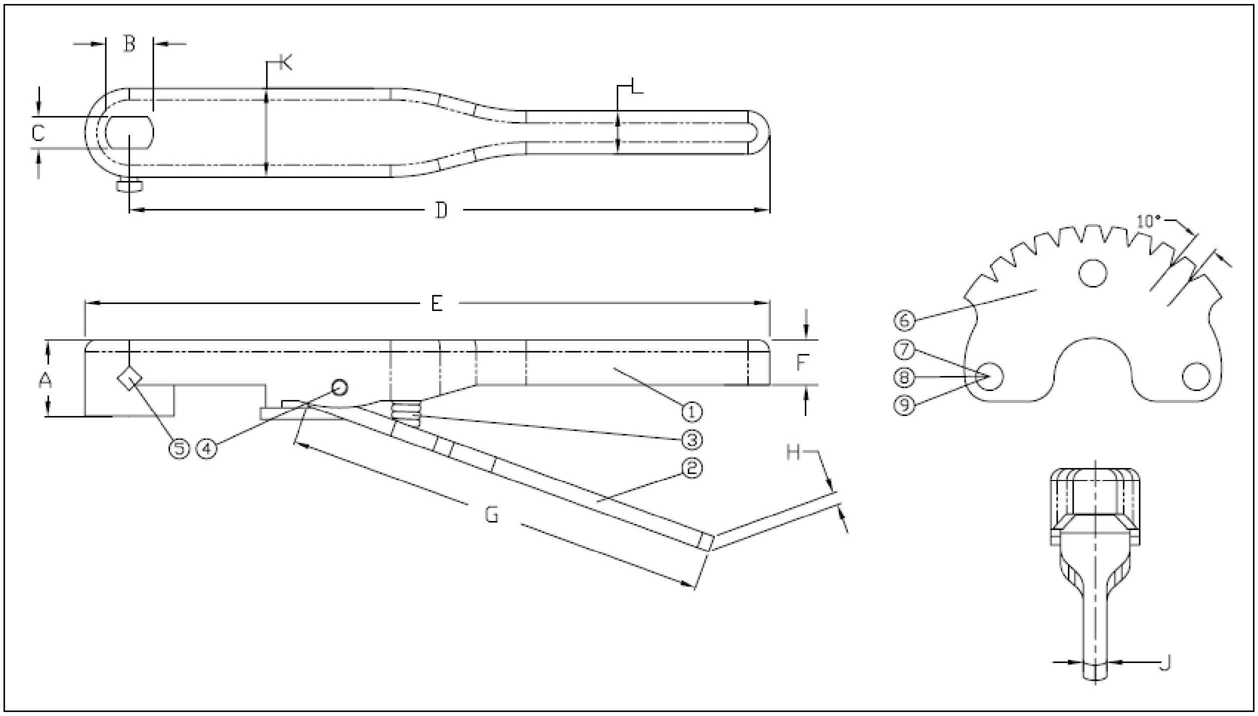
Valve Size	ØA	ØB	C	D	ØE	ØF	G
4”	4 1/8” (105)	5 15/16” (151)	7” (178)	2” (51)	3 5/8” (92)	4” (102)	1 1/4” (32)

ØH	K	T.O.L.	WEIGHT lbs (kg)
5/8” (16)	7/16” (11)	12.50” (318)	20 (9.1)

Top Plate Drilling			Tapped Lug Data		
Bolt Circle	No. of Holes	Hole Dia.	Bolt Circle	No. of Holes	Tap
3 1/4” / F07 (83)	4	7/16” (11)	7 1/2” (191)	8	5/8”-11 unc

Valve Part # 2617000

Butterfly, 4", ABZ, Series 397, Lever Operated



Handle Subassembly Number: 800-320-040-101-000

ITEM NO.	NAME	NO. REQ'D	PART NO.	MATERIAL
1	HANDLE	1	202-321	DI
2	LEVER	1	202-322	DI
3	SPRING	1	204-323	316 SS
4	PIN	1	204-324	316 SS
5	SIDE BOLT	1	211-325	C.P. STEEL
6	90° NOTCH PLATE	1	211-326	C.P. STEEL
7	BOLTS	2	211-327	C.P. STEEL
8	NUTS	2	211-327	C.P. STEEL
9	WASHERS	2	211-327	C.P. STEEL

Dimensions in inches (mm):

A	B	C	D	E	F	G	H
1 1/4” (32)	5/8” (16)	7/16” (11)	10.05” (255)	10 3/4” (273)	0.71” (18)	6.70” (170)	0.26” (7)

J	K	L	WEIGHT Lbs (kg)
3/8” (10)	1.40” (36)	0.68” (17)	2.50 (1.1)

Valve **Part # 2617002**

Butterfly, 8", ABZ, Series 397, Lever Operated

Features:

- Rated up to 200 PSI bi-directional and dead end service
- Stub shaft design with internal drive (stems removable and replaceable with no special tools).
- Designed in accordance with sections of API 609 Category A, ASME 16.1/16.5, ASME 16.34 and MSS SP67.
- Design tested in accordance with API 598.
- Molded Seat forms a seal against all standard ANSI 125/150 flanges. Gasketing requirements are eliminated.
- Viton seat rated for 350°F (176°C)

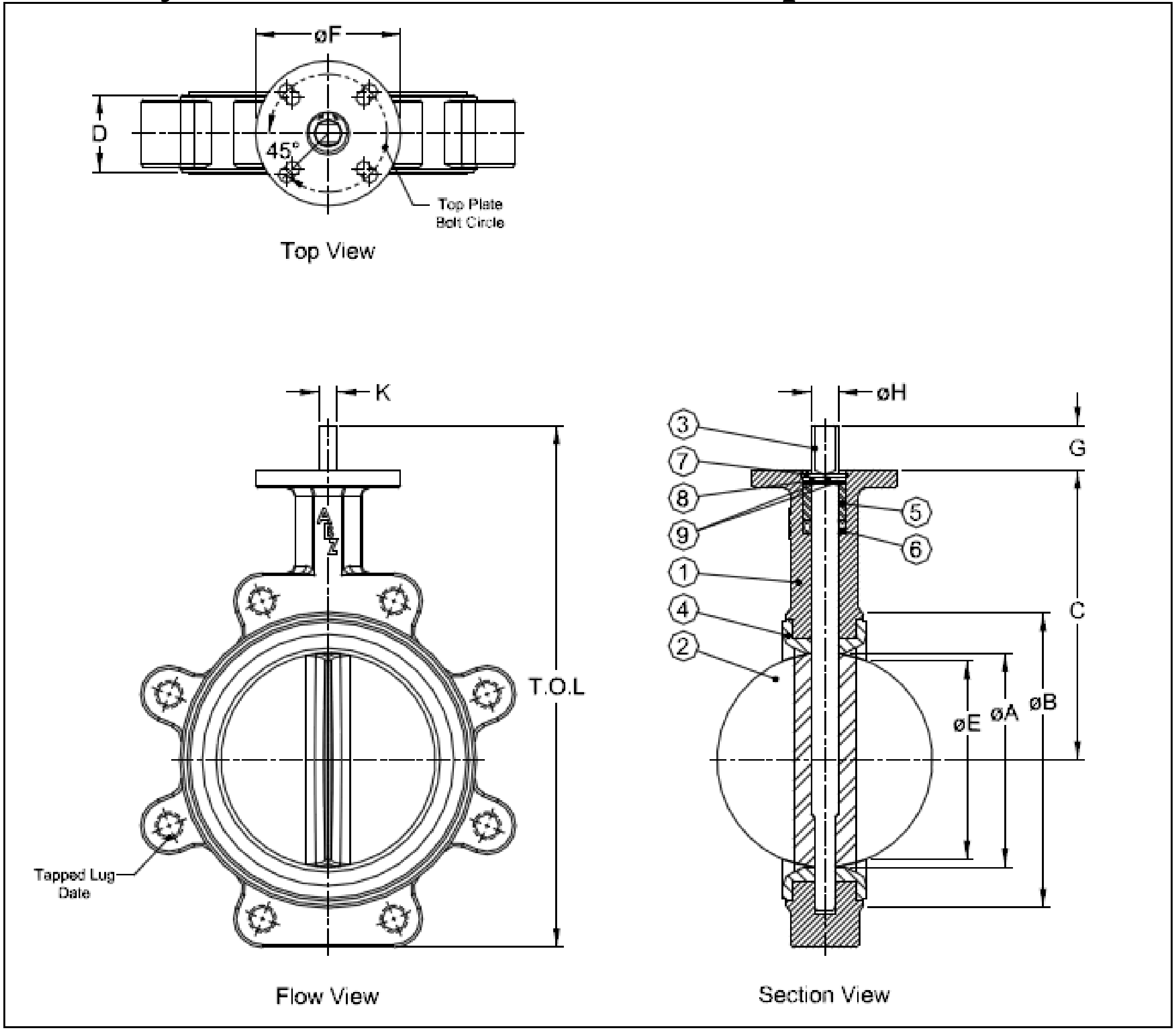
Materials of Construction:

Item No.	Name	Material
1	Lug Body	Ductile Iron
2	Disc	316 SS
3	Stem	416 SS
4	Seat	Viton
5	Bushing	Teflon – Graphite Impregnated
6	Seal	Buna
7	Body Clip	Carbon Steel
8	Stem Clip	Carbon Steel
9	Washer	Zinc Plated Steel

Valve

Part # 2617002

Butterfly, 8", ABZ, Series 397, Lever Operated



Dimensions in inches (mm):

Valve Size	ØA	ØB	C	D	ØE	ØF	G
8”	7 15/16” (202)	10 1/4” (260)	9 1/2” (241)	2 1/2” (64)	7 1/2” (191)	6” (152)	1 1/4” (32)

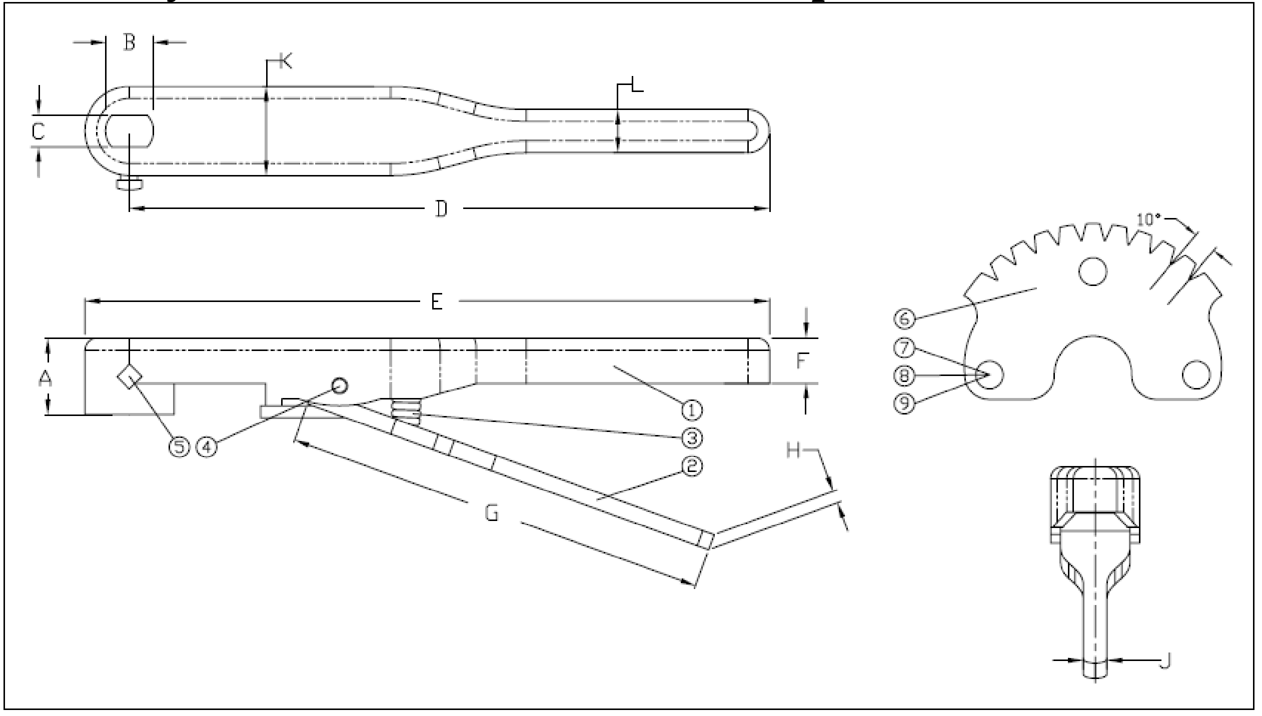
ØH	K	T.O.L.	WEIGHT lbs (kg)
7/8” (22)	5/8” (16)	17.20” (437)	41 (18.6)

Top Plate Drilling			Tapped Lug Data		
Bolt Circle	No. of Holes	Hole Dia.	Bolt Circle	No. of Holes	Tap
5” (127)	4	9/16” (14)	11 3/4” (298)	8	¾”-10 unc

Valve

Part # 2617002

Butterfly, 8", ABZ, Series 397, Lever Operated



Handle Subassembly Number: 800-320-080-101-000

ITEM NO.	NAME	NO. REQ'D	PART NO.	MATERIAL
1	HANDLE	1	202-321	DI
2	LEVER	1	202-322	DI
3	SPRING	1	204-323	316 SS
4	PIN	1	204-324	316 SS
5	SIDE BOLT	1	211-325	C.P. STEEL
6	90° NOTCH PLATE	1	211-326	C.P. STEEL
7	BOLTS	2	211-327	C.P. STEEL
8	NUTS	2	211-327	C.P. STEEL
9	WASHERS	2	211-327	C.P. STEEL

Dimensions in inches (mm):

A	B	C	D	E	F	G	H
1 1/4” (32)	3/4” (19)	1/2” (13)	13.77” (350)	14.77” (375)	0.60” (15)	9.38” (238)	0.325” (8)

J	K	L	WEIGHT Lbs (kg)
3/8” (10)	1.72” (44)	0.85” (22)	4.0 (1.8)

Valve

Part # 2617003

Butterfly, 10", ABZ, Series 397, Lever Operated

Features:

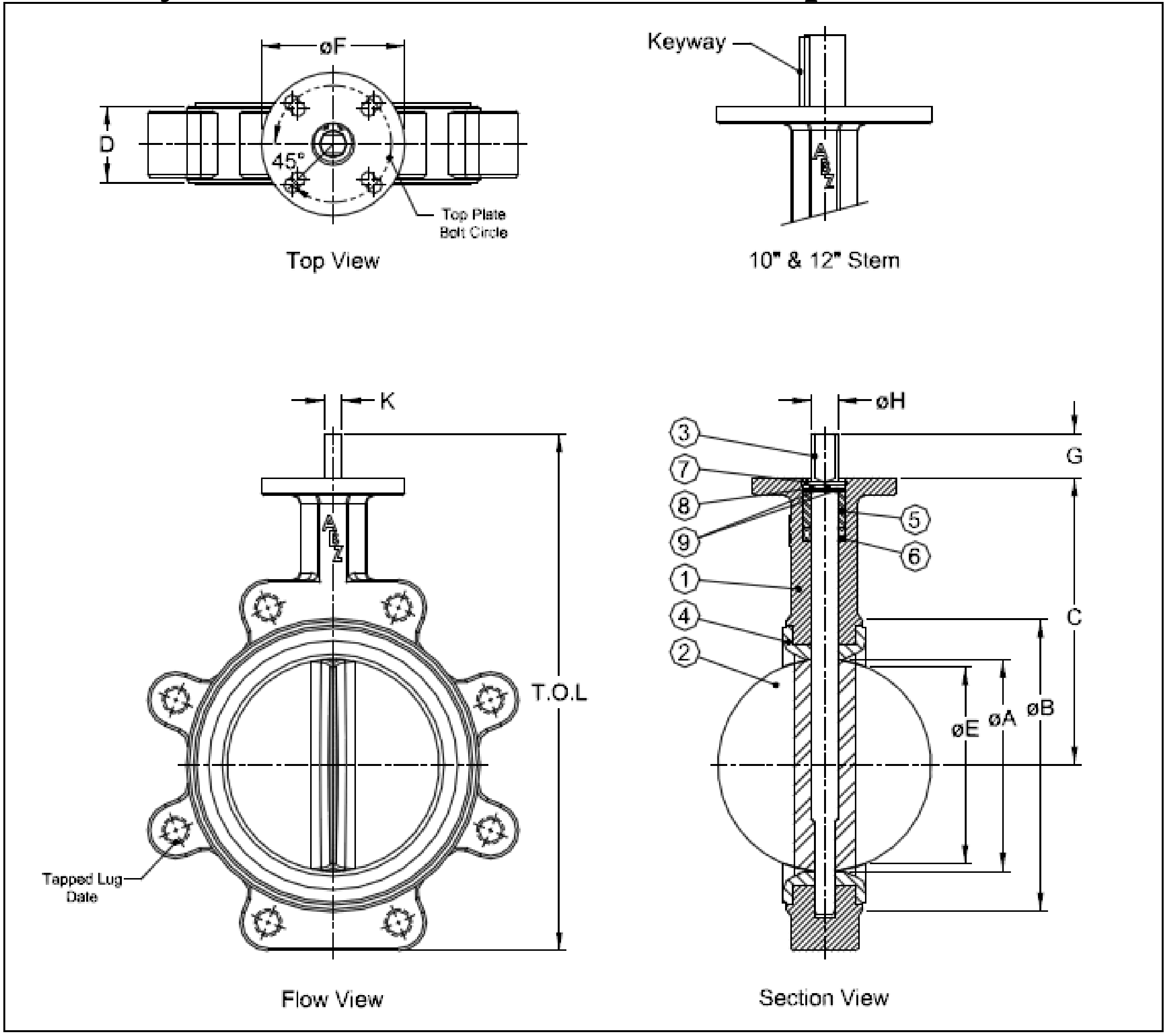
- Rated up to 200 PSI bi-directional and dead end service
- Stub shaft design with internal drive (stems removable and replaceable with no special tools).
- Designed in accordance with sections of API 609 Category A, ASME 16.1/16.5, ASME 16.34 and MSS SP67.
- Design tested in accordance with API 598.
- Molded Seat forms a seal against all standard ANSI 125/150 flanges. Gasketing requirements are eliminated.
- Viton seat rated for 350°F (176°C)

Materials of Construction:

Item No.	Name	Material
1	Lug Body	Ductile Iron
2	Disc	316 SS
3	Stem	416 SS
4	Seat	Viton
5	Bushing	Teflon – Graphite Impregnated
6	Seal	Buna
7	Body Clip	Carbon Steel
8	Stem Clip	Carbon Steel
9	Washer	Zinc Plated Steel

Valve

Butterfly, 10", ABZ, Series 397, Lever Operated



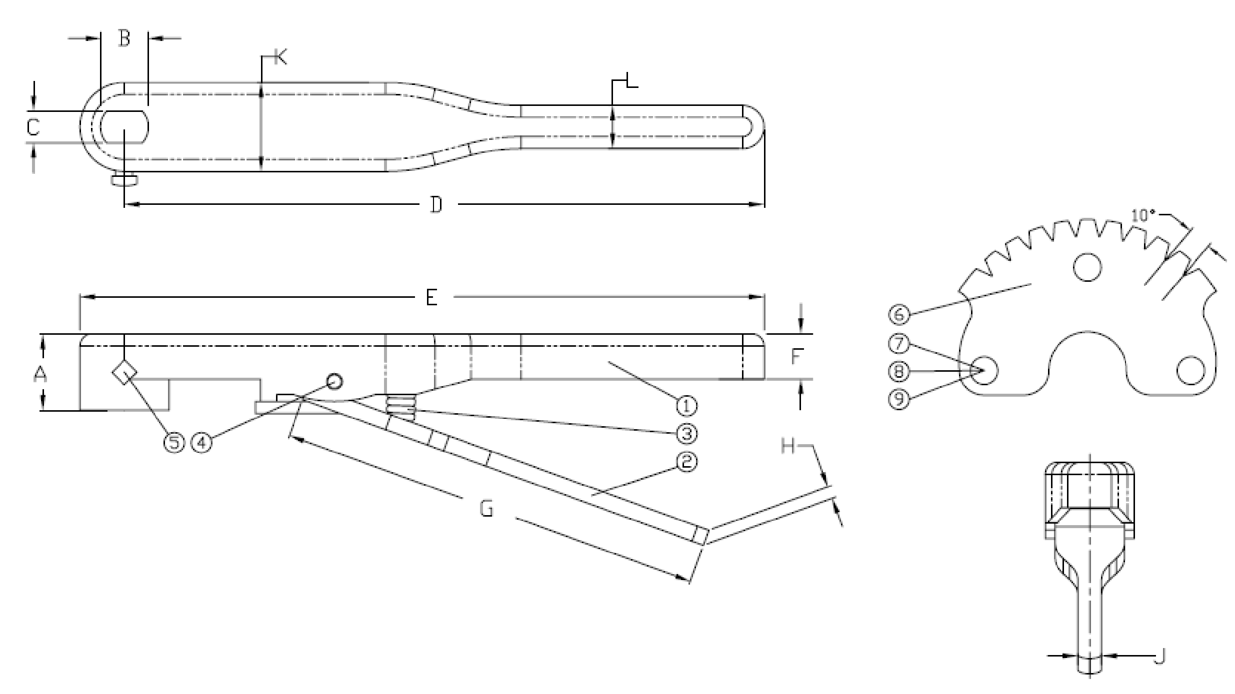
Dimensions in inches (mm):

Valve Size	ØA	ØB	C	D	ØE	ØF	G
10”	9 3/4” (248)	12 5/8” (321)	10 3/4” (273)	2 1/2” (64)	9 5/8” (244)	6” (152)	2” (51)

ØH	Keyway	T.O.L.	WEIGHT lbs (kg)
1 1/8” (29)	1/4x1/4 (6x6)	20.44” (519)	64 (29)

Top Plate Drilling			Tapped Lug Data		
Bolt Circle	No. of Holes	Hole Dia.	Bolt Circle	No. of Holes	Tap
5” (127)	4	9/16” (14)	14 1/4” (362)	12	7/8”-9 unc

Butterfly, 10", ABZ, Series 397, Lever Operated



Handle Subassembly Number: 800-320-100-101-000

ITEM NO.	NAME	NO. REQ'D	PART NO.	MATERIAL
1	HANDLE	1	202-321	DI
2	LEVER	1	202-322	DI
3	SPRING	1	204-323	316 SS
4	PIN	1	204-324	316 SS
5	SIDE BOLT	1	211-325	C.P. STEEL
6	90° NOTCH PLATE	1	211-326	C.P. STEEL
7	BOLTS	2	211-327	C.P. STEEL
8	NUTS	2	211-327	C.P. STEEL
9	WASHERS	2	211-327	C.P. STEEL

Dimensions in inches (mm):

A	B	C	D	E	F	G	H
1 1/4” (32)	7/8” (22)	5/8” (16)	13.77” (350)	14.77” (375)	0.60” (15)	9.38” (238)	0.325” (8)

J	K	L	WEIGHT Lbs (kg)
3/8” (10)	1.72” (44)	0.85” (22)	4.0 (1.8)

BUTTERFLY VALVE
LESS OPERATOR

Valve Part # 2615543

Butterfly, Milliken 18" 511A LO

Features:

- Body Style: Flanged x Flanged ends
- Pressure Class: 150B per AWWA Standard C504
- Working Pressure: 150psig
- Flanges: Flat faced and drilled in accordance with ANSI B16.1, Class 125 standards
- Rubber Seat: Bonded seat-in-body
- Conforms to NSF Standard 61
- Manufacturer shall be prepared to provide Proof of Design Test reports
- Hydrostatic and seat leakage tests shall be conducted in strict accordance with AWWA Standard C504

Materials:

- Body: ASTM A126, Class B cast Iron
- Seats: One piece rubber-body construction molded and bonded into a recessed cavity
- Disc: ASTM A126, Class B cast iron disc with a stainless steel type 316 edge
- Shaft: Type 304SS
- Bearings: Self-lubricating non-metallic material
- Packing: Chevron V-type

Cv value: 14444

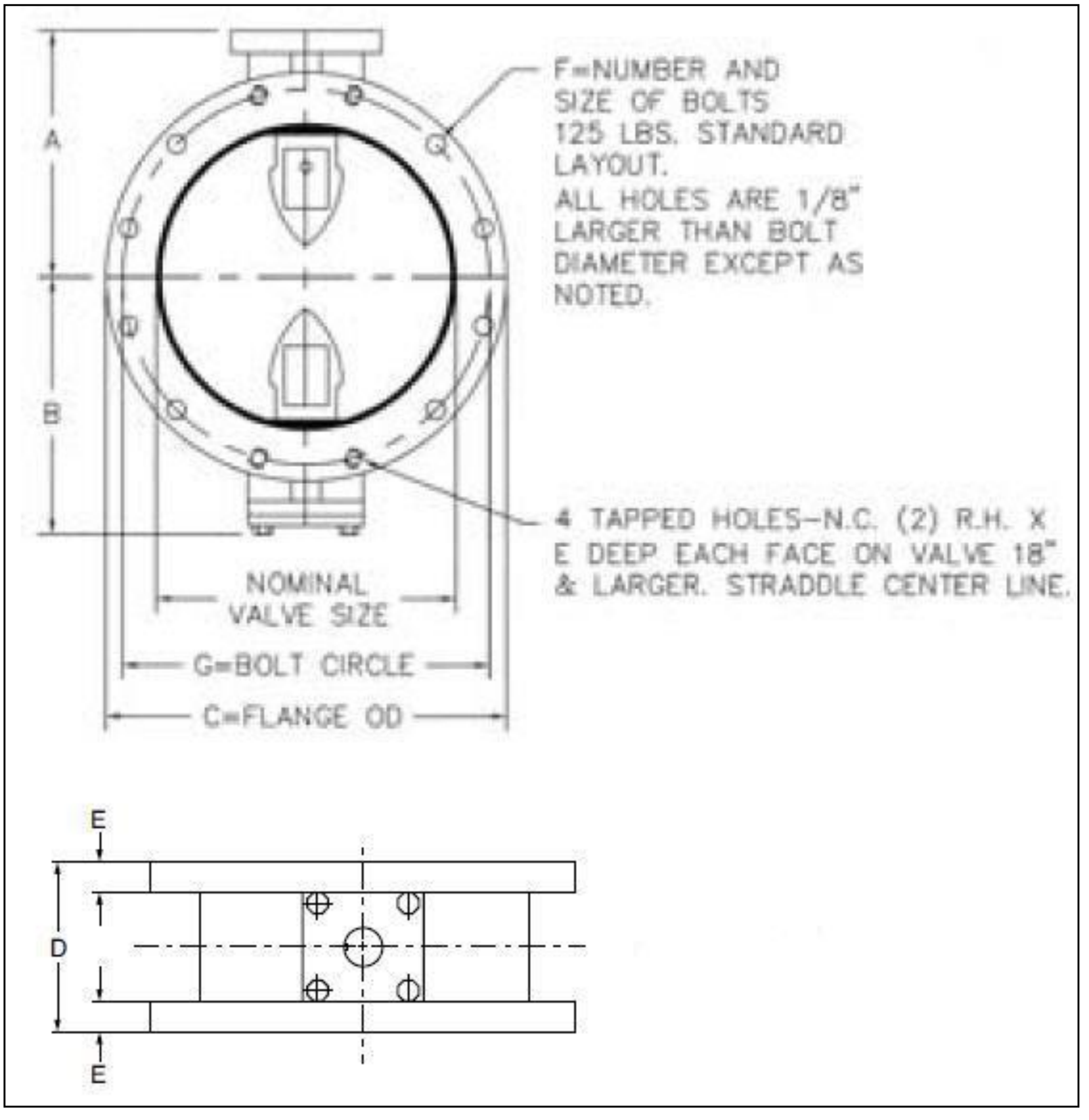
Painting:

- The valve interior and exterior, except for disc edge, rubber seat, and finished portions shall be evenly coated with a 2-part liquid epoxy to comply with NSF61 and AWWA Standard C504
- Paint: AMERCOAT® 370 Epoxy, Oxide Red, 8 mils DFT

Valve

Butterfly, Milliken 18" 511A LO

Dimensions:



	Size	A	B	C	D	E	F	G
Inch	18	13 3/8	15 1/4	25	8	1 9/16	16 – 1 1/8	22 3/4
mm	457.2	339.7	387.4	635	203.2	39.7		577.9

Valve

Part # 2617008

Butterfly, 4", ABZ, Series 397, Less Operator

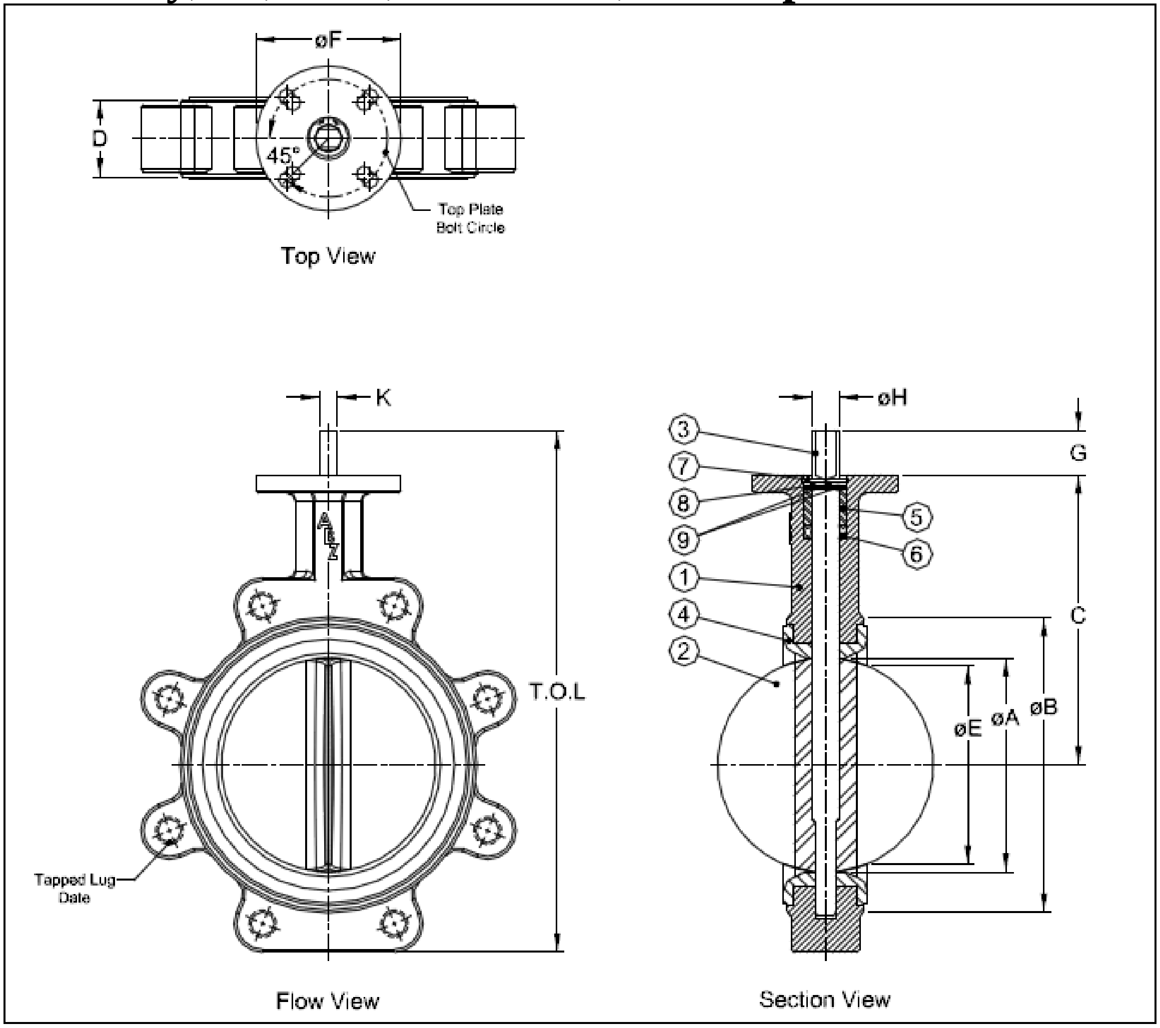
Features:

- Rated up to 200 PSI bi-directional and dead end service
- Stub shaft design with internal drive (stems removable and replaceable with no special tools).
- Designed in accordance with sections of API 609 Category A, ASME 16.1/16.5, ASME 16.34 and MSS SP67.
- Design tested in accordance with API 598.
- Molded Seat forms a seal against all standard ANSI 125/150 flanges.
- Viton seat rated for 350°F (176°C)

Materials of Construction:

Item No.	Name	Material
1	Lug Body	Ductile Iron
2	Disc	316 SS
3	Stem	416 SS
4	Seat	Viton
5	Bushing	Teflon – Graphite Impregnated
6	Seal	Buna
7	Body Clip	Carbon Steel
8	Stem Clip	Carbon Steel
9	Washer	Zinc Plated Steel

Butterfly, 4", ABZ, Series 397, Less Operator



Dimensions in inches (mm):

Valve Size	ØA	ØB	C	D	ØE	ØF	G
4”	4 1/8” (105)	5 15/16” (151)	7” (178)	2” (51)	3 5/8” (92)	4” (102)	1 1/4” (32)

ØH	K	T.O.L.	WEIGHT lbs (kg)
5/8” (16)	7/16” (11)	12.50” (318)	20 (9.1)

Top Plate Drilling			Tapped Lug Data		
Bolt Circle	No. of Holes	Hole Dia.	Bolt Circle	No. of Holes	Tap
3 1/4” / F07 (83)	4	7/16” (11)	7 1/2” (191)	8	5/8”-11 unc

Valve **Part # 2617009**

Butterfly, 6", ABZ, Series 397, Less Operator

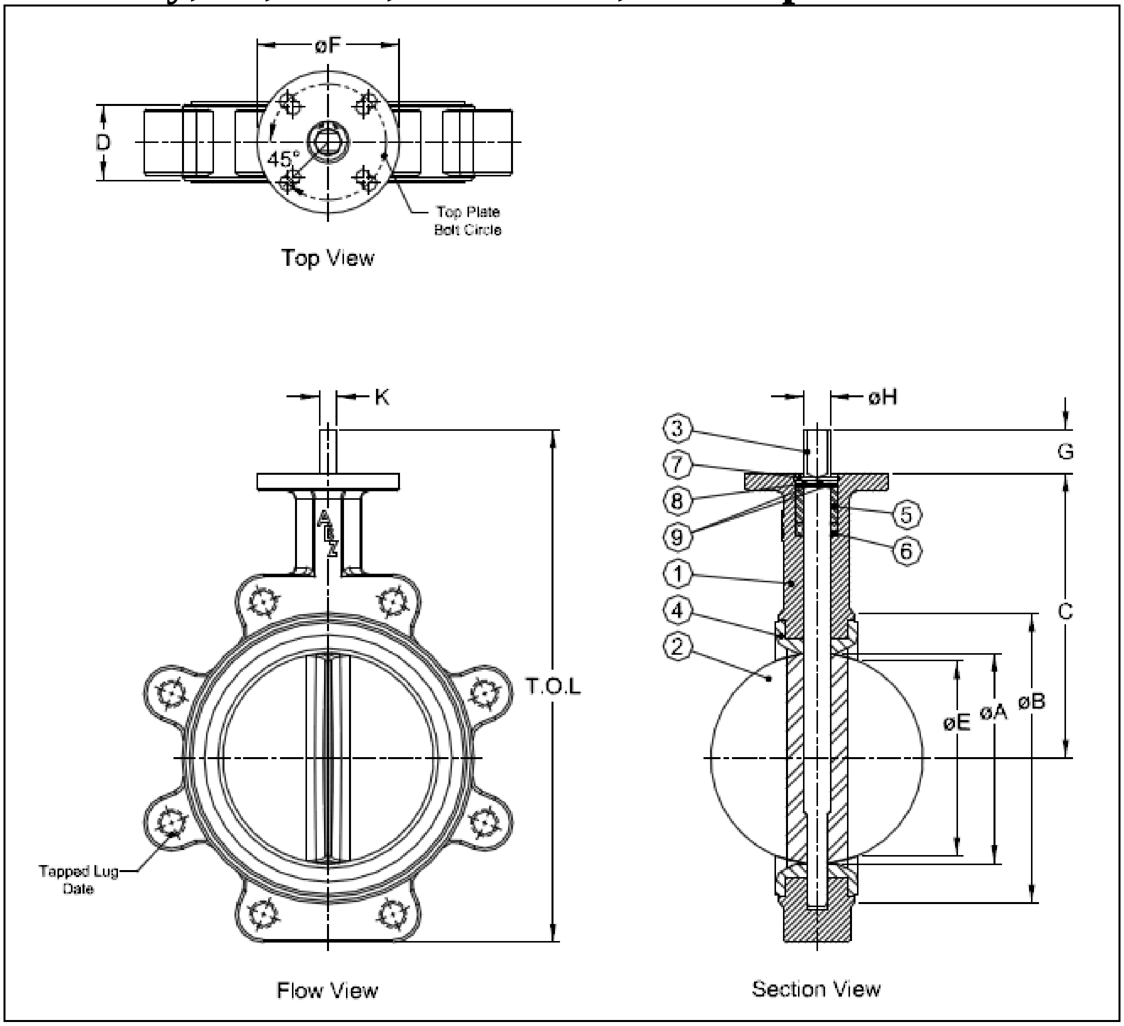
Features:

- Rated up to 200 PSI bi-directional and dead end service
- Stub shaft design with internal drive (stems removable and replaceable with no special tools).
- Designed in accordance with sections of API 609 Category A, ASME 16.1/16.5, ASME 16.34 and MSS SP67.
- Design tested in accordance with API 598.
- Molded Seat forms a seal against all standard ANSI 125/150 flanges. Gasketing requirements are eliminated.
- Viton seat rated for 350°F (176°C)

Materials of Construction:

Item No.	Name	Material
1	Lug Body	Ductile Iron
2	Disc	316 SS
3	Stem	416 SS
4	Seat	Viton
5	Bushing	Teflon – Graphite Impregnated
6	Seal	Buna
7	Body Clip	Carbon Steel
8	Stem Clip	Carbon Steel
9	Washer	Zinc Plated Steel

Butterfly, 6", ABZ, Series 397, Less Operator



Dimensions in inches (mm):

Valve Size	ØA	ØB	C	D	ØE	ØF	G
6”	6” (152)	8 3/16” (208)	8” (203)	2 1/8” (54)	5 1/2” (140)	4” (102)	1 1/4” (32)

ØH	K	T.O.L.	WEIGHT lbs (kg)
3/4” (20)	1/2” (13)	14.42” (366)	26 (11.8)

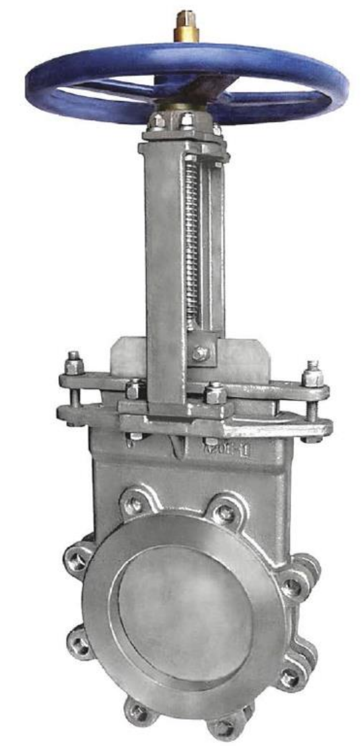
Top Plate Drilling			Tapped Lug Data		
Bolt Circle	No. of Holes	Hole Dia.	Bolt Circle	No. of Holes	Tap
3 1/4” / F07 (83)	4	7/16” (11)	9 1/2” (241)	8	3/4”-10 unc

KNIFE GATE VALVE

Valve

Part # 9704419A30355

Pratt Series 77, Knife Gate, 24", Less Operator



(Handwheel shown for reference only)

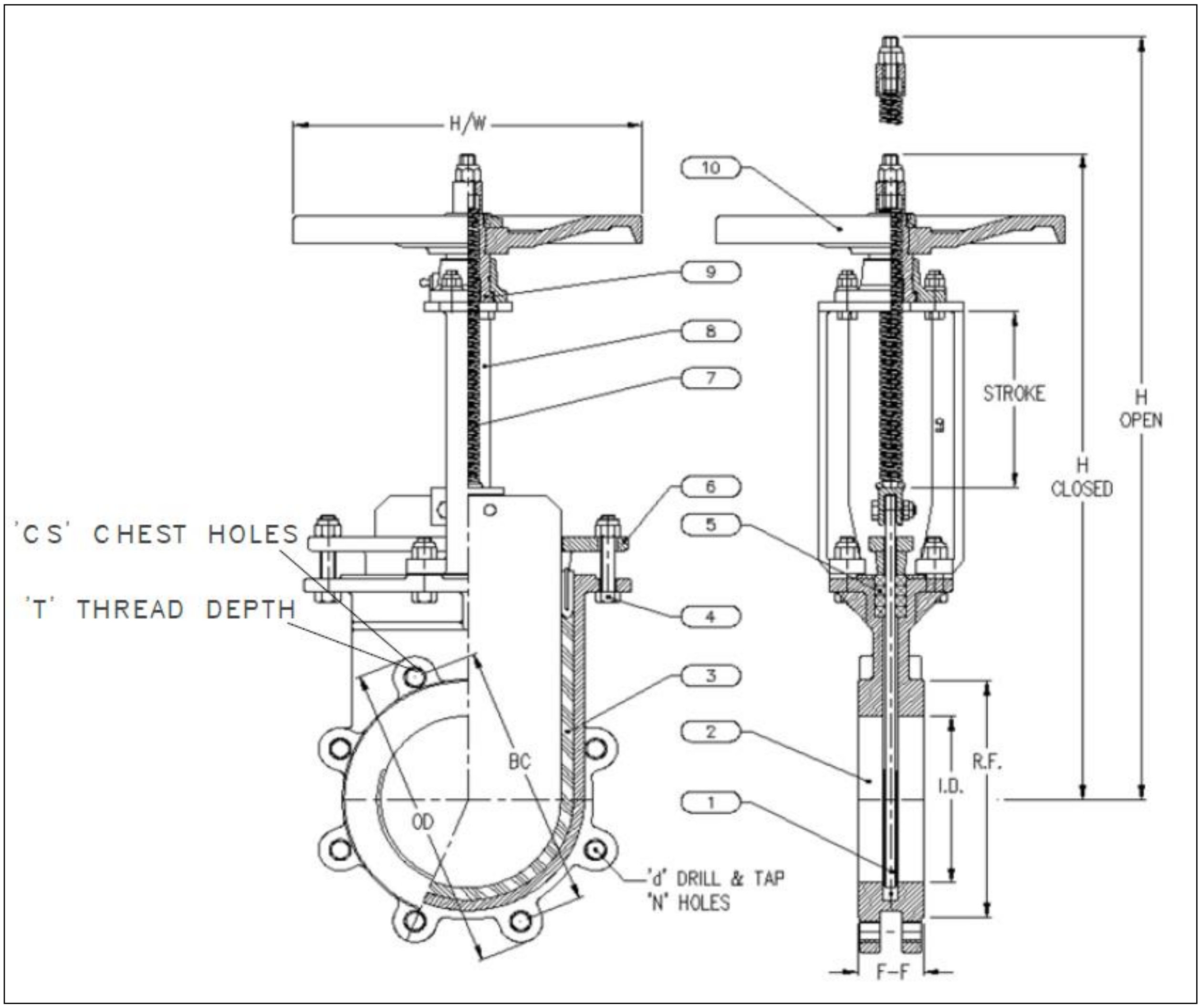
Specifications:

- **Manufacturer:** Pratt
- **Model:** Series 77
- **Valve Size:** 24”
- **Body Material:** 316 SS
- **Gate Material:** 316 SS
- **Seat Material:** Buna-N
    - **Temperature Limits:** -35 to 250°F (-37 to 121°C)
- **Body Style:** Lugged
- **Packing:** TFE Lubricated Synthetic Packing
- **Stem Material:** 316 SS
- Gate design withstands full 150PSI rated pressure as required by MSS SP-81
- Rubber seat provides a bi-directional, drip tight seal across the gate from 0 to 150 PSI.
- Full Port ID.

Valve

Part # 9704419A30355

Pratt Series 77, Knife Gate, 24", Less Operator



Dimensions: inches (mm)

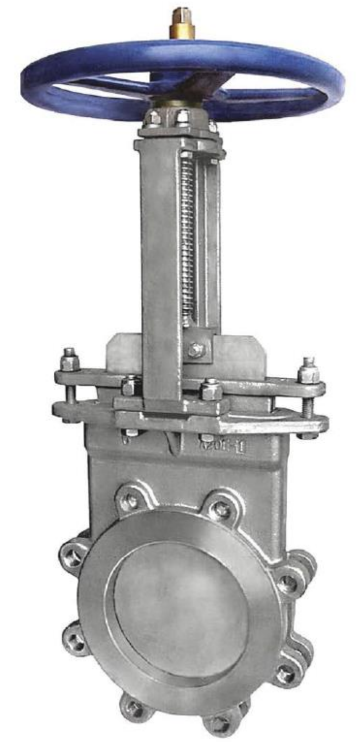
F-F	OD	BC	RF	ID	N	D	CS	T
4.50 (114)	32 (813)	29.5 (749)	27.25 (692)	23.25 (591)	20	1-1/4”-7UNC	12	1-1/8

H-CLS	H-OPN	H/W	S	WEIGHT
62.875 (1597)	85.625 (2175)	N/A	22.75 (578)	988 lbs (488 kg)

Valve

Part # 9704419A30356

Pratt Series 77, Knife Gate, 18", Less Operator



(Handwheel shown for reference only)

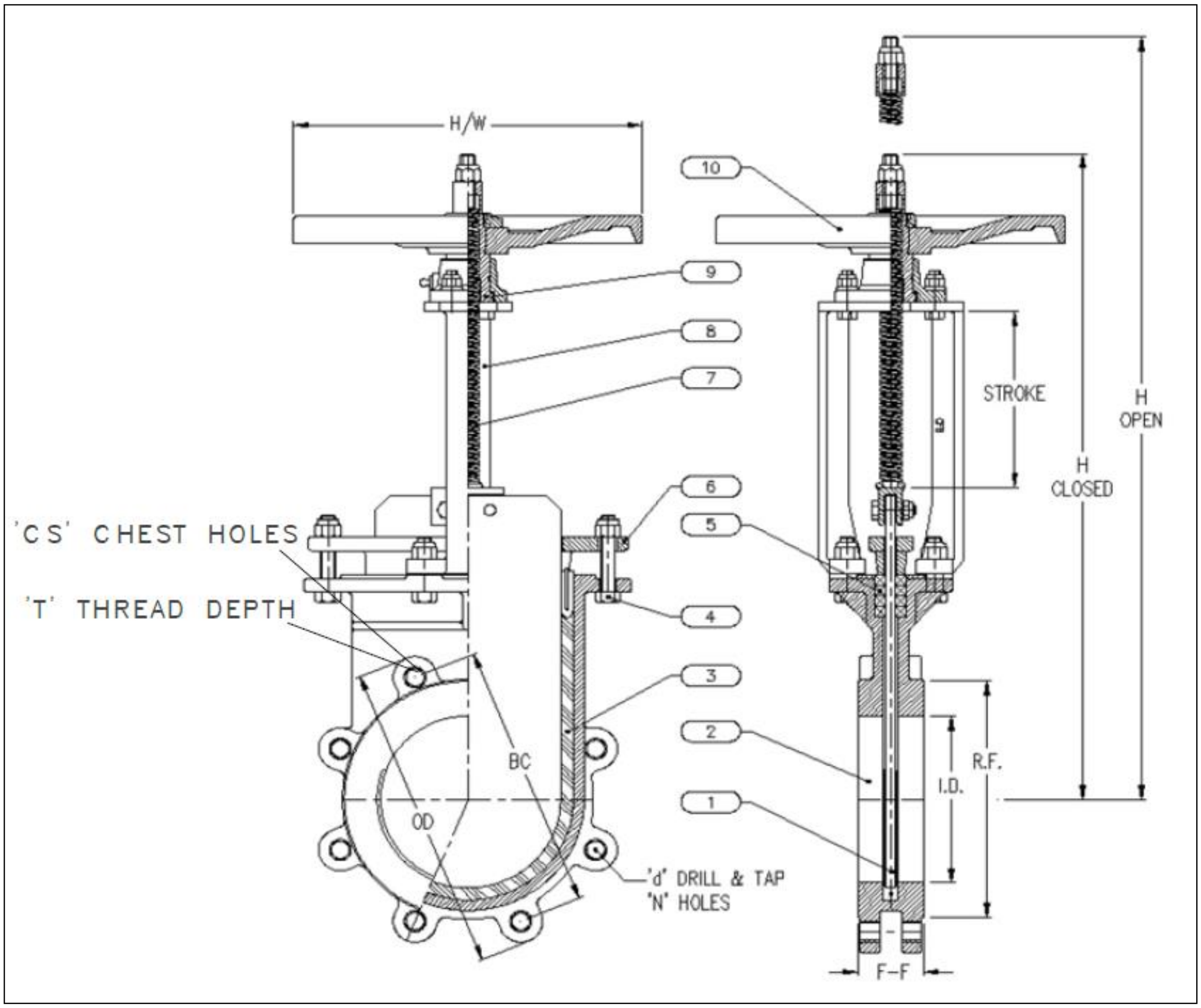
Specifications:

- **Manufacturer:** Pratt
- **Model:** Series 77
- **Valve Size:** 18”
- **Body Material:** 316 SS
- **Gate Material:** 316 SS
- **Seat Material:** Buna-N
  - **Temperature Limits:** -35 to 250°F (-37 to 121°C)
- **Body Style:** Lugged
- **Packing:** TFE Lubricated Synthetic Packing
- **Stem Material:** 316 SS
- Gate design withstands full 150PSI rated pressure as required by MSS SP-81
- Rubber seat provides a bi-directional, drip tight seal across the gate from 0 to 150 PSI.
- Full Port ID.

Valve

Part # 9704419A30356

Pratt Series 77, Knife Gate, 18", Less Operator



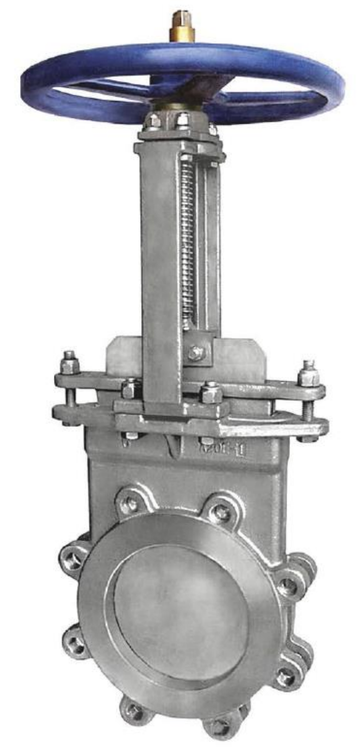
Dimensions: inches (mm)

F-F	OD	BC	RF	ID	N	D	CS	T
3.50 (89)	25 (635)	22.75 (577.9)	21 (533)	17.25 (438)	16	1 1/8”-7UNC	6	7/8
H-CLS	**H-OPN**	**H/W**	**S**	**WEIGHT**				
51 (1295)	68.75 (1746)	N/A	17.75 (451)	422 lbs (191 kg)				

Valve

Part # 9704419A30357

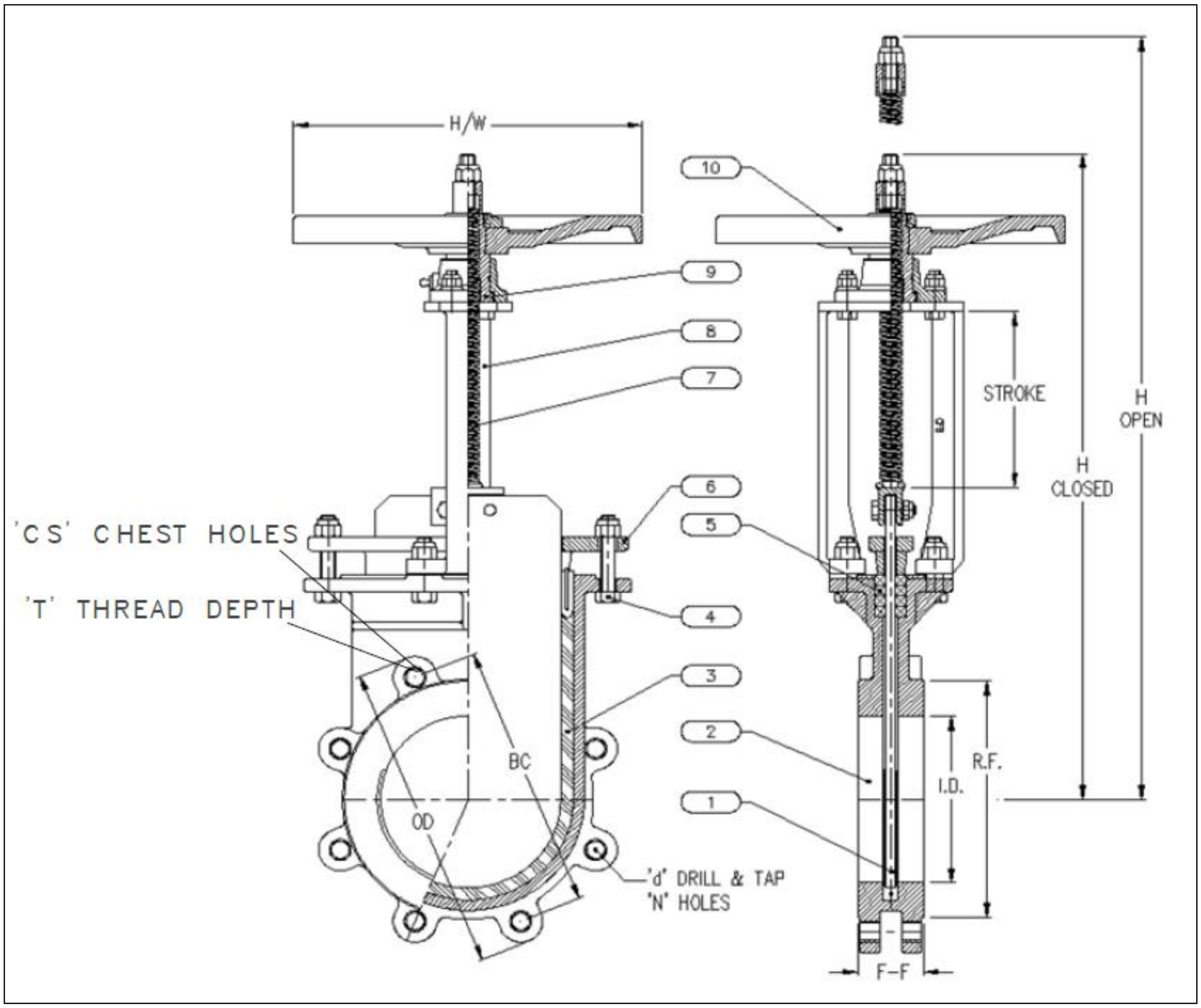
Pratt Series 77, Knife Gate, 16", Less Operator


(Handwheel shown for reference only)

Specifications:

- **Manufacturer:** Pratt
- **Model:** Series 77
- **Valve Size:** 16"
- **Body Material:** 316 SS
- **Gate Material:** 316 SS
- **Seat Material:** Buna-N
  - **Temperature Limits:** -35 to 250°F (-37 to 121°C)
- **Body Style:** Lugged
- **Packing:** TFE Lubricated Synthetic Packing
- **Stem Material:** 316 SS
- Gate design withstands full 150PSI rated pressure as required by MSS SP-81
- Rubber seat provides a bi-directional, drip tight seal across the gate from 0 to 150 PSI.
- Full Port ID.

Pratt Series 77, Knife Gate, 16", Less Operator



Dimensions: inches (mm)

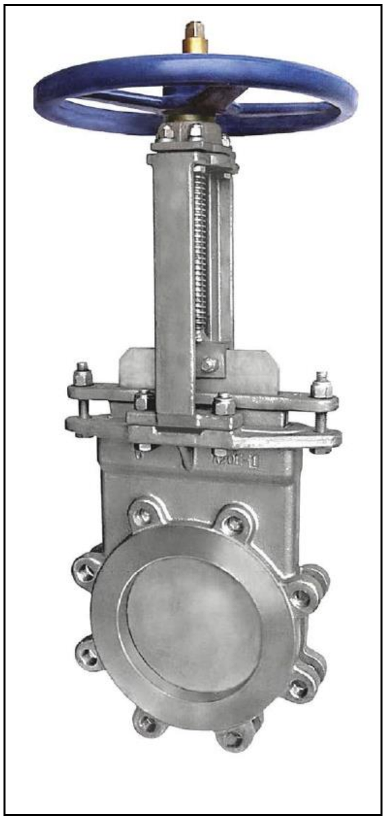
F-F	OD	BC	RF	ID	N	D	CS	T
3.50 (89)	23.5 (597)	21.25 (540)	18.5 (470)	15.25 (387)	16	1"-8UNC	6	7/8

H-CLS	H-OPN	H/W	S	WEIGHT
45.625 (1159)	61.188 (1554)	N/A	15.56 (395)	360 lbs (163 kg)

Valve

Part # 9704419A30364

Pratt Series 77, Knife Gate, 18", Handwheel



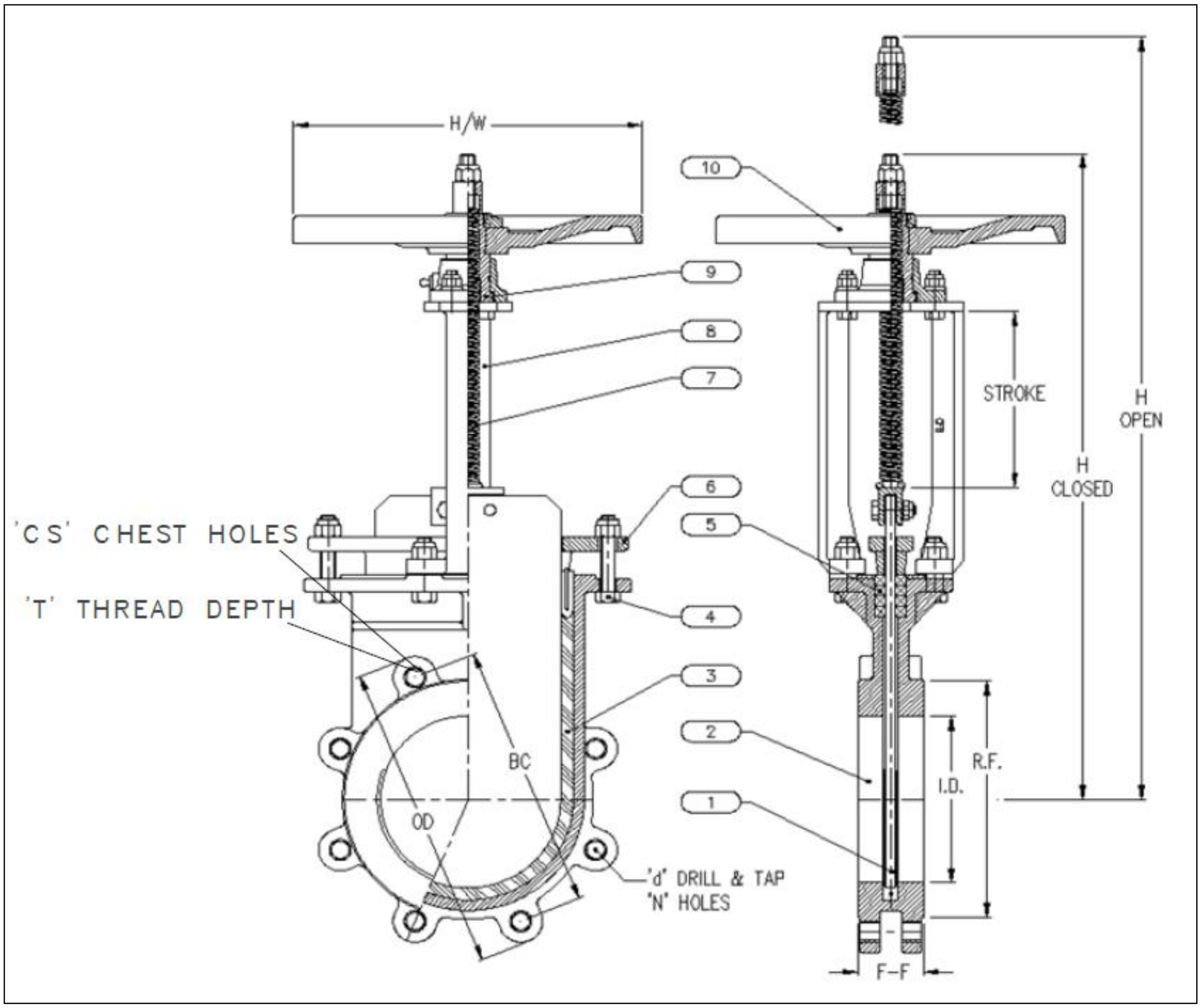
Specifications:

- **Manufacturer:** Pratt
- **Model:** Series 77
- **Valve Size:** 18”
- **Body Material:** 316 SS
- **Gate Material:** 316 SS
- **Seat Material:** Buna-N
  - **Temperature Limits:** -35 to 250°F (-37 to 121°C)
- **Body Style:** Lugged
- **Packing:** TFE Lubricated Synthetic Packing
- **Stem Material:** 316 SS
- Gate design withstands full 150PSI rated pressure as required by MSS SP-81
- Rubber seat provides a bi-directional, drip tight seal across the gate from 0 to 150 PSI.
- Full Port ID.

Valve

Part # 9704419A30364

Pratt Series 77, Knife Gate, 18", Handwheel



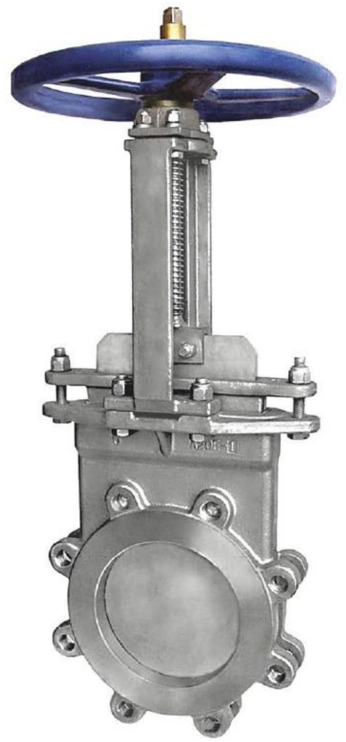
Dimensions: inches (mm)

F-F	OD	BC	RF	ID	N	D	CS	T
3.50 (89)	25 (635)	22.75 (577.9)	21 (533)	17.25 (438)	16	1 1/8”-7UNC	6	7/8

H-CLS	H-OPN	H/W	S	WEIGHT
51 (1295)	68.75 (1746)	20 (508)	17.75 (451)	422 lbs (191 kg)

Valve **Part # 9704419A30365**

Pratt Series 77, Knife Gate, 16", Handwheel



(Handwheel shown for reference only)

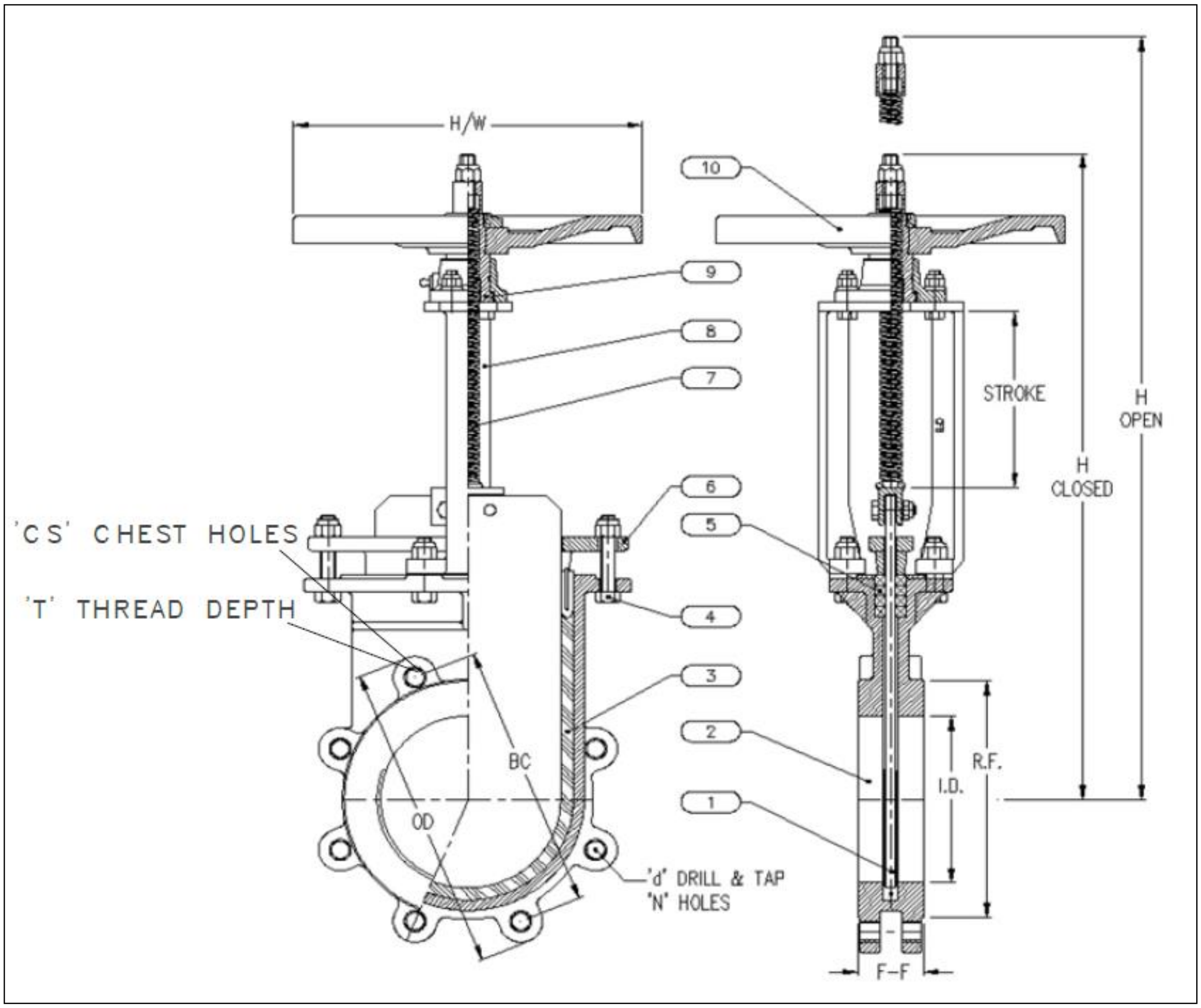
Specifications:

- **Manufacturer:** Pratt
- **Model:** Series 77
- **Valve Size:** 16”
- **Body Material:** 316 SS
- **Gate Material:** 316 SS
- **Seat Material:** Buna-N
  - **Temperature Limits:** -35 to 250°F (-37 to 121°C)
- **Body Style:** Lugged
- **Packing:** TFE Lubricated Synthetic Packing
- **Stem Material:** 316 SS
- Gate design withstands full 150PSI rated pressure as required by MSS SP-81
- Rubber seat provides a bi-directional, drip tight seal across the gate from 0 to 150 PSI.
- Full Port ID.

Valve

Part # 9704419A30365

Pratt Series 77, Knife Gate, 16", Handwheel



Dimensions: inches (mm)

F-F	OD	BC	RF	ID	N	D	CS	T
3.50 (89)	23.5 (597)	21.25 (540)	18.5 (470)	15.25 (387)	16	1”-8UNC	6	7/8

H-CLS	H-OPN	H/W	S	WEIGHT
45.625 (1159)	61.188 (1554)	20 (508)	15.56 (395)	360 lbs (163 kg)

ELECTRICAL CONTROL PANEL COMPONENT INFORMATION

6306 N. Alpine Rd. Loves Park, IL 61111-7655 p 815.654.2501 f 815.654.2508 www.aqua-aerobic.com

CONTROL PANEL
SAFETY PRECAUTIONS

⚠ CAUTION

- Be aware of electrical hazards:
    - Electric shock and burns – An electric shock occurs when electric current passes through the body. This can happen when touching an energized part.
    - Arc-flash burns – An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure. The arc flash can cause severe burns by direct heat exposure and by igniting clothing.
    - Arc-blast impacts – The heating of air and vaporization of metal during an arc, creates a pressure wave that can damage hearing and cause concussions among other injuries.
    - Falls – Electric shocks and arc blasts can cause falls.
- All electrical service should be performed by qualified personnel.
- Treat all electrical equipment and conductors as though they are energized until they are placed in an electrically safe work condition.
- Create an electrically safe work condition by performing the following lockout/tag out procedures.
    - Notify others prior to beginning a lockout/tag out procedure.
    - Lockout/Tagout out all energy sources following sheet EP-10095 and / or documented site procedures.
    - Confirm that equipment is de-energized by checking voltages.
    - Clean, service, inspect or clear equipment.
    - Make sure others are safe; machine guards are in place; tools, locks, and tags are removed before restoring energy.
- See NFPA 70E for additional guidelines on safety related work practices.

GENERAL SAFETY

- Protect panel components from contamination (metal chips, loose bolts, liquids, etc.).
- Do not use control panels for storage.
- Do not leave an open panel unattended.
- Exercise all necessary precautions with regard to personal hygiene and sanitation.

Electrical Lockout / Tag Out Procedures

Consult your facility procedure. Each facility should have a written lockout/tag out program and train employees in this program. The typical program should cover planning for locating and labeling energy sources, identifying employees at risk, how and by whom the equipment is de-energized, releasing of stored energy, verifying that the circuit is de-energized and can't be restarted, voltage testing, grounding requirements, shift changes, coordination with other jobs in progress, a procedure for keeping track of all involved personnel, applying and removing lockout/tag out devices, return to service, and temporary re-energizing for testing/positioning. Lockout/tag out procedures should be developed for each machine or piece of equipment that will require servicing.

Lockout / Tag Out Application

Each person who could be exposed to electric energy must be involved in the lockout/tag out process. A typical process is described below.

- After de-energizing, each employee at risk should apply an individual lockout/tag out device to each source of electric energy. Pushbuttons or selector switches cannot be used as the only way to de-energize.
- **Lockout Device:** A lockout device is a key or combination lock with a tag that can be attached to a disconnecting device to prevent the re-energizing of the equipment being worked on without removal of the lock. The lockout device should have a way of identifying the individual who tagged it and the reason why it was tagged. Individual lockout devices with worker’s name and picture on them are preferred. That worker must be the only person who has the key or combination for the lockout device they install, and that worker should be the only person to remove the lock after all work has been completed.
- **Tag Out Device:** A tag out device is a tag or means that can be attached to the actual lockout device to notify all workers that this equipment has been locked out. The tag out device must include a way to attach to the lockout device that can withstand at least 50 pounds of force. Tag out devices on electrical power should be used alone only when it is **not** possible to install a lockout device.
- **Lockout Tag:** The tag used in conjunction with a lockout or tag out device must have a warning label prohibiting unauthorized disconnecting or removal of the lockout/tag out device.
- Before beginning work, each involved worker must verify through testing that all energy sources have been de-energized.
- Electric lockout/tag out procedures should be coordinated with all other site procedures for controlling exposure to electric energy and other types of energy sources.
- Complex lockout/tag out procedures are special procedures that are needed when there is more than one energy source, crew, craft, location, employer, way to disconnect, or lockout/tag out procedure or for work that lasts beyond one shift. In any of these cases, one qualified person should be in charge of the lockout/tag out procedure with full responsibility for ensuring all energy sources are under lockout/tag out and to account for all people on the job.

- **Removal of Lockout/Tag Out devices:** Lockout and tag out devices should be removed only by the person installing them. If work is not completed when the shift changes, workers arriving on shift should apply their locks before departing workers remove their locks.
- **Return to service:** When electrical work has been completed tests and visual inspections must be made to confirm that all tools, mechanical restraints, electric jumpers, shorts, and grounds have been removed. Once work is completed and lockout/tag out devices are removed, tests and visual inspection must confirm that all tools, mechanical restraints, electric jumpers, shorts, and grounds have been removed. Only then is it safe to re-energize and return to service.
- **Temporary release**: If the job requiring lockout/tag out is interrupted for any reason, the steps outlined in Return to Service (above) should be followed before removing the lockout/tag out devices, and placing the equipment back into operation.

⚠ WARNING

Electrical Hazards

- **Electric shock and burns: An electric shock occurs when electric current passes through the body. This can happen when touching an energized part. If the electric current passes across the chest or head, death can result. At high voltages, severe burns can result.**
- **Arc-flash burns: An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure (for instance, while opening or closing disconnects). The arc can heat the air to temperatures as high as 35,000° F, and vaporize metal in the equipment. The arc flash can cause severe skin burns by direct heat exposure and by igniting clothing.**
- **Arc-blast impacts: The heating of air and vaporization of metal creates a pressure wave that can damage hearing and cause memory loss (from concussion) and other injuries. Flying metal parts are also a hazard.**
- **Falls: Electric shocks and arc blasts can cause falls, especially from ladders or unguarded scaffolding.**

Electric Safety Principles - Energized Condition

- **De-energize whenever possible**.
- **Plan every job**. The approach and step-by-step procedures to complete the work at hand must be discussed and agreed upon between all involved employees before beginning. Write down first-time procedures. Discuss hazards and procedures in a job briefing with supervisors and other workers before starting any job. It is the employer’s responsibility to have or develop a checklist system for working on live circuits, if such a scenario arises.
- **Identify the hazards**. Conduct a job hazard analysis. Identify steps that could create electric shock or arc-flash hazards.

- **Minimize the hazards**. De-energize any equipment, and insulate, or isolate exposed live parts so contact cannot be made. If this is impossible, obtain and wear proper Personal Protective Equipment (PPE) and tools.
- **Anticipate problems**. If it can go wrong, it might. Make sure the proper PPE and tools are immediately available for the worst-case scenario.
- **Obtain training**. Make sure all involved employees are qualified electrical workers with appropriate training for the job.

Working on De-Energized Equipment

Electrically Safe Condition

The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker ensures they are not.** Every circuit and conductor must be tested every time work is done on them. Proper PPE must be worn until the equipment is proven to be de-energized.

The National Fire Protection Association (NFPA) lists six steps to ensure conditions for electrically safe work.

1. Identify all sources of power to the equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. Remove the load current, and then open the disconnecting devices for each power source.
3. Where possible, visually verify that blades of disconnecting devices are fully open or that drawout-type circuit breakers are fully withdrawn.
4. Apply lockout/tag out devices in accordance with your facilities formal, written policy.
5. Test each phase conductor or circuit part with an adequately rated voltage detector to verify that the equipment is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Check the voltage detector before and after each test to be sure it is working.
6. Properly ground all possible sources of induced voltage and stored electric energy (such as, capacitors) before touching. If conductors or circuit parts that are being de-energized could contact other exposed conductors or circuit parts, apply ground-connecting devices rated for the available fault current.

The process of de-energizing is "live" work and can result in an arc flash due to equipment failure. When de-energizing, follow the procedures below described in "Working on / or Near Energized Equipment."

Working on / or Near Energized Equipment

Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk even though work is on de-energized parts. Common tasks where there may be a need to work on or near live circuits include:

- Taking voltage measurements
- Opening and closing disconnects and breakers

- Racking breakers on and off the bus
- Removing panels and dead fronts
- Opening electric equipment doors for inspection

Facilities should adopt standard written procedures and training for these common tasks. For instance, when opening and closing disconnects, use the **left-hand rule** when possible (stand to the right side of the equipment and operate the disconnect switch with the left hand).

Approach Distances to Exposed Live Parts

The National Fire Protection Association (NFPA) defines three approach boundaries for *shock hazards* and one for *arc flash*.

Shock Hazards

- The *Limited Approach Boundary* is the distance from an exposed live part within which a shock hazard exists.
- The *Restricted Approach Boundary* is the closest distance to exposed live parts a qualified person can approach with or without proper PPE and tools. Inside this boundary, accidental movement can put a part of the body or conductive tools in contact with live parts or inside the prohibited approach boundary. To cross the restricted approach boundary, the qualified person must review and understand Annex C, Limits of Approach, of NFPA 70-E
- The *Prohibited Approach Boundary* is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with a live part.

Arc Flash Hazard

- The Flash Protection Boundary is the approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur. For systems of 600 volts and less, the flash protection boundary is 4 feet (1.2m), based on an available bolted fault current of 50 kA and a clearing time of 6 cycles for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles.

Approach Boundaries to Live Parts for Shock Protection
(All dimensions are distance from live part to worker)

	Limited approach boundary			
Nominal system voltage range, phase to phase	Exposed movable conductor	Exposed fixed-circuit part	Restricted approach boundary (allowing for accidental movement)	Prohibited approach boundary
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in. (3.0m)	3 ft. 6 in. (1.1m)	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in. (3.0m)	3 ft. 6 in. (1.1m)	1 ft. 0 in. (0.3m)	0 ft. 1 in. (25.4mm)
751 to 15 KV KV	10 ft. 0 in. (3.0m)	5 ft. 0 in. 1.5m)	2 ft. 2 in. (0.7m)	0 ft. 7 in. (177.8mm)

Source: Excerpted from table 130.2(C), “Approach Boundaries to Live Parts for Shock

Protection" *(NFPA 70-E Standard for Electrical Safety Requirements for Employee Workplaces, 2004 edition).*

Wet or Damp Locations

Work in wet or damp work locations (i.e., areas surrounded or near water or other liquids) should not be performed unless it is absolutely critical. Electrical work should be postponed until the liquid can be cleaned up. The following special precautions must be incorporated while performing work in wet or damp locations:

- Only use electrical cords that have Ground Fault Circuit Interrupters (GFCIs);
- Place a dry barrier over any wet or damp work surface;
- Remove standing water before beginning work. Work is prohibited in areas where there is standing water;
- Do not use electrical extension cords in wet or damp locations; and
- Keep electrical cords away from standing water.

Other Precautions

When working on de-energized parts, but still inside the flash protection boundary for nearby live exposed parts:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact or PPE must be worn.
- Do not reach blindly into areas that might contain exposed live parts.
- Do not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.
- Conductive articles of jewelry and clothing shall not be worn where they present an electrical contact hazard with exposed live parts.
- Conductive materials, tools, and equipment that are in contact with any part of the body shall be handled in a manner that prevents accidental contact with live parts.

References

- NFPA 70-E, "Standard for Electrical Safety Requirements for Employee Workplaces", 2004 edition.

CABLE, CONDUIT & WIRE

Patch Cord Part # 2702605

Hubbell PCX6GY03

The Hubbell PCX6 patch cord provides Category 6 Ethernet connectivity via RJ45 connectors.

Specifications:

- Category 6 Four-Pair 24AWG stranded UTP cable
- UL flame retardant PVC cable jacket
- Modular plug contacts 50µ" gold plated
- PVC, snagless, slip on boot
- Length = 3' (0.9m)
- Color = Gray

Standards

- UL and cUL Listed
- Modular Plugs conform to FCC 47 Part 68.5

Applications Supported

- Gigabit Ethernet 1000Base-TX (TIA-854)
- 10/100/1000Base-T (IEEE 802.3)
- Analog Voice and Digital (VolP)Voice
- Supports application of IEEE 802.3af – DTE Power Compliant
- 155/62.2 Mbps ATM

Patch Cord Part # 2702606

Hubbell PCX6GY10

The Hubbell PCX6 patch cord provides Category 6 Ethernet connectivity via RJ45 connectors.

Specifications:

- Category 6 Four-Pair 24AWG stranded UTP cable
- UL flame retardant PVC cable jacket
- Modular plug contacts 50µ" gold plated
- PVC, snagless, slip on boot
- Length = 10' (3.0m)
- Color = Gray

Standards

- UL and cUL Listed
- Modular Plugs conform to FCC 47 Part 68.5

Applications Supported

- Gigabit Ethernet 1000Base-TX (TIA-854)
- 10/100/1000Base-T (IEEE 802.3)
- Analog Voice and Digital (VolP)Voice
- Supports application of IEEE 802.3af – DTE Power Compliant
- 155/62.2 Mbps ATM

CIRCUIT BREAKER

Circuit Breaker Part # 2753909

Schneider Electric M9F42102

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	2 A at 25 °C conforming to EN/IEC 60947-2
Network type	DC AC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
[Ue] rated operational voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Circuit Breaker

Part # 2753909

Schneider Electric M9F42102

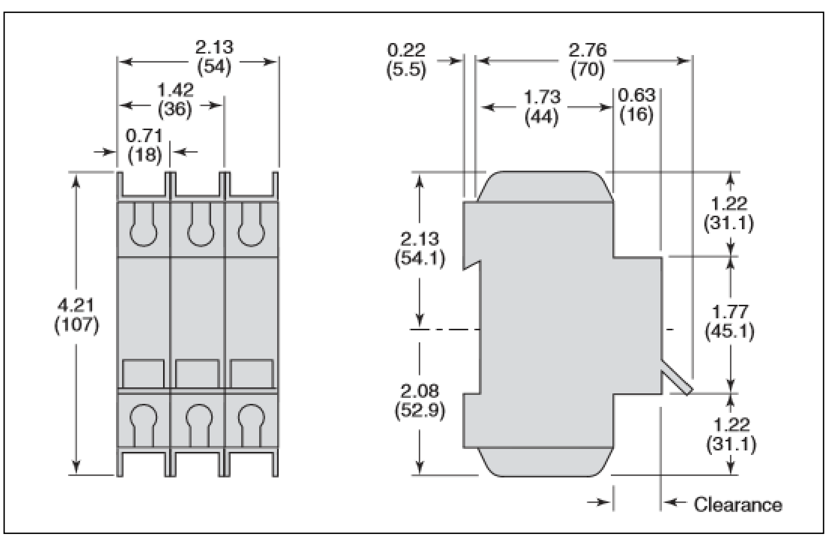
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2
[Ui] rated insulation voltage	500 V AC conforming to EN/IEC 60947-2
[Uimp] rated impulse withstand voltage	6 kV conforming to EN/IEC 60947-2
Contact position indicator	Yes
Control type	Toggle
Local signalling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



Circuit Breaker **Part # 2753912**

Schneider Electric M9F42103

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	3 A at 77 °F (25 °C) conforming to EN/IEC 60947-2
Network type	DC AC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
System Voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Schneider Electric M9F42103

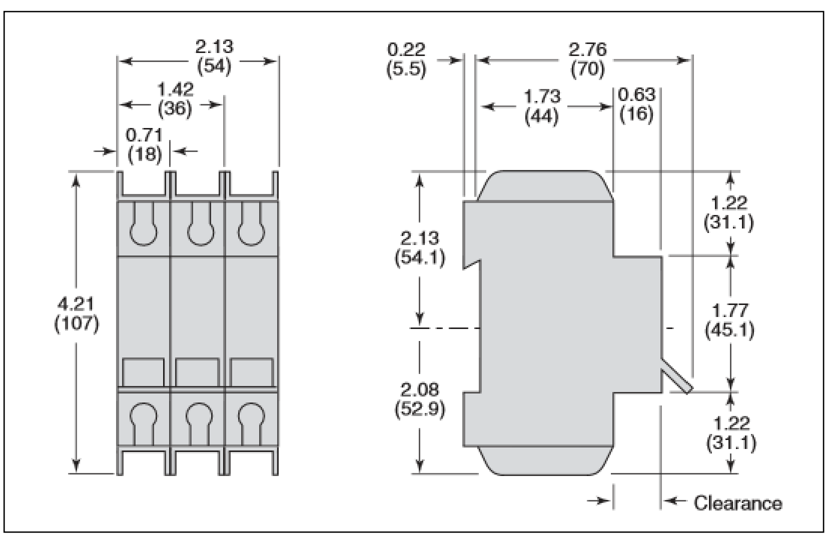
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2 [Ui] rated insulation voltage 500 V AC conforming to EN/IEC 60947-2 [Uimp] rated impulse withstand voltage 6 kV conforming to EN/IEC 947-2
Contact position indicator	Yes
Control type	Toggle
Local signalling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



Circuit Breaker **Part # 2753916**

Schneider Electric M9F42105

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	5 A at 77 °F (25 °C) conforming to EN/IEC 60947-2
Network type	DC AC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
System Voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Circuit Breaker **Part # 2753916**

Schneider Electric M9F42105

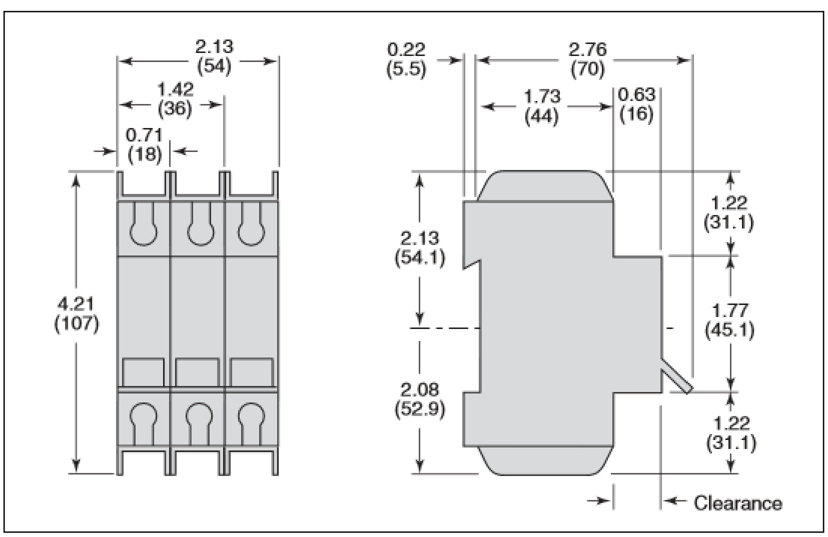
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2
[Ui] rated insulation voltage	500 V AC conforming to EN/IEC 60947-2
[Uimp] rated impulse withstand voltage	6 kV conforming to EN/IEC 60947-2
Contact position indicator	Yes
Control type	Toggle
Local signalling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



Circuit Breaker Part # 2753917

Schneider Electric M9F42106

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	6 A at 25 °C conforming to EN/IEC 60947-2
Network type	AC DC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
[Ue] rated operational voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Circuit Breaker

Part # 2753917

Schneider Electric M9F42106

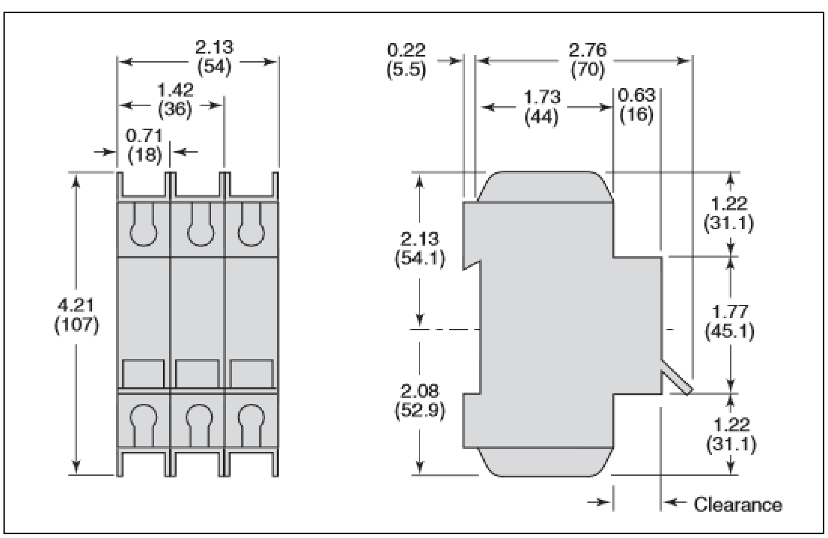
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2
[Ui] rated insulation voltage	500 V AC conforming to EN/IEC 60947-2
[Uimp] rated impulse withstand voltage	6 kV conforming to EN/IEC 60947-2
Contact position indicator	Yes
Control type	Toggle
Local signalling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



Circuit Breaker   Part # 2753922

Schneider Electric M9F42110

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	10 A at 25 °C conforming to EN/IEC 60947-2
Network type	AC DC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
[Ue] rated operational voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Circuit Breaker **Part # 2753922**

Schneider Electric M9F42110

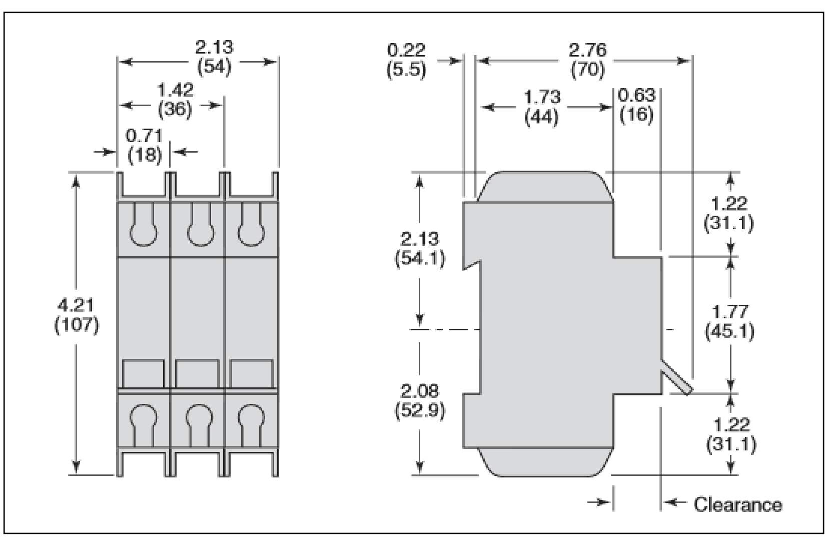
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2
[Ui] rated insulation voltage	500 V AC conforming to EN/IEC 60947-2
[Uimp] rated impulse withstand voltage	6 kV conforming to EN/IEC 60947-2
Contact position indicator	Yes
Control type	Toggle
Local signalling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



Circuit Breaker   Part # 2753929

Schneider Electric M9F42115

C60BP are multi-standard miniature circuit breakers and branch circuit protection as defined by UL 489. It combines following functions:

- circuit protection against short-circuit currents
- circuit protection against overload currents
- tripping and fault indication by the addition of auxiliaries..

Standards:

- UL 489
- CSA C22.2 No 5
- RoHS Compliant
- EN/IEC 60947-2
- GB 14048-2

Specifications:

Product name	Multi 9 C60
Product or component type	Miniature circuit-breaker
Device short name	C60BP
Device application	Distribution
Poles description	1P
Number of protected poles	1
[In] rated current	15 A at 25 °C conforming to EN/IEC 60947-2
Network type	DC AC
Trip unit technology	Thermal-magnetic
Curve code	C
Breaking capacity	Icu 3 kA at 415 V AC conforming to EN/IEC 60947-2 Icu 10 kA at 240 V AC conforming to EN/IEC 60947-2 Icu 20 kA at 60 V DC conforming to EN/IEC 60947-2 Icu 3 kA at 415 V AC conforming to GB 14048.2 Icu 10 kA at 240 V AC conforming to GB 14048.2 Icu 20 kA at 60 V DC conforming to GB 14048.2 AIR 10 kA at 277 V AC conforming to UL 489 AIR 14 kA at 240 V AC conforming to UL 489 AIR 14 kA at 120 V AC conforming to UL 489 AIR 10 kA at 60 V DC conforming to UL 489 AIR 10 kA at 277 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 240 V AC conforming to CSA C22.2 No 5 AIR 14 kA at 120 V AC conforming to CSA C22.2 No 5 AIR 10 kA at 60 V DC conforming to CSA C22.2 No 5
Suitability for isolation	Yes conforming to EN/IEC 60947-2
[Ue] rated operational voltage	240 V AC 50/60 Hz 415 V AC 50/60 Hz 60 V DC
Magnetic tripping limit	8.5 x In +/- 20% AC 12 x In +/- 20% DC

Circuit Breaker **Part # 2753929**

Schneider Electric M9F42115

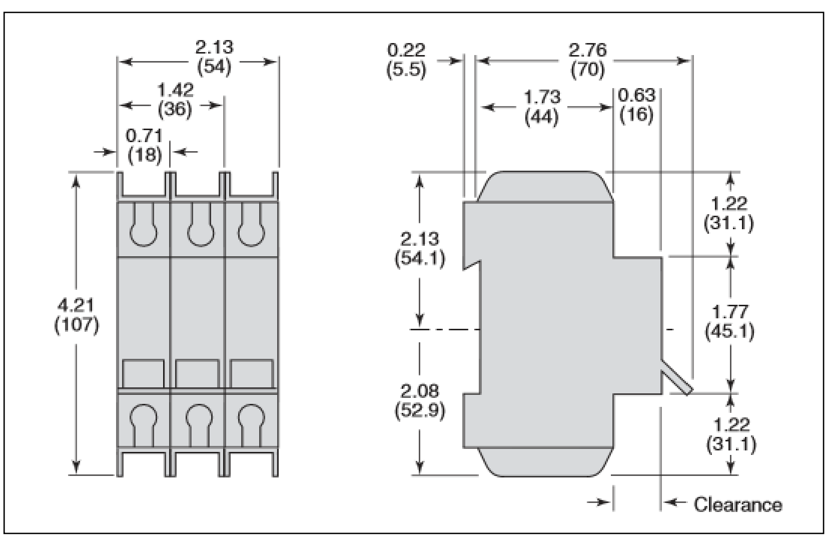
[Ics] rated service breaking capacity	2.25 kA 75 % x Icu at 415 V AC conforming to EN/IEC 60947-2 7.5 kA 75 % x Icu at 240 V AC conforming to EN/IEC 60947-2 2.25 kA 75 % x Icu at 415 V AC conforming to GB 14048.2 7.5 kA 75 % x Icu at 240 V AC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to GB 14048.2 15 kA 75 % x Icu at 60 V DC conforming to EN/IEC 60947-2
[Ui] rated insulation voltage	500 V AC conforming to EN/IEC 60947-2
[Uimp] rated impulse withstand voltage	6 kV conforming to EN/IEC 60947-2
Contact position indicator	Yes
Control type	Toggle
Local signaling	ON/OFF indication
Mounting mode	Clip-on
Mounting support	DIN rail
Colour	Grey
Mechanical durability	20000 cycles
Electrical durability	10000 cycles
Provision for padlocking	Padlockable

Environment:

IP degree of protection	IP40 modular enclosure conforming to IEC 60529 IP20 conforming to IEC 60529
Pollution degree	3 conforming to EN/IEC 60947-2
Tropicalisation	2 conforming to IEC 60068-1
Relative humidity	95 % 131 °F (55 °C)
Operating altitude	0...6561.68 ft (0...2000 m)
Ambient air temperature for operation	-22...158 °F (-30...70 °C)
Ambient air temperature for storage	-40...176 °F (-40...80 °C)

Dimensions:

in.
(mm)



COMPUTER and MONITOR

19in 12U Server Rack Cabinet - 4-Post Adjustable Depth (2" to 30") Network Equipment Rack Enclosure w/Casters/Cable Management/1U Shelf/Locking Doors

Product ID: RK1233BKM

This server rack provides 12U of storage space in a sleek, secure cabinet for storing standard 19" rack-mount devices such as Dell, HP and IBM servers, along with telecommunication and A/V equipment. The rack is compatible with EIA-310 compliant equipment and supports a total load capacity of 450 kg (992 lb).

This rack includes a variety of features that enable you to easily incorporate plenty of equipment. With adjustable mounting rails, you can easily change the rail depth from 3" up to 30.7" (76.2 mm - 780 mm) to ensure compatibility your standard rack-mount equipment. The added depth also provides support for additional cable and power management behind your equipment. For hassle-free cable management, the rack includes a 3 meter roll of hook-and-loop cable tie that makes it easy to keep your cables neat and tidy by binding them together or binding them to the rack. The self-gripping fabric can be cut to any size, enabling a wrap-around solution for the cables of any rack-mount equipment.

The rack features holes with covers on the ceiling and floor panels that make it easy to run cabling to the inside and outside of the cabinet, for discreet cable management. The rack also features grounding lugs that enable you to ground your equipment for added protection. This rack also includes a 1U shelf that gives you a stable surface for placing equipment that's not rack-mountable or storing your tools.

To provide hassle-free deployment, the rack ships fully assembled.

To keep your rack-mounted equipment secure, this rack features front and rear locking mesh doors. The mesh doors look great in any server room and help provide passive cooling. The doors are also reversible, which gives you the freedom to choose which side of the rack the door opens from, to suit your server room's spatial requirements.

The rack also has removable side panels with independent quick-release locks that enable you to access your equipment easily, while still keeping it secure.

The cabinet features casters for hassle-free access to rear-mounted equipment while providing ease of mobility around your office, studio or server room. Plus, the width and height of the rack fit through standard doorways, giving you the freedom to wheel your server rack into different rooms.

The RK1233BKM is backed by a StarTech.com 5-year warranty and free lifetime technical support.

Certifications, Reports and Compatibility

RoHS Compliant

CE

Applications

• Deploy in technology shops and repair centers that have limited space but tend to have mountable equipment that requires security

• Install rack-mount servers, KVM switches, networking equipment and cabinet consoles

• House rack-mount audio/video equipment for broadcasting in your editing room or television studio

Features

• SECURE RACK: 19" server rack cabinet w/adjustable mounting depth up to 30", internal depth of 33", height 25.2"; Locking doors/sides (2 keys inc.); Rolling/Mobile data/IT/enclosure

• FULLY ASSEMBLED WITH CASTERS: Pre-built w/casters & levelling feet to offer manoeuvrability & stability; 50 M6 Cage nuts/screws, hook & loop tape & 1U shelf provided to easily mount equipment

• DESIGN AND VENTILATION: Strong mesh doors and side panels with vented top allow for airflow; 1U height intervals marked for identification

• COMPATIBILITY: EIA/ECA-310-E Compliant for server/networking equipment; Compatible with brands like HPE ProLiant, Dell PowerEdge, and Lenovo ThinkSystem

• SPECS: 12U 19in Enclosure Cabinet Mounting Depth 2 to 30in. 995 lb stationary capacity 50xM6 cage nuts & screws 1U vented shelf 10ft hook and loop tape inc. Grounding lugs

Hardware		
	Warranty	5 Years
	Wallmountable	No
	Rack Type	4-Post
	Frame Type	Enclosed Cabinet
	U Height	12U
	Special Features	Adjustable Mounting Rails

		Built-in Cable Management
		Casters (Included)
		Grounding Lug(s)
		Leveling Feet
		Ships Fully Assembled
		U-Markings
	Mounting Rail Profile	L-Shape
	Fan Options	Four Optional Fans: 120 mm
	Mounting Hole Types	Square (For Cage Nut)
	Industry Standards	EIA/ECA-310-E
Performance		
	Weight Capacity (Stationary)	992.2 lb [450 kg]
Special Notes / Requirements		
	Note	Includes CABSHELFV1U and 2 pairs of keys
Physical Characteristics		
	Color	Black
	Front Door Construction	Steel Mesh
	Front Door Features	Secure Key Lock with Reversible and Removable Front Door
	Side Panel Construction	Steel Mesh
	Side Panel Features	Secure Key Lock with Removable Side Panels
	Rear Door Construction	Steel Mesh
	Rear Door Features	Secure Key Lock with Reversible and Removable Back Door
Product Measurements		
	Internal Width	23.4 in [59.5 cm]
	Internal Depth	33.5 in [85.2 cm]

	Product Length	33.6 in [85.4 cm]
	Product Width	23.6 in [60.0 cm]
	Product Height	25.2 in [64.0 cm]
	Weight of Product	112.0 lb [50.8 kg]
	Maximum Mounting Depth	30.0 in [76.2 cm]
	Minimum Mounting Depth	2.8 in [7 cm]
	Product Height with Casters	27.8 in [70.7 cm]
Packaging Information		
	Flat Pack (Assembly Required)	No
	Package Length	35.8 in [90.9 cm]
	Package Width	25.0 in [63.5 cm]
	Package Height	33.5 in [85.0 cm]
	Shipping (Package) Weight	124.0 lb [56.2 kg]
What's in the Box		
	Included in Package	1 - 10 ft. Hook and Loop
		1 - Enclosure Cabinet
		1 - 1U Fixed Shelf
		50 - M6 Cage Nuts
		50 - M6 Screws
		2 - Door Keys
		2 - Side Panel Keys

Product appearance and specifications are subject to change without notice.

Dell PowerEdge R250

Spec Sheet

Deliver the value of data

The Dell PowerEdge R250 affordably addresses common business workloads while delivering compute with an entry-level 1U rack server.

Your Innovation Engine for businesses of all sizes

The Dell PowerEdge R250, powered by Intel® Xeon® E-2300 processors, delivers powerful compute for common business applications and streamlines productivity. It supports 3200 MT/s DDR4 speeds and 32 GB DIMMs, up to 128 GB for memory intensive workloads. In addition, to address substantial throughput improvements, the PowerEdge R250 supports PCIe Gen 4 and offers enhanced thermal efficiency to support increasing power and thermal requirements. This makes the PowerEdge R250 an rack ideal server for buisness critical workloads, cloud infrastructure, and point of sale transactions in a 1U form factor, for small to midsized businesses, inside and outside of the data center.

Increase efficiency and accelerate operations with autonomous collaboration

The Dell OpenManage systems management portfolio tames the complexity of managing and securing IT infrastructure. Using Dell Technologies' intuitive end-to-end tools, IT can deliver a secure, integrated experience by reducing process and information silos in order to focus on growing the business. The Dell OpenManage portfolio is the key to your innovation engine, unlocking the tools and automation that help you scale, manage, and protect your technology environment.

- Built-in telemetry streaming, thermal management, and RESTful API with Redfish offer streamlined visibility and control for better server management
- Intelligent automation lets you enable cooperation between human actions and system capabilities for added productivity
- Integrated change management capabilities for update planning and seamless, zero-touch configuration and implementation
- Full-stack management integration with Microsoft, VMware, ServiceNow, Ansible and many other tools

Protect your data assets and infrastructure with proactive resilience

The Dell PowerEdge R250 server is designed with a cyber-resilient architecture, integrating security deeply into every phase in the lifecycle, from design to retirement.

- Operate your workloads on a secure platform anchored by cryptographically trusted booting and silicon root of trust
- Maintain server firmware safety with digitally signed firmware packages
- Prevent unauthorized configuration or firmware change with system lockdown
- Securely and quickly wipe all data from storage media, including hard drives, SSDs and system memory with System Erase

PowerEdge R250

The Dell PowerEdge R250 offers streamlined productivity, high-speed memory and capacity, powerful compute to address common business applications. Ideal for:

- Small midsized businesses
- Remote office/branch office
- Collaboration and sharing
- Mail/messaging and file/print

Feature	Technical Specifications
Processor	One Intel Xeon E-2300 series processor with up to 8 cores or one Intel Pentium processor with up to 2 cores
Memory	• Four DDR4 DIMM slots, supports UDIMM 128 GB max, speeds up to 3200 MT/s • Supports unregistered ECC DDR4 DIMMs only Note: For Pentium processor, the maximum memory speed is 2666 MT/s.
Storage controllers	• Internal controllers: PERC H345, H755, HBA355i, S150 • Internal Boot: Internal Dual SD Module or USB or Boot Optimized Storage Subsystem (BOSS-S1): HWRAID 2 x M.2 SSDs • External HBAs (non-RAID): HBA355e
Drive bays	Front bays: • Up to 4 x 3.5-inch hot swap SAS/SATA (HDD/SSD) max 30.72 TB • Up to 2 x 3.5-inch cabled SAS/SATA (HDD/SSD) max 15.36 TB • Up to 4 x 3.5-inch cabled SAS/SATA (HDD/SSD) max 30.72 TB
Power supplies	• 450 W Bronze 100-240 V AC, cabled • 450 W Platinum 100-240 V AC, cabled • 700 W Titanium 200-240 V AC, cabled • 700 W Titanium 240 V DC, cabled
Cooling options	Air cooling
Fans	• Up to four cabled fans
Dimension	• Height: 42.8 mm (1.68 inches) • Width: 482 mm (18.97 inches) • Depth: 598.64 mm (23.56 inches) with bezel 585 mm (23.03 inches) without bezel
Form Factor	1U rack server
Embedded management	• iDRAC9 • iDRAC Direct • iDRAC RESTful API with Redfish • iDRAC Service Manual
Bezel	Optional bezel or security bezel
OpenManage Software	• OpenManage Enterprise • OpenManage Power Manager plugin • OpenManage SupportAssist plugin • OpenManage Update Manager plugin
Mobility	OpenManage Mobile
Integrations and Connections	OpenManage Integrations • BMC Truesight • Microsoft System Center • Red Hat Ansible Modules • VMware vCenter and vRealize Operations Manager OpenManage Connections • IBM Tivoli Netcool/OMNIbus • IBM Tivoli Network Manager IP Edition • Micro Focus Operations Manager • Nagios Core • Nagios XI
Security	• Cryptographically signed firmware • Secure Boot • Secure Erase • Silicon Root of Trust • System Lockdown (requires iDRAC9 Enterprise or Datacenter) • TPM 1.2/2.0 FIPS, CC-TCG certified, TPM 2.0 China NationZ
Embedded NIC	2 x 1 GbE LOM
GPU options	Not supported
Ports	Front Ports • 1 x USB 2.0 • 1 x iDRAC Direct (Micro-AB USB) port Internal Ports • 1 x USB 3.0 (optional) Rear Ports • 1 x USB 2.0 • 1 x iDRAC ethernet port • 1 x USB 3.0 • 1 x VGA • 1 x Serial port
PCIe	2 PCIe slots: • 1 x8 Gen4 (x16 connector) low profile, half length • 1 x8 Gen4 (x8 connector) low profile, half length
Operating System and Hypervisors	• Canonical Ubuntu Server LTS • Microsoft Windows Server with Hyper-V • SUSE Linux Enterprise Server • VMware ESXi (support only from Dec'21) • Red Hat Enterprise Linux For specifications and interoperability details, see Dell.com/OSsupport.
OEM-ready version available	From bezel to BIOS to packaging, your servers can look and feel as if they were designed and built by you. For more information, visit Dell.com/OEM.

Recommended support and services

Dell ProSupport Plus for critical systems or Dell ProSupport for premium hardware and software support for your PowerEdge solution. Consulting and deployment offerings are also available. Contact your Dell representative today for more information. Availability and terms of Dell Services vary by region. For more information, visit Dell.com/ServiceDescriptions.

APEX Flex on Demand

Consume technology, infrastructure and services any way you want with Dell Technologies on Demand, the industry's broadest end-to-end portfolio of flexible consumption and as-a-Service solutions. For more information, visit www.delltechnologies.com/en-us/payment-solutions/flexible-consumption/flex-on-demand.htm.

February 2023

DELL Technologies

10ZiG®

7000q Series
Thin Clients

Model Numbers: 7072q, 7010q, 7011q

Industry Leading Secure Endpoint Solutions

The 10ZiG 7000q Series is a flexible, powerful Thin Client workhorse in the 10ZiG hardware lineup. A compact, durable, reliable, and fanless endpoint, the 7000q puts more speed into the Power, Speed, and Performance of 10ZiG and offers superior support for today's modern workforces. Equipped with free centralized management via 10ZiG Manager – cloud-enabled with unlimited user licenses. Covered by a 3-Year Advance Warranty, technical support, and software upgrades. Also available in a Zero Client device.

- Intel J6412 Quad Core 2.00GHz (2.60GHz Burst)
- 2 x (3840 x 2160) @ 60Hz via DisplayPort (2 Monitors at 4KUHD*)
- Up to 16GB RAM and 256GB Storage
- 4 x USB 2.0, 2 x USB-3.2, 1 x USB-C (Data Only)
- RJ45 LAN/Fiber LAN (SFP) Ready Options
- TPM 2.0**
- TAA Compliant***
- Optional Wireless (Dual External Antenna)
- Supports VESA Mounting and Kensington Lock[1]
- FREE Centralized Management via 10ZiG Manager™

***Supported by Windows 10/11 IoT Enterprise LTSC*
****TAA compliant on request for EMEA market*
[1]VESA Mounting Bracket required and sold separately

Amazon Workspaces | Azure Virtual Desktop | Citrix | VMware/Omnissa | Windows 365 Cloud PC | HP Teradici | Nerdio | Parallels | Dizzion Frame | Inuvika | Leostream | Apporto | Workspot | Controlup | Liquidware | Imprivata | ThinPrint | 90Meter | FabulaTech

Americas	P: +1 (866) 865-5250	E: info@10ZiG.com
EMEA	P: +44 (0) 116 214 8650	E: info@10ZiG.eu
APAC	P: +61 2 80027421	E: info@10ZiG.com.au
DE	P: +49 (0) 6724 9304 45	E: vertrieb@10ZiG.de

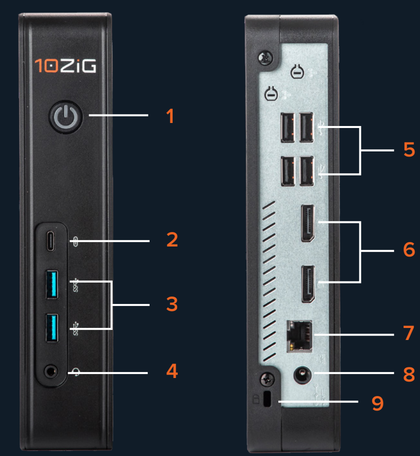
www.10ZiG.com

7000q Series
Thin Clients

10ZiG®

System	
Management	10ZiG Manager™
Processor	Intel J6412 Quad Core 2.00GHz (2.60GHz Burst)
Processor Graphics	Intel HD Graphics
Dimensions	
Device	1.7" (D) x 6.0" (W) x 7.9" (H) in.
Weight	3.53 lbs. (1.6 kg.)
Connections	
Ports on Device	2 x DisplayPort, **4 x USB 2.0, 2 x USB-3.2,** 1 x **USB-C (Data Only),** 1 x DC Jack, 1 x 3.5mm Headset Jack (TRRS)
Video Resolution	2 x (3840 x 2160) @ 60Hz via DisplayPort (2 Monitors at 4KUHD*)
Networking	
Wireless	Optional (802.11 a/b/g/n/ac/ax External Antenna)
Ethernet	10/100/1000 Base-T, RJ45 LAN or **Fiber LAN (SFP) Ready Options**
Environmental	
Operating Temp	32°-95°F (0°-35°C), 20-80% non-condensing humidity

Specifications



1. Power Button/Power LED
2. USB Port Type Type C (Data Only)
3. USB Port Type 3.2
4. Headset Jack (TRRS)
5. USB Port Type 2.0
6. DisplayPorts
7. RJ45 LAN/Fiber LAN (SFP) Ready Options
8. 12V DC Jack
9. Kensington Lock Slot

**Note: Actual display performance, such as multi-monitor and higher resolutions including 4K/UHD/QHD/WQHD are dependent upon your current VDI infrastructure and any additional requirements. Consult with 10ZiG for further guidance and model recommendation.*

Operating System	7072q PeakOS™ (Linux)	7010q Windows 10 IoT Enterprise LTSC	7011q Windows 11 IoT Enterprise LTSC
RAM	Std: 8GB Max: 16GB	Std: 8GB Max: 16GB	Std: 8GB Max: 16GB
Storage	Std: 8GB Max: 256GB	Std: 32GB Max: 256GB	Std: 128GB Max: 256GB
Software Applications	AVD/W365 Client, Citrix Workspace App, Dizzion Frame Client, Firefox, FreeRDP Client, Google Chrome, HP Anyware PCoIP Client, Inuvika OVD, iSeries/5250 Emulation, Island Browser (coming soon), Leostream (coming soon), Parallels Client, Putty, VMware Horizon Client, VNC (Shadowing)	10ZiG Quick Start, 10ZiG UWF Wizard, Amazon Workspaces Client, AVD/W365 Client, Citrix Workspace App, Dizzion Frame Client, Edge Browser, HP Anyware PCoIP Client, Inuvika OVD, Island Browser (coming soon), Leostream (coming soon), Parallels Client, RDP Client, VMware Horizon Client, VNC (Shadowing), Workspot Client	10ZiG Quick Start, 10ZiG UWF Wizard, Amazon Workspaces Client, AVD/W365 Client, Citrix Workspace App, Dizzion Frame Client, Edge Browser, HP Anyware PCoIP Client, Inuvika OVD, Island Browser (coming soon), Leostream (coming soon), Parallels Client, RDP Client, VMware Horizon Client, VNC (Shadowing), Workspot Client
Connection Servers	Citrix: Citrix Storefront, Netscaler, Citrix Cloud, VMware: VMware Horizon, Workspace One, Horizon Security Server, Unified Access Gateway (UAG), RD Client: AVD, Windows 365 Cloud PC, FreeRDP: RDP, RD Gateway, RD Load Balancer, RD Web, Parallels Client: RAS, RDP, HP Anyware Client: Anyware (CAS), Amazon Workspaces, Frame Client	Citrix: Storefront, Netscaler, Citrix Cloud, VMware: VMware Horizon, Workspace One, Horizon Security Server, Unified Access Gateway (UAG), RD Client: AVD, Windows 365 Cloud PC, RDP Client: RDP, RD Gateway, RD Load Balancer, RD Web, Amazon Workspaces: Workspaces via PCoIP or WSP, Workspot Client: Workspot VDI via RDP, Parallels Client: RAS, RDP, HP Anyware Client: Anyware (CAS), Amazon Workspaces, Frame Client	Citrix: Storefront, Netscaler, Citrix Cloud, VMware: VMware Horizon, Workspace One, Horizon Security Server, Unified Access Gateway (UAG), RD Client: AVD, Windows 365 Cloud PC, RDP Client: RDP, RD Gateway, RD Load Balancer, RD Web, Amazon Workspaces: Workspaces via PCoIP or WSP, Workspot Client: Workspot VDI via RDP, Parallels Client: RAS, RDP, HP Anyware Client: Anyware (CAS), Amazon Workspaces, Frame Client

Rackmount KVM Console HD 1080p - Single Port VGA KVM with 17" LCD Monitor for Server Rack - Fully Featured 1U LCD KVM Drawer w/Cables & Hardware - USB Support - 50,000 MTBF

Product ID: RKCONS17HD

Providing centralized control of your single PC or dozens of servers, this HD rackmount KVM console (QWERTY keyboard) also gives you easy access to and visibility of your system while it’s mounted in a server rack or cabinet. Connected to your servers through a separate KVM switch (sold separately), the LCD console installs into 1U of rack-space, offering a space-efficient solution for complete console control.

The 1080p KVM console’s monitor is 17.3” and LED back-lit, for low power consumption. It supports high-definition resolutions up to 1920x1080 providing sharper video performance. This HD console also provides more screen space, helping you to run multiple applications on the same screen, increasing your productivity.

The rack-mount LCD console slides out from 1U of rack space, enabling you to easily monitor and control a single server or multiple servers when connected through a KVM switch. The rackmount VGA KVM features a handle that makes it easy to slide the console in and out of the server rack, keeping your area organized and clutter-free.

This single-port KVM console comes with everything you need to set up:

• 1 Audio Cable

• 1 Set of KVM Cables (VGA)

• 2 Rear Mounting Brackets

• M5 Cage Nuts and Screws

This KVM console provides all the essential controls you’ll need to manage your server room at a low cost. The console features a built-in keyboard and a touchpad for intuitive control, as well as a high-definition LCD display.

StarTech.com offers a wide selection of KVM consoles to help you access your systems more efficiently without the expense and clutter of extra peripherals. This rackmount KVM console is backed by a 2-year warranty and free lifetime technical support.

Certifications, Reports and Compatibility

Applications

• Large server farms

• Colocation facilities

Features

• HIGH DEFINITION: Rackmount KVM console w/high-resolution widescreen (16:9) 1080p LCD panel is perfect for applications needing extra detail or substantial info on one screen E.g. IP camera monitoring

• WIDE COMPATIBILITY: This HD KVM console drawer works with virtually any KVM switch brand or model that supports VGA and USB interfaces and conveniently slides into the server rack when not in use

• VERSATILE INTERFACES: Rack mount monitor with 17.3" Active Matrix TFT 16:9 widescreen 1U height Single Port Full keyboard + Trackpad Integrated Power Supply Supports VGA + USB

• MAX DURABILITY: Features durable steel housing and rails that withstand frequent use, rated to work in environments from 0 to 40 deg. C and a 44,230 hour MTBF with 24/5 Tech Support

• TESTED AND PROVEN: Our KVM consoles are backed by a 2 year warranty with 24/5 by multi-lingual tech support based in North America with free technical support for the life of the product

Hardware		
	Warranty	2 Years
	U Height	1U
	Audio	No
	Display Size	17.3"
	Panel Type	Active Matrix TFT LCD
	KVM Ports	1
	PC Interface	USB
	PC Video Type	VGA

	Number of Monitors Supported	1
	Rack-Mountable	Yes
	Cables Included	Yes
Performance		
	IP Control	No
	Maximum Analog Resolutions	1920x1080
	Supported Resolutions	Resolutions up to 1920x1080 @ 60Hz
	Aspect Ratio	16:9
	Contrast Ratio	800:1
	Brightness	300 cd/m
	Color Depth	6-bit, 262144 colors
	Pixel Pitch Support	0.1989 x 0.1989 mm
	Viewing Angle	170 (H), 170 (V)
	Maximum Number of Users	1
	MTBF	44,230 hours
Connector(s)		
	Host Connectors	1 - HD15 (15 pin, High Density D-Sub)
	Other Interface(s)	1 - IEC 60320 C14 Power
Special Notes / Requirements		
	Note	The minimum mounting depth of this rackmount console is less than the length of the console itself. Please consider the length of the rackmount console when evaluating if it will fit into your rack.
Indicators		
	LED Indicators	1 - Power / Status LED
Power		
	Power Source	International Power Cords

	Input Voltage	100 - 240 AC
	Input Current	1.5A
	Power Consumption (In Watts)	13W
Environmental		
	Operating Temperature	0C to 40C (32F to 104F)
	Storage Temperature	-20C to 60C (-4F to 140F)
	Humidity	10 ~ 80% RH
Physical Characteristics		
	Color	Black
	Material	Steel
	Cable Length	1.8 m
	Product Length	22.2 in [56.5 cm]
	Product Width	19.0 in [48.3 cm]
	Product Height	1.7 in [4.3 cm]
	Weight of Product	24.7 lb [11.2 kg]
	Maximum Mounting Depth	33.5 in [85 cm]
	Minimum Mounting Depth	20.1 in [51 cm]
Packaging Information		
	Package Quantity	1
	Package Length	30.3 in [76.9 cm]
	Package Width	24.6 in [62.4 cm]
	Package Height	7.3 in [18.5 cm]
	Shipping (Package) Weight	36.2 lb [16.4 kg]

What's in the Box

Included in Package	1 - KVM console
	1 - KVM cable
	8 - M5 cage nuts
	8 - M5 screws
	5 - regional power cords (NA, JP, UK, EU, ANZ)
	1 - quick-start guide
	2 - mounting rails

Product appearance and specifications are subject to change without notice.

ENCLOSURE

Type 12 Enclosure

Hoffman, Two-Door Floor-Mount

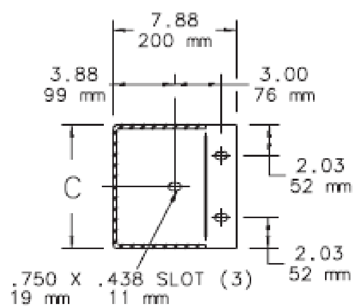
Cat. No. A727212ULP

The Hoffman Two-Door Floor-Mount Type 12 Enclosure is designed to protect electrical and electronic controls, components and instruments in typical industrial environments. The Type 12 rating protects enclosed equipment from dust, dirt, oil, and dripping water. These enclosures are used in machine tool applications for housing motor starters, drivers, contactors, and PLCs, as well as a wide variety of other electrical and electronic equipment found in the automotive, pulp and paper, wood products, textile, and similar industries.

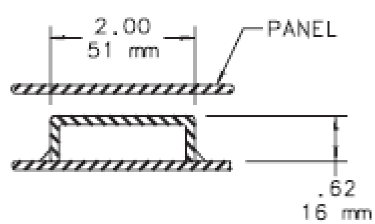
Standards:

- UL 508A, 508, File No E61997: Type 12
- NEMA/EEMAC Type 12
- JIC standard EGP-1-1967
- CSA, File No 42186, Type 12
- IEC 60529, IP55

Gauge	Enclosure Size (A x B x C)	Panel Catalog Number	Panel Gauge	Panel Size (D x E)	Body Stiffeners
12	72.06 x 72.06 x 12.06 (1830 x 1830 x 306)	A72P72	10	68.00 x 68.00 (1727x 1727)	24.00 (610)



SECTION W-W

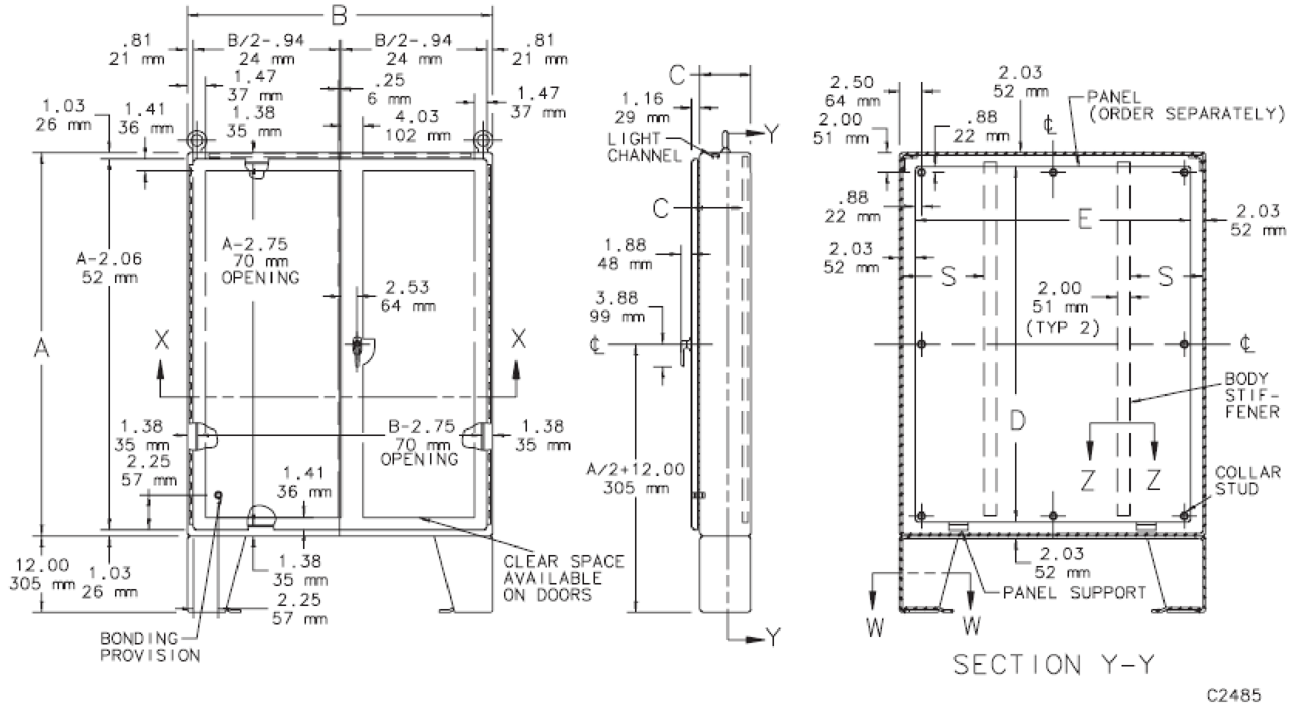


SECTION Z-Z

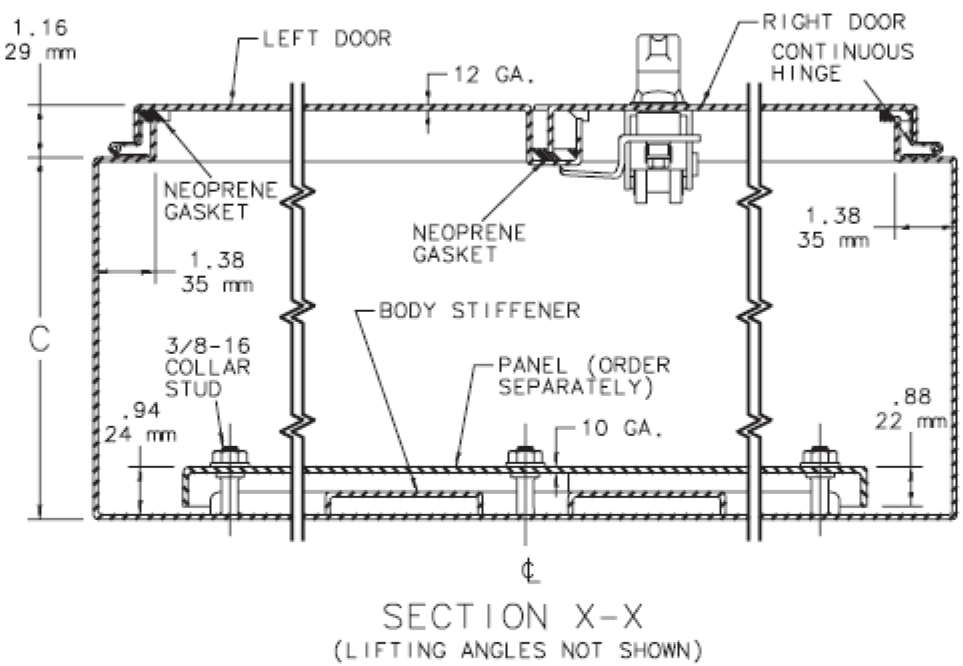
Type 12 Enclosure

Part # 2750136

Hoffman, Two-Door Floor-Mount



NOTES: 1. Panels are 10 gauge steel.
2. Right door has removable 12.00 x 12.00 in. (305 x 305mm) data pocket.

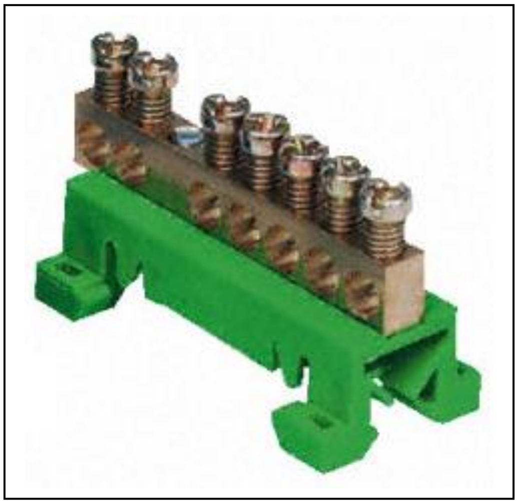


ENCLOSURE ACCESSORIES

Ground Bar

ABB

Cat. No. RAU0356 103.04

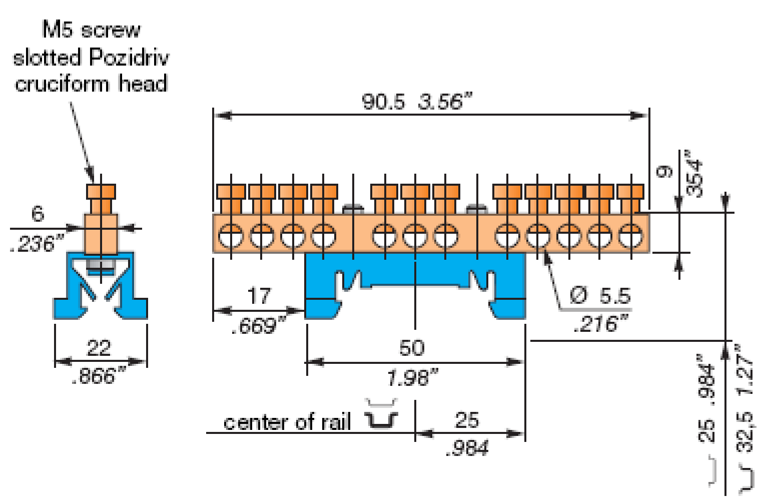


The ABB ground bar provides a convenient DIN rail mounted means for ground wiring.

- 12 position
- Green color
- DIN rail mount
- Max wire size $10mm^2$ per IEC
- Torque on screws 1.5Nm per IEC, 13.3 lb.in. per UL and CSA

Dimension information:

12 outputs



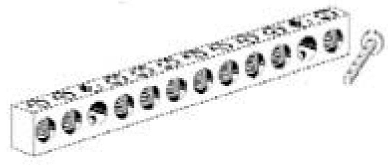
Mounting on DIN 3 rail

Ground Bar, Non-Isolated

Part # 2750028

ITE

Cat. No. GB10



The ITE non-isolated ground bar provides a convenient means for terminating ground wires.

- 10 position bar
- #14-4 AWG wires

Data Access Port **Part # 2754532**

Panduit DAP4BC-G0-5

The Data Access Port provides data port and electrical outlet access to equipment without opening the control panel.

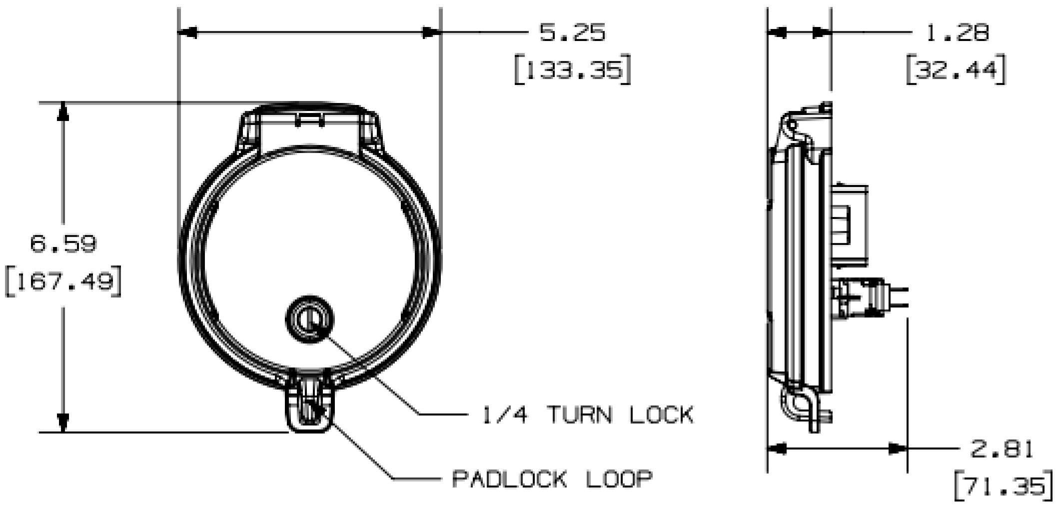
Certifications:

- Listed to UL50, UL50E, UL508A, CSA C22.2 No. 14-13 and
CSA C22.2 No. 94.1/No. 94.2
- CE Mark

Specifications:

Degree of Protection:	Rated Type (UL, CSA, NEMA) 4, 4X and 12
Ingress Rating:	IP65 and IP66 per IEC 60529
Operating Temperature:	23° to 122° F (-5° to 50° C)
Storage Temperature:	-40° to 158° F (-40° to 70° C)

Dimensions:



Type PNL Bronze Penn-Lug Part # 2750031

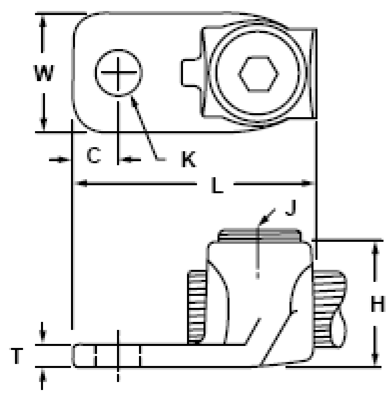
Penn-Union, 1-Hole tongue

Cat. No. PNL-1-0

The Penn-Union Type PNL Bronze Penn-Lug tightens directly on the conductor forcing the conductor into intimate contact with the body for maximum conductivity. Flat bottom allows mounting either on tongue only or with full contact surface.

Conductor Range	Wire Diameter Range (inch)	Wrench Size
8 Solid-1/0 Str.	0.128-0.375	0.25

C	K	H	L	T	W	J (threads)
0.375 (10)	0.328 (8)	0.781 (20)	1.594 (40)	0.141 (3.57)	0.734 (16)	1/2-20



ENVIRONMENTAL CONTROL ENCLOSURE

Industrial Corrosion Inhibitor Part # 2607334

Hoffman

Cat. No. AHCI5E

The Hoffman corrosion inhibitors contain a special chemical combination that vaporizes and condenses on all surfaces in an enclosed area. Vapors will redeposit as needed in the event of condensation of moisture on surfaces. These vapors reach every part of an enclosure, protecting all interior components. Spraying, wiping, or greasing or not required. This eliminates precoating, special wraps, and drying agents. Protection is effective even in salt water atmospheres. There are additional red metal inhibitors for further protection.

These inhibitors protect:

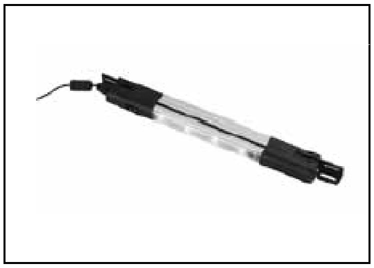
- Interior components of electrical enclosures, boxes, consoles, and wireways
- Interior components of electronic enclosures
- Electrical and electronic equipment and controls
- Parts and components that are packaged in crates during shipping and storage
- Switch gear and relay cabinets
- Interiors of pipes, conduits, and fuse boxes
- Process control computers, instruments, and recording devices
- Tool chest interiors and contents
- Equipment stored at construction sites

AHCI5E Emitter protects five cubic feet (141.6 liter) of enclosure volume for approximately one year. Emitters contain additional red metal (non-ferrous) inhibitors.

Size: 2.50” (diameter) x 1.50” (high)
(63mm x 51mm)

Enclosure Light **Part # 2754981**

Hoffman CEL550M



The enclosure light package illuminates the interior of an electrical enclosure.

Industry Standards:

- UL 508A Component Recognized; File No. E61997
- cUL Component Recognized per CSA C22.2 No. 14; File No. E61997
- CSA File No. 42186
- Maintains UL/CSA Type 4, 4X and 12 enclosure ratings when properly installed
- Motion Activated

Specifications:

Operating Voltage	Power Consumption	Illumination	Color Temperature
24 V – 240 V DC or AC	5.1 Watts	550 Lumens	5800K

Materials of Construction
• Plastic • Light Color = Neutral White • Can be mounted vertically or horizontally

Dimensions:

Height: 15.59” / 396 mm

Width: 1.3” / 33mm

Depth: 1.57” / 40 mm

Door Switch Cable

Part # 2754804

Hoffman CELC3001PBUL

Hoffman PaneLite Door Switch Cable, 18-in.

<u>Compact LED Light Connection Cable, CELC, 3000mm, Black, Plastic, UL</u>

- Colour: Black, Orange
- Design: Infeed, with through wiring 2-pole cables
- Description: To save time and easily mount the compact LED lights, use these pre-fabricated cables.

- Nominal Voltage: 250 V
- Input Voltage AC: 250 V max

- Operating Temperature: 140 °F / 60 °C
- Weight 0.68 lb

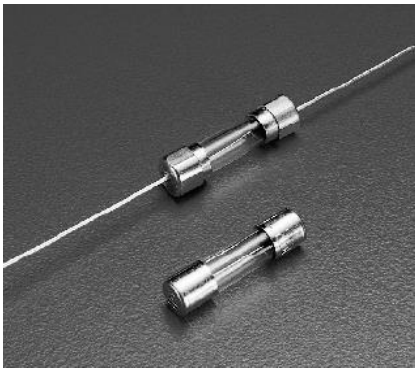
FUSE

Axial Lead and Cartridge Fuse

Part # 2751144

Littelfuse, 250Volt Fast Acting 217 Series

Cat. No. 217.050

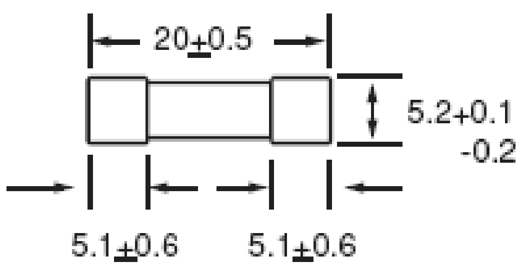


Littelfuse 250 Volt Fast Acting Type 217 Series fuses are designed to IEC standards.

ELECTRICAL CHARACTERISTICS:

% of Ampere Rating	Ampere Rating	Opening Time
150%	.032–6.3	60 minutes, **Min**imum
	8-15	30 minutes, **Min**imum
210%	.032-15	30 minutes, **Max**imum
275%	.032–.100	0.01 sec., **Min.**; .5 sec. **Max.**
	.125–15	0.05 sec., **Min.**; 2 sec. **Max.**
400%	.032–.100	.003 sec., **Min.**; 0.1 sec. **Max.**
	.125–6.3	.01 sec., **Min.**; 0.3 sec. **Max.**
	8 - 15	.01 sec., **Min.**; 0.4 sec. **Max.**
1000%	.032–6.3	.02 second, **Max**imum
	8-15	.04 second, **Max**imum

Voltage Ratings	Ampere Ratings	Interrupting Ratings
250 VAC	0.050 A	35 Amps @250VAC, unity power factor



Axial Lead and Cartridge Fuse

Littelfuse, 250Volt Fast Acting 217 Series

Agency Approvals

Agency Approvals			Ampere Range
PS E		Cartridge NBK120802-E10480 A&C Leaded NBK120802-E10480 B&D	1A – 15A
	Certificate No.	2002010207007600 2002010207007599	32mA – 800mA 1A – 6.3A
	Certificate No.	SU05001-3004 SU05001-2005 SU05001-2006 SU05001-2007	32mA – 40mA 50mA – 315mA 400mA – 6.3A 8A & 10A
	Recognised File No. Guide No.	E10480 JDYX2	32mA – 6.3A
	File No. Acc. Class No.	029862 LR1422-30	32mA – 6.3A
	Licence No.	KM41462	400mA – 6.3A
	File No.	9848103, 9931059 304518 & 304555	32mA – 6.3A
		Pending	32mA – 10A
			32mA – 15A

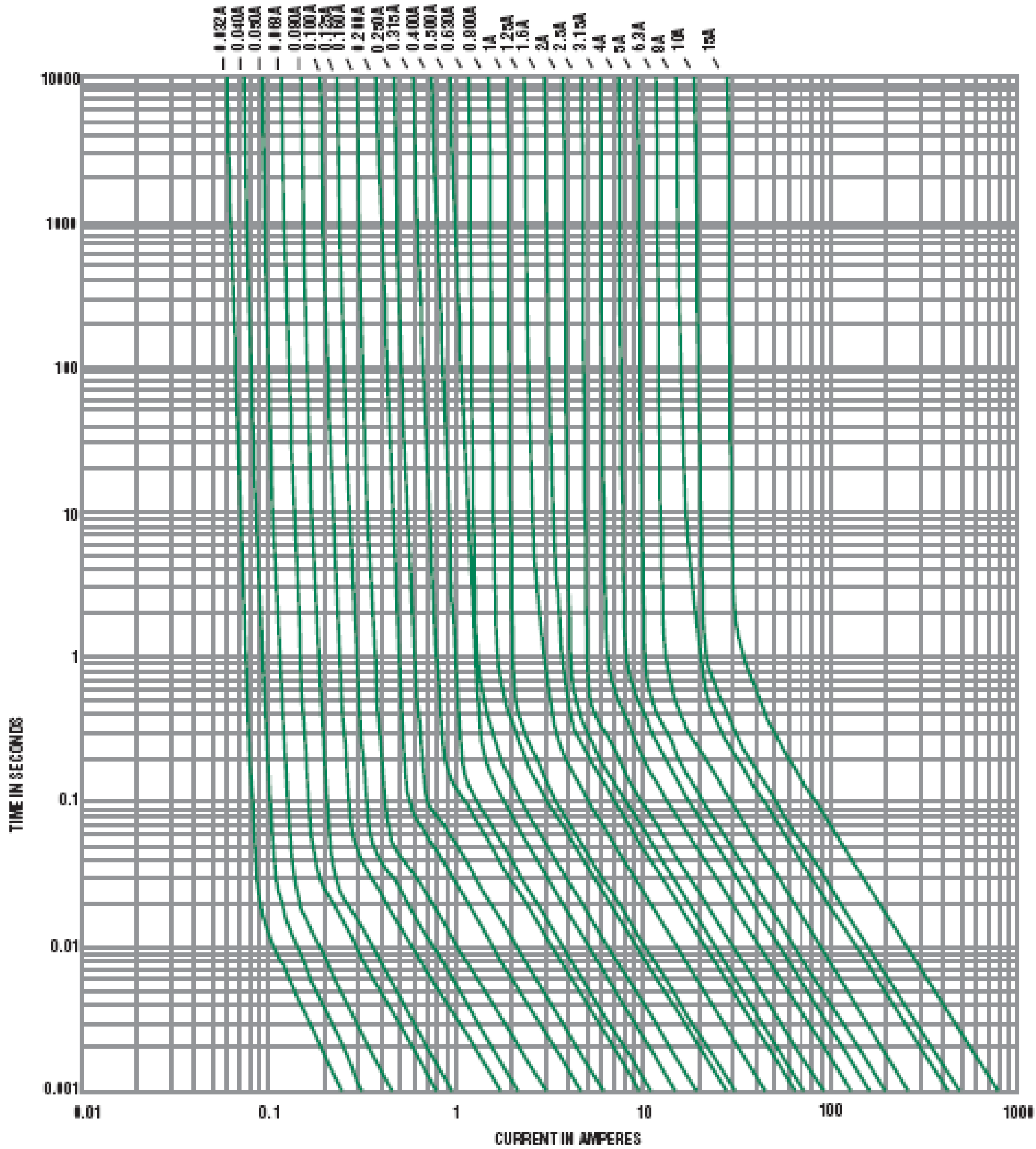
Note: 600mA, 1.5A and 3A ratings are available with UL recognition and CSA acceptance only. 8A and 10A are under consideration by IEC(125V).

Axial Lead and Cartridge Fuse

Part # 2751144

Littelfuse, 250Volt Fast Acting 217 Series

Average Time Current Curves



Axial Lead and Cartridge Fuse
Part # 2608762

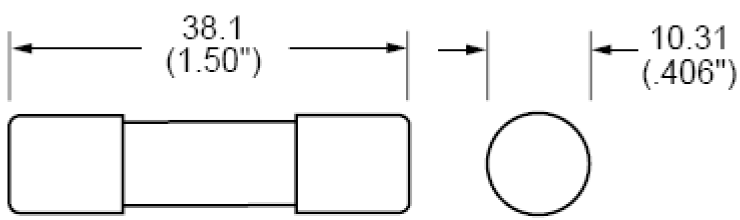
Littelfuse, 250 Volt Slo-Blo FLM Series

Cat. No. FLM 1

Littelfuse 250 Volt Slo-Blo Type Fuse FLM Series. Agency approvals listed by Underwriters Laboratories and Certified by CSA.

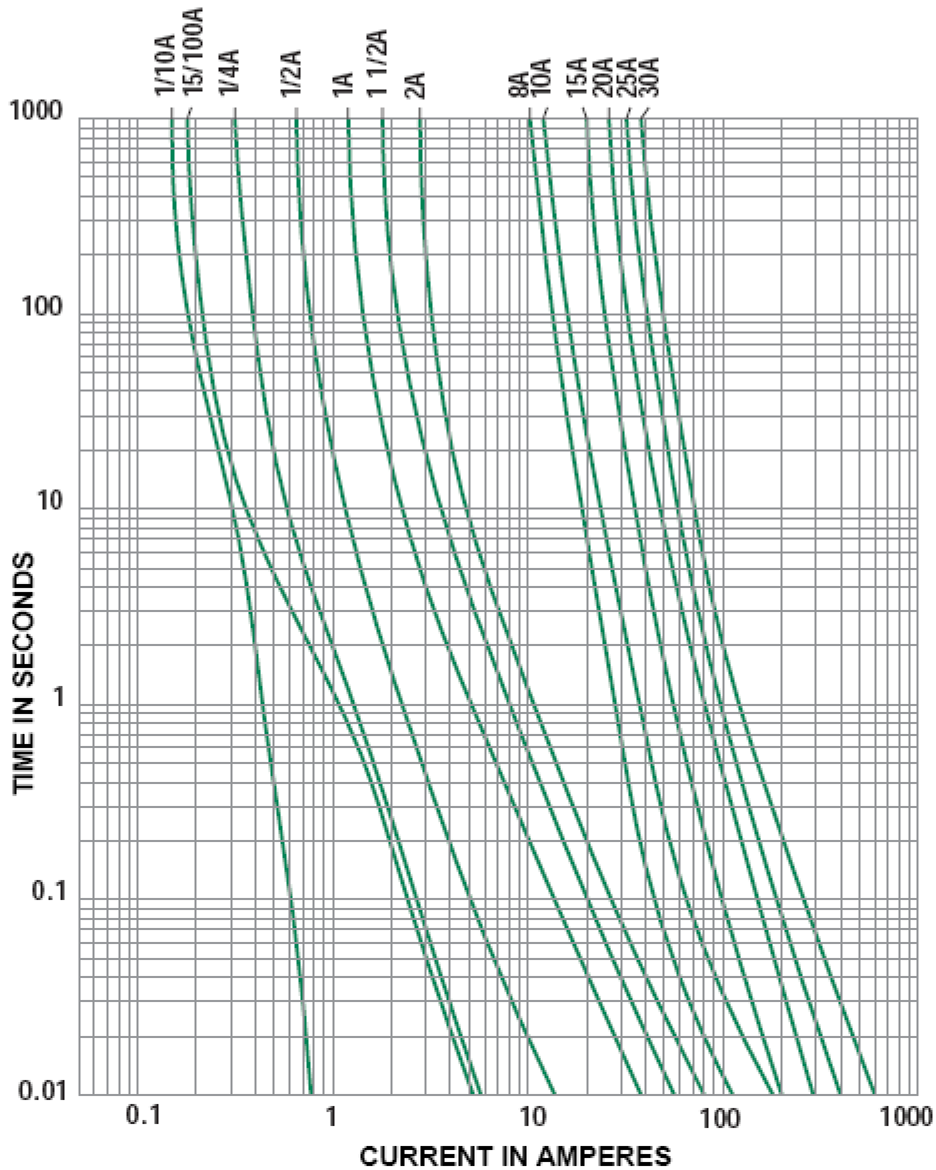
% of Ampere Rating	Ampere Rating	Opening Time
135%	1/10-30	1 hour, **Max**imum
200%	32/10–30	12 seconds, **Min**imum
	0–3	5 seconds, **Min**imum

Voltage Ratings	Ampere Ratings	Interrupting Ratings
250 VAC	1.0 A	10,000 amperes at 250 VAC



Littelfuse, 250 Volt Slo-Blo FLM Series

Average Time Current Curves



Axil Lead and Cartridge Fuse
Part # 2608763

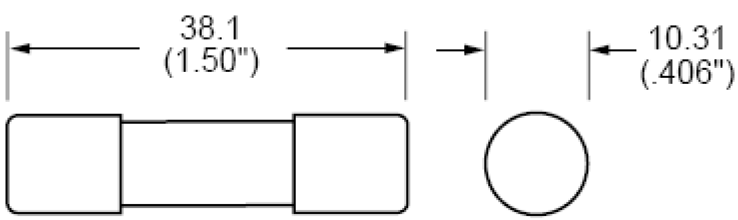
Littelfuse, 250 Volt Slo-Blo FLM Series

Cat. No. FLM 5

Littelfuse 250 Volt Slo-Blo Type Fuse FLM Series. Agency approvals listed by Underwriters Laboratories and Certified by CSA.

% of Ampere Rating	Ampere Rating	Opening Time
135%	1/10-30	1 hour, **Max**imum
200%	32/10–30	12 seconds, **Min**imum
	0–3	5 seconds, **Min**imum

Voltage Ratings	Ampere Ratings	Interrupting Ratings
250 VAC	5.0 A	10,000 amperes at 250 VAC

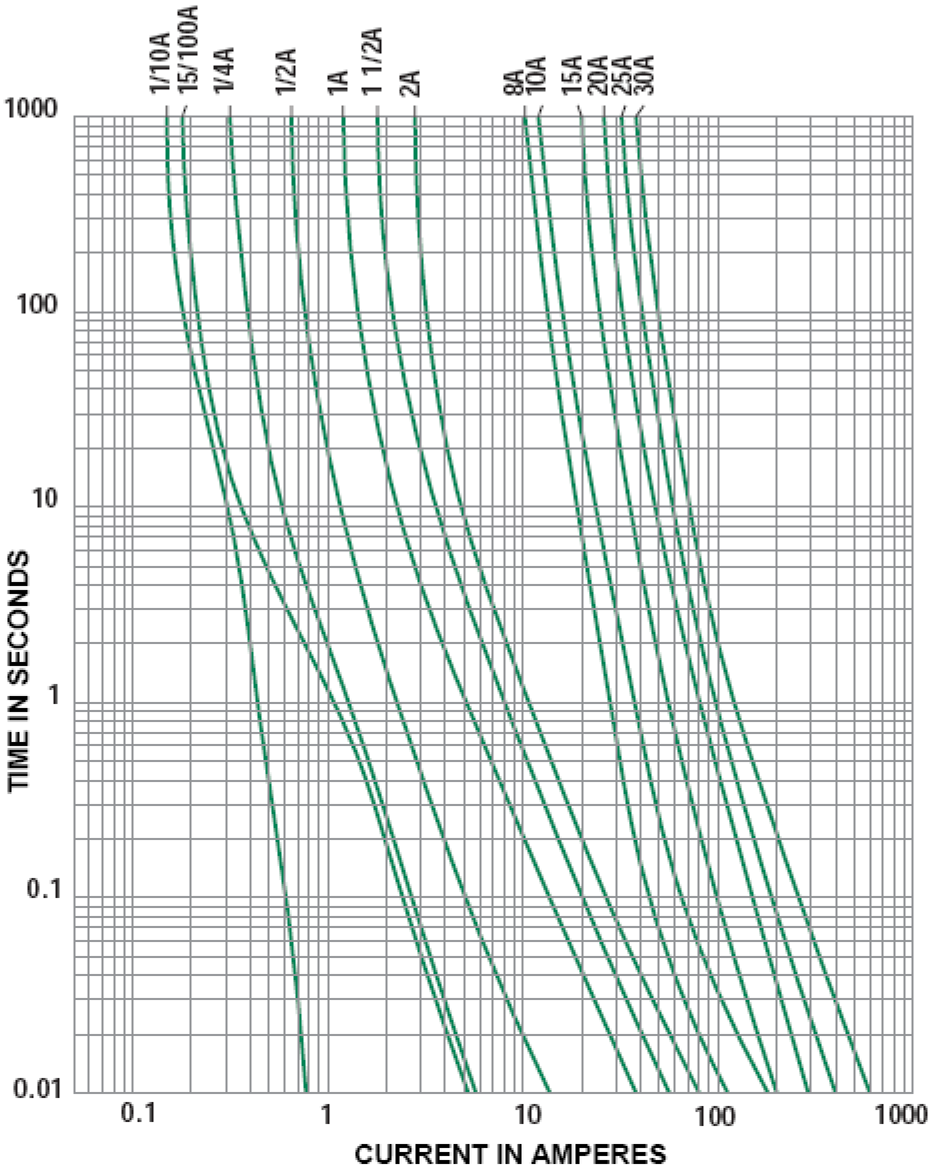


Axil Lead and Cartridge Fuse

Part # 2608763

Littelfuse, 250 Volt Slo-Blo FLM Series

Average Time Current Curves



FUSE BLOCK

Fuse Block

Part # 2751333

Allen Bradley

Cat. No. 1492-FB1M30

Allen Bradley fuse holder provides a safe and convenient means for installation of 1-1/2” x 13/32” Midget Fuses. The 1492-FB fuse holder family is designed for use in many OEM applications such as power supplies, equipment protection, primary and secondary control transformers, solenoids, lighting and heater loads, and drives.

Standards:

- UL512
- CSA C22.2 No. 39
- EN/IEC 60947-3
- EN/IEC 60269-2-1
- CE marked

Poles	**Fuse Class**	**Wire Range**	**Tightening Torque**
1	M – Midget Fuses (1-1/2” x 13/32”)	#16-#4 AWG Cu.	22 lb – in (2.5 Nm)

Temperature Range	**Withstand Rating**	**Maximum Current Rating**	**Maximum Voltage Rating**	**Dimensions**		
				Height	**Depth**	**Width**
-4-130 F -20 C to 55 C	50kA	30 A	600V AC/DC	3.19 in (81 mm)	2.51 in (64 mm)	0.71 in (18 mm)

Terminal Block

Part # 2750034

Allen Bradley, Screw Connection

Cat. No. 1492-WFB4

Allen Bradley Fuse Block, 50 Pcs. / Pkg.

Specifications		*Single-circuit fuse block with or without fuse indication.*		
Certifications			CSA	IEC
Voltage Rating	H6/WFB4	300V AC/DC		500V AC/DC
	H5/WFB424	10…57V AC/DC		
	H4/WFB4250	85…264V AC		
Maximum Current		15 A		15 A *
Wire Range (Rated Cross Section)		#22… #12 AWG		0.5… 4 mm^2
Wire Strip Length		0.31 in (6 mm)		
Recommended Tightening Torque		5.0…5.6 lb•in (0.6 Nm)		
Density	(Blocks per ft/meter)	36 pcs/ft (125/m)		
Housing Temperature Range		–40…+195 °F (–40…+90 °C)		
H6/WFB4		Non-Indicating		
H5/WFB424		Red LED		
H4/WFB4250		Neon		
H6/WFB4		—		
H5/WFB424		2 mA @ 24V		
H4/WFB4250		2 mA @ 300V		
Fuse Size (Not Supplied)		5 x 20 mm		

HMI-HUMAN MACHINE INTERFACE

Operator Interface Part # 2753561

Allen Bradley 2711P-T15C22D9P

The Allen Bradley PanelView Plus 7 Performance terminals are operator interface devices that monitor and control devices that are connected to a PLC.

Certifications:

Certification	Value
cULus	cULus Listed Industrial Control Equipment for use in Hazardous Locations (E10314) per standards ANSI / ISA 12.12.01 and CSA C22.2 No. 213. rated: • Class I, Div 2, Groups A, B, C, D Enclosure type ratings per UL50 and CSA C22.2 No. 94.2-07. Enclosure ingress protection classified by UL per IEC 60529.
CE (EMC)	European Union 2004/108/EC EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers
CE (LVD)	European Union 2006/95/EC Low Voltage Directive, compliant with: • EN 61131-2; Programmable Controllers
RCM	Australian Radiocommunications Act, compliant with: • AS/NZS CISPR 11; Industrial Emissions
RoHS	China RoHS, Turkey RoHS, European RoHS
KCC	Certificate of compliance
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications

Technical Specifications:

Environmental:

Temperature		Humidity		Ratings
Operating	Storage			
0 to 55 °C (32 to 131 °F)	-25 to 70 °C (-13 to 158 °F)	5 to 95%, without condensing		NEMA and ULType 12, 13, 4X, also rated IP66 as Classified by UL
Heat Dissipation	Altitude Operating	Shock		Vibration
		Operating	Storage	
61 BTU/Hr	2000 m (6561 ft)	15 g at 11 ms	30 g at 11 ms	10..57 Hz, 0.006 pk-pk displacement 57…500 Hz, 1g peak acceleration

Operator Interface Part # 2753561

Allen Bradley 2711P-T15C22D9P

Display:

Operator Input	Type	Viewing Area (W x H)	Backlight Life
Touch	Thin Film Transistor (TFT) Color	12" x 9" (304mm x 228mm)	White light-emitting diode, solid-state Life: 50,000 h min at 40 °C (104 °F) to half-brightness, backlight is not replaceable
Display Size (Diagonal)	**Display Resolution**	**Touch Screen**	**Battery (Real-time Clock Back-up)**
15	1024 x 768 WXGA, 18-bit color graphics	Analog resistive Actuation rating: 1 million presses Operating force: 100 grams	Accuracy: +/-2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell

Memory: • System • User	US Ports: • Host • Device
• 512 MB RAM and 512 MB storage • 80 MB, approx, nonvolatile storage for applications	• Two USB high-speed 2.0 host ports (type A) support removable flash drives for external storage • One high-speed 2.0 device port (type B) that will be functional in a future release

Operating System	Ethernet Ports
Windows CE with Extended Features and MS Office Viewers (includes FTP, VNC client server, ActiveX controls, PDF reader, third-party device support)	Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports that support Device Level Ring (DLR), linear, or star network topologies

Electrical:

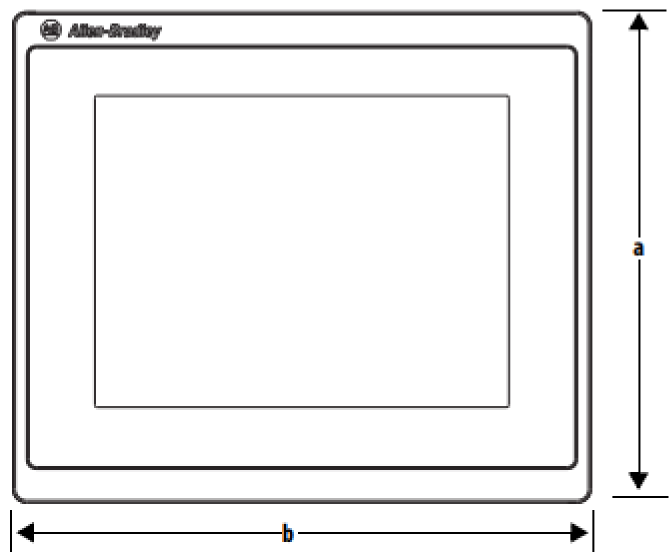
Input Voltage	Power Consumption
24V DC Nom (18-30V DC)	50 W max. (2.1 A at 24V DC)

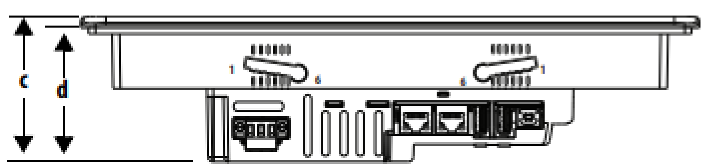
Allen Bradley 2711P-T15C22D9P

Mounting:

Weight, Touch Screen	**Cutout Dimensions (H x W)**
8.4 lbs (3.69 kg)	11.42” x 13.9” (290 mm x 353 mm)

Dimensions:





Height (a) mm (in.)	**Width (b) mm (in.)**	**Overall Depth (c) mm (in.)**	**Mounted Depth (d) mm (in.)**
318 (12.52)	381 (15.0)	69.6 (2.74)	63.6 (2.50)

MAIN DISCONNECT

Circuit Breaker

Part # 2754162

Square D BDL16020

The Square D PowerPact B-Frame molded case circuit breaker protects electrical systems from damage caused by overloads and short circuits.

Standards:

- UL 489
- CSA C22.2 No.5
- IEC 60947-2 and 60947-5-1
- NEMA AB1
- NMX J-266
- GB 14048.2

Specifications:

Line Rated Current	20 A
Poles description	1P
Protected poles description	1t
Control type	Toggle
Mounting mode	By screws plate Clip-on 35 mm symmetrical DIN rail
Network type	AC
Network frequency	50/60 Hz
Breaking capacity code	D
Breaking capacity	25 kA at 240 V AC 50/60 Hz according to UL 489 Icu: 25 kA at 220...240 V AC 50/60 Hz according to IEC 60947-2 18 kA at 480Y/277 V AC 50/60 Hz according to UL 489 14 kA at 600Y/347 V AC 50/60 Hz according to UL 489 25 kA at 208Y/120 V AC 50/60 Hz according to UL 489
System Voltage	240 V AC 50/60 Hz according to IEC 60947-2
[Ics] rated service breaking capacity	25 kA: at 220...240 V AC 50/60 Hz according to IEC 60947-2
[Uimp] rated impulse withstand voltage	8 kV according to IEC 60947-2
[Ui] rated insulation voltage	800 V according to IEC 60947-2
Trip unit technology	Thermal-magnetic
Trip unit name	TM-D
Trip unit protection functions	LI
Protection type	Overload protection (thermal) Short-circuit protection (magnetic)
Trip unit rating	20 A at 104 °F (40 °C)

Circuit Breaker **Part # 2754162**

Square D BDL16020

Magnetic hold current	400 A
Magnetic tripping current	600 A
Suitability for isolation	Yes according to IEC 60947-2
Utilisation category	Category A
Mechanical durability	15000 cycles according to IEC 947-1 Annex F ed 5.2
Electrical durability	10000 cycles according to IEC 947-1 Annex K ed 5.2 for In at 240 V

<u>Dimensions</u>:

Color	Grey (RAL 7016)	
Height	137 mm	5.39 in
Width	27 mm	1.06 in
Depth	80 mm	3.15 in
Product weight	0.51 kg	1.12 lbs

NETWORK

Stratix 2000 Industrial Unmanaged Switches

Features and Benefits

Our Stratix® 2000 unmanaged switches offer:

- **Various combinations** of copper and fiber solutions from 5 to 18 ports using SFP for increased network flexibility
- **100 MB and 1 Gb port speeds** to meet network performance requirements
- **Extended temperature range** from -40 °C to 75 °C in select versions to meet a wide variety of applications
- **Compact design** for maximized cabinet space
- **"Plug-and-Play" operation** for easier installation and integration
- **Broadcast storm protection** against unwanted network traffic
- **Rugged metal housing and IP30 rating** for industrial applications
- **Dual power inputs** to help maximize uptime in harsh environments

Rockwell Automation unmanaged switches offer a compact, solution for small applications requiring reliable network connectivity.

With the Allen-Bradley® Stratix 2000 line of unmanaged switches, you get copper and fiber (SFP) ports with 100 MB or 1 Gb speeds for increased network flexibility and performance. With protection against unwanted network traffic, you also get increased reliability when you need it.

The Stratix 2000 unmanaged switches offer an industrial-grade enclosure with an IP-30 rating and extended temperature range for enhanced environmental protection. In addition to these benefits, you get "Plug-and-Play" operation for quick and easy integration.

Selection Overview

In the table below, you will find the Series B versions of our Stratix unmanaged switches. Select the combination of ports that meet your application requirements, without all of the complexity.

Catalog Number	Total Ports	RJ45 Ports[1]	SFP Ports[1]
1783-US5T	5	5 FE	-
1783-US5TG	5	5 GE	-
1783-US4T1F	5	4 FE	1 FE multimode*
1783-US4T1H	5	4 FE	1 FE singlemode*
1783-US8T	8	8 FE	-
1783-US6T2F	8	6 FE	2 FE multimode*
1783-US6T2H	8	6 FE	2 FE singlemode*
1783-US7T1F	8	7 FE	1 FE multimode*
1783-US7T1H	8	7 FE	1 FE singlemode*
1783-US6T2TG2F	10	6 FE + 2 GE	2 FE multimode*
1783-US6T2TG2H	10	6 FE + 2 GE	2 FE singlemode*
1783-US8TG2GX	10	8 GE	2 GE slots[2]
1783-US16T	16	16 FE	-
1783-US16T2S	18	16 FE	2 FE slots[2]

[1] FE = Fast Ethernet; GE = Gigabit Ethernet
[2] SFP modules must be ordered separately
** preinstalled fiber SFP module(s)*

Additional Information

http://ab.rockwellautomation.com/networks-and-communications/stratix-2000-ethernet-switches

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication ENET-PP010D-EN-P - May 2017
Supersedes Publication ENET-PP010C-EN-P August 2016

User Manual

Original Instructions

Allen-Bradley

Stratix 2000 Ethernet Unmanaged Switches

Catalog Numbers 1783-US5T, 1783-US5TG, 1783-US4T1F, 1783-US4T1H, 1783-US8T, 1783-US6T2F, 1783-US6T2H, 1783-US7T1F, 1783-US7T1H, 1783-US6T2TG2F, 1783-US6T2TG2H, 1783-US8TG2GX, 1783-US16T, 1783-US16T2S

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Broadcast Storm Protection

A broadcast storm occurs when a network is overwhelmed by continuous multicast or broadcast traffic typically caused by loops in the network. A severe broadcast storm can block all other network traffic. Stratix® 2000 switches provide protection against broadcast storms. When the broadcast storm protection feature is enabled, the switch drops incoming broadcast traffic if the traffic exceeds a certain threshold.

Stratix 2000 switches use two methods to determine the threshold for incoming broadcast traffic, depending on the switch catalog number:

- Packet-based threshold—The switch counts the number of broadcast packets received within a time cycle. Once the number of broadcast packets reaches the maximum number of packets in the time cycle, the port drops any excess broadcast packets. For threshold values based on packet number, see Table 1.

- Rate-based threshold—The switch tracks the bandwidth of each port based on a maximum bit rate. Once a port reaches the maximum bit rate, the port drops any excess broadcast packets. For threshold values based on rate, see Table 2.

Table 1 - Packet-based Thresholds

Cat. No.	Broadcast Storm Threshold (Packets per Second)
1783-US5T	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US4T1F	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US4T1H	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US8T	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US6T2F	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US6T2H	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US7T1F	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US7T1H	20 pps for 10 Mbps per port; 200 pps for 100 Mbps per port
1783-US6T2TG2F	128 pps for 10/100/1000 Mbps
1783-US6T2TG2H	128 pps for 10/100/1000 Mbps
1783-US8TG2GX	128 pps for 10/100/1000 Mbps

Table 2 - Rate-based Thresholds

Cat. No.	Broadcast Storm Threshold
1783-US16T	10 Mbps per port
1783-US16T2S	10 Mbps per port
1783-US5TG	25 Mbps per port

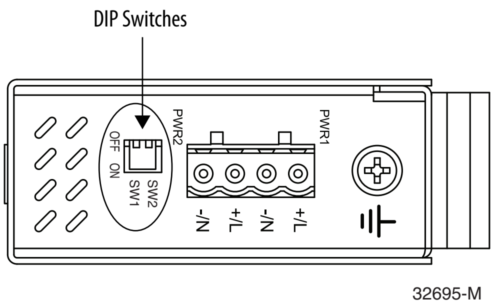
You can enable or disable broadcast storm protection by using DIP switch SW1 on the top panel of the switch:

- To enable the feature, set SW1 to the On position and restart the switch.
- To disable the feature, set SW1 to the Off position. By default, the feature is disabled.

DIP Switches

There are two DIP switches on the top panel of the switches. Each switch has On and Off states.

IMPORTANT To activate DIP switch settings, you must restart the switch.



The function of the DIP switches varies by catalog number.

Cat. No.	DIP Switch	Status	Description	Default
1783-US5T, 1783-US4T1F, 1783-US4T1H, 1783-US8T, 1783-US6T2F, 1783-US6T2H, 1783-US7T1F, 1783-US7T1H, 1783-US16T, 1783-US16T2S	SW1	On	Enables broadcast storm protection.	Off
		Off	Disables broadcast storm protection.	
	SW2	Reserved		Off
1783-US6T2TG2F 1783-US6T2TG2H	SW1	On	Enables broadcast storm protection.	Off
		Off	Disables broadcast storm protection.	
	SW2	On	Sets the SFP fiber port speed to 100 Mbps (100Base-FX). SW2 must remain in the On position.	On
		Off	Reserved	
1783-US5TG 1783-US8TG2GX	SW1	On	Enables broadcast storm protection.	Off
		Off	Disables broadcast storm protection.	
	SW2	On	Transmits jumbo frames up to 10 KB on the 1783-US5TG switch and up to 9.6 KB on the 1783-US8TG2GX switch.	Off
		Off	Drops jumbo frames.	

Status Indicators

The status indicators on the switches indicate the following:

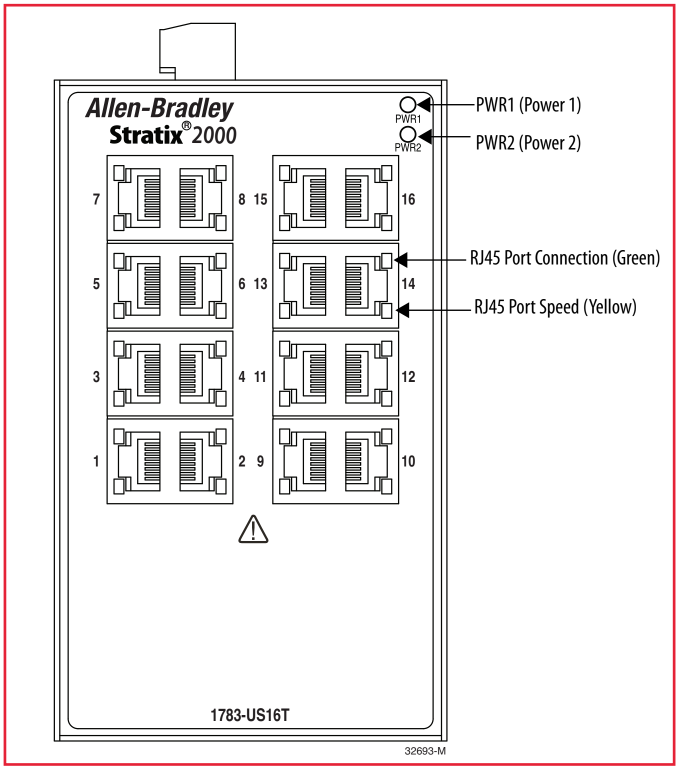
- Status of each power supply
- Status of port speed
- Status of network connection or activity

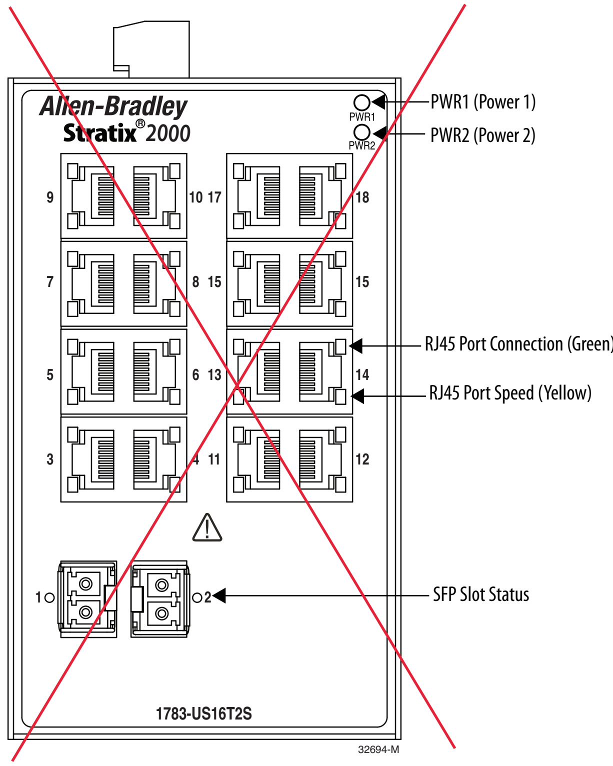
The function of the status indicators varies by catalog number:

- 5- and 8-port Fast Ethernet Switches on page 5
- 10-port Fast Ethernet Switches on page 6
- 16- and 18-port Fast Ethernet Switches on page 7
- 5- and 10-port Gigabit Ethernet Switches on page 8

16- and 18-port Fast Ethernet Switches

These illustrations show the status indicators on the 1783-US16T and 1783-US16T2S switches.





Indicator	Status	Description
PWR1	On	PWR1 is connected and operates normally.
	Off	PWR1is not connected or operates abnormally.
PWR2	On	PWR2 is connected and operates normally.
	Off	PWR2 is not connected or operates abnormally.
RJ45 port connection (green)	On	The port has an operating network connection.
	Blinking(2)	There is network activity on the port.
	Off	The port has no network connection.
RJ45 port speed (yellow)	On	The port is operating at 100 Mbps (100Base-TX).
	Off	The port is operating at 10 Mbps, or the port has no network connection.
SFP slot status(1)	On	The port has an operating network connection.
	Blinking(2)	There is network activity on the port.
	Off	The port has no network connection.

(1) Available only on 1783-US16T2S switches.
(2) For blink rate, see page 9.

Status Indicator Blink Rate

A port status indicator blinks to indicate network activity on the port. The rate at which a status indicator blinks varies by catalog number.

Cat. No.	Rate
1783-US5T	105 ms
1783-US5TG	84 ms
1783-US4T1F	105 ms
1783-US4T1H	105 ms
1783-US8T	105 ms
1783-US6T2F	105 ms
1783-US6T2H	105 ms
1783-US7T1F	105 ms
1783-US7T1H	105 ms
1783-US6T2TG2F	100 ms
1783-US6T2TG2H	100 ms
1783-US8TG2GX	100 ms
1783-US16T	42 ms
1783-US16T2S	42 ms

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Stratix 2000 Ethernet Unmanaged Switches Installation Instructions, publication 1783-IN003	Describes how to install Stratix 2000 switches.
Stratix Ethernet Device Specifications Technical Data, publication 1783-TD001	Provides specification information for Stratix 2000 switches and other Ethernet devices.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

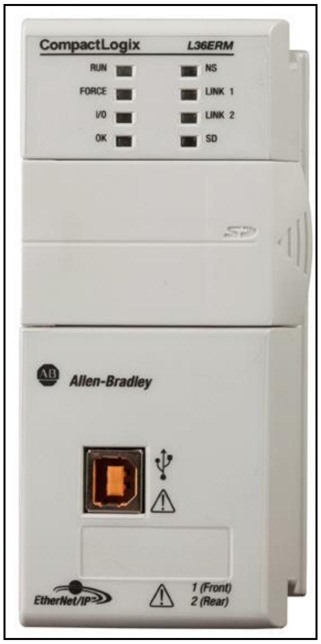
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1783-UM011B-EN-P - September 2017
Supersedes Publication 1783-UM011A-EN-P - April 2017

PLC-PROGRAMMABLE LOGIC CONTROL

PLC Processor Part #2754692

Allen Bradley 1769-L36ERM, CompactLogix 5370 L3

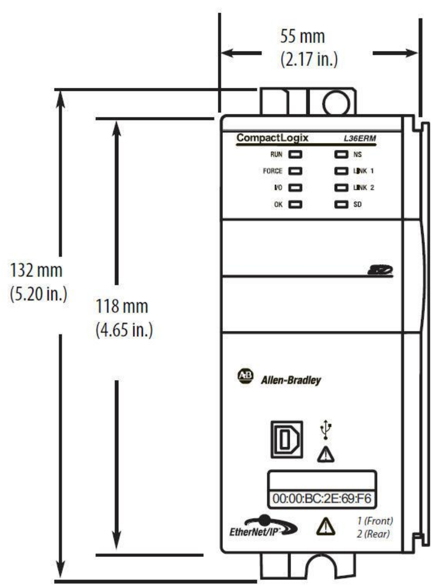


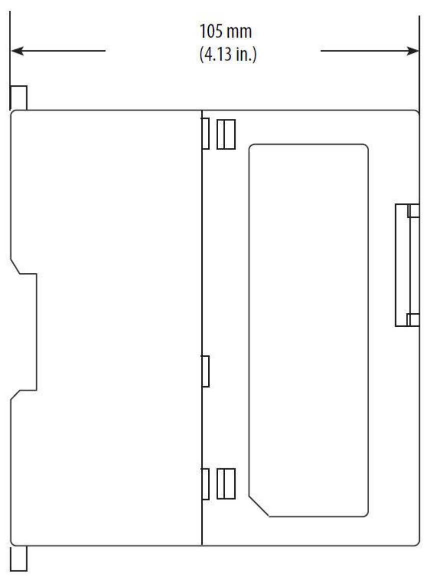
Specifications:

- **User Memory: 5** MB
- **Secure Digital Memory Card:** 1 GB (standard); 2 GB (optional)
- **Communication Ports:** Dual-port Ethernet DLR, USB
- **Communication Options:** DeviceNet with 1769-SDN
- **Module Expansion Capacity:** Up to 16 Compact I/O modules and 32 Ethernet nodes
- **Power Supply Distance Rating:** 4 modules
- **Operating Temperature:** 32…140°F (0…60°C)
- **Storage Temperature:** -40…185°F (-40…85°C)
- **Surrounding Air Temperature (max.):** 140°F (60°C)
- **Relative Humidity:** 5…95% non-condensing
- **Vibration:** 5g @10...500 Hz
- **Operating Shock:** 20 g (DIN rail); 30 g (Panel)
- **Non-operating Shock:** 30 g (DIN rail); 40 g (Panel)
- **Weight:** 10.93 oz (0.31 kg)

Certifications:

- UL Listed Industrial Control Equipment for US & Canada, File E65584
- UL Listed for Class I, Div II Group A,B,C,D Hazardous Locations US & Canada, File E194810
- European Union 2004/108/EC EMC Directive compliant with EN 61326-1, EN61000-6-2, EN 61000-6-4, EN 61131-2
- Australian Radiocommunications Act compliant with AS/NZS CISPR 11
- European Union 94/9/EC ATEX Directive compliant with EN 60079-15, EN 60079-0, II 3 G Ex nA IIC T5 X





Power Supply

Part # 2701833

Allen Bradley, CompactLogix

Cat. No. 1769-PA4

Allen Bradley CompactLogix Programmable Logic Controllers feature input filtering, optical isolation, and build-in surge protection to enhance the reliability of operation in noisy industrial environments. Certified to C-UL (under CSA C22.2 No. 142), UL 508, CE. Features include:

- Short circuit protection
- Class 1 Div2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No 213)

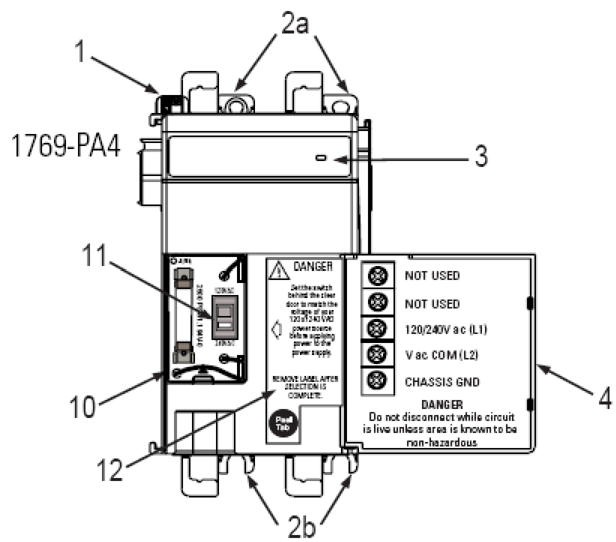
Line Voltage	Bus Current Capacity at 5V (0 to+55 °C)	Bus Current Capacity at 24V (0 to+55 °C)	User Current Capacity	Inrush Current, Max
85…132/170…250V AC, 47…63Hz	4A at 5 VDC	2A at 24 VDC	N/A	25A at 132 VAC 40A at 265 VAC

Shock		
Operating (Non-Relay)	**Relay Operation**	**Non-Operating**
30G panel mounted (20G DIN rail mounted)	7.5G panel mounted (5G DIN rail mounted)	40G panel mounted (30G DIN rail mounted)

Vibration		Temperature range		Operating Humidity
Operating	**Relay Operation**	**Operating**	**Storage**	
10 to 500Hz, 5G, 0.030 in. max. peak-to-peak	2G	0 to +60 °C (32 to 140 °F)	-40 to +85 °C (-40 to 185 °F)	5 to 95% without condensation

Power Supply

Allen Bradley, CompactLogix

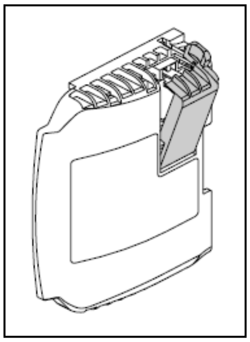


Item	Description
1	bus lever (with locking function)
2a	upper panel mounting tabs
2b	lower panel mounting tabs
3	green power LED
4	power supply door with terminal identification label
5a	movable bus connector with female pins
5b	stationary bus connector with male pins
6	nameplate label
7a	upper tongue-and-groove slots
7b	lower tongue-and-groove slots
8a	upper DIN rail latches
8b	lower DIN rail latches
9	terminal block with finger-safe cover
10	fuse housing cover for replaceable fuse
11	120V ac or 240V ac line input power selector switch (PA4 only)
12	selector switch label (PA4 only)

End Cap, Right
Part # 2701823

Allen Bradley, CompactLogix

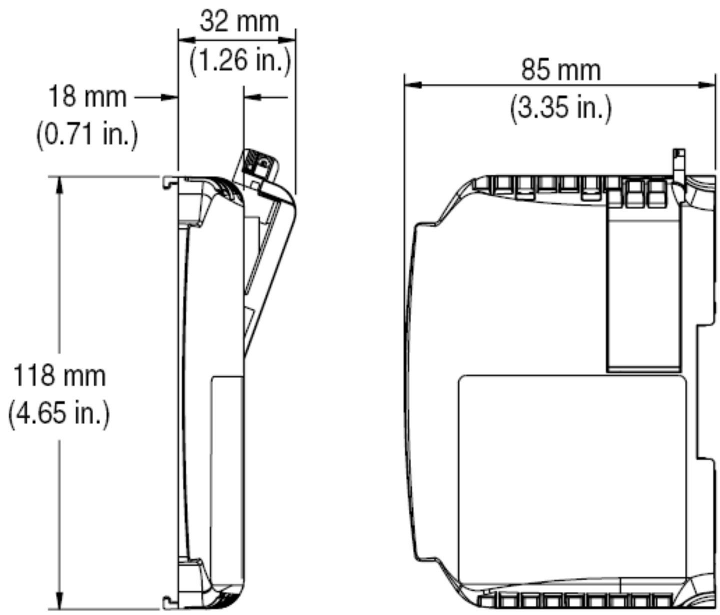
Cat. No. 1769-ECR



The final module of each Compact I/O system must be an end cap. It provides termination for the system. There are left end caps for terminating the left-most slot, if applicable.

Vibration, Operating	Temperature Range		Humidity, Operating
	Operating	Storage	
10…500Hz, 5G, 0.030" max peak-to-peak	0 to 60 °C (32 to 140 °F)	-40 to 85 °C (-40 to 185 °F)	5…95% without condensation

Bus Current Draw	Shock		
	Operating (Non-Relay)	Operating (Relay contact)	Non-Operating
5mA at 5VDC	30G panel mounted 20G DIN rail mounted	7.5G panel mounted 5G DIN rail mounted	40G panel mounted 30G DIN rail mounted



Digital I/O Module

Part # 2701824

Allen Bradley, CompactLogix, 100/120V AC

Cat. No. 1769-IA16

Allen Bradley CompactLogix Programmable Logic Controllers feature input filtering, optical isolation, and build-in surge protection to enhance the reliability of operation in noisy industrial environments. Certified to C-UL (under CSA C22.2 No. 142), UL 508, CE. Features include:

- Terminal identification diagrams on each module
- LEDs indicate the status of each I/O point
- Digital and field circuits are isolated
- Class 1 Div2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No 213)

Voltage Category	**Operating Voltage**	**Number of Inputs**	**Points per Common**	**Bus Current Draw**	
				5V	**24V**
100/120V AC	79…132V AC at 47…63Hz	16	16	115mA	0mA

Voltage, Off-State input, max	**Input Current Min.**	**Current, Off-State Input, Max**	**Signal Off Delay, Max**
20V AC	5mA at 79V AC	2.5mA	20ms

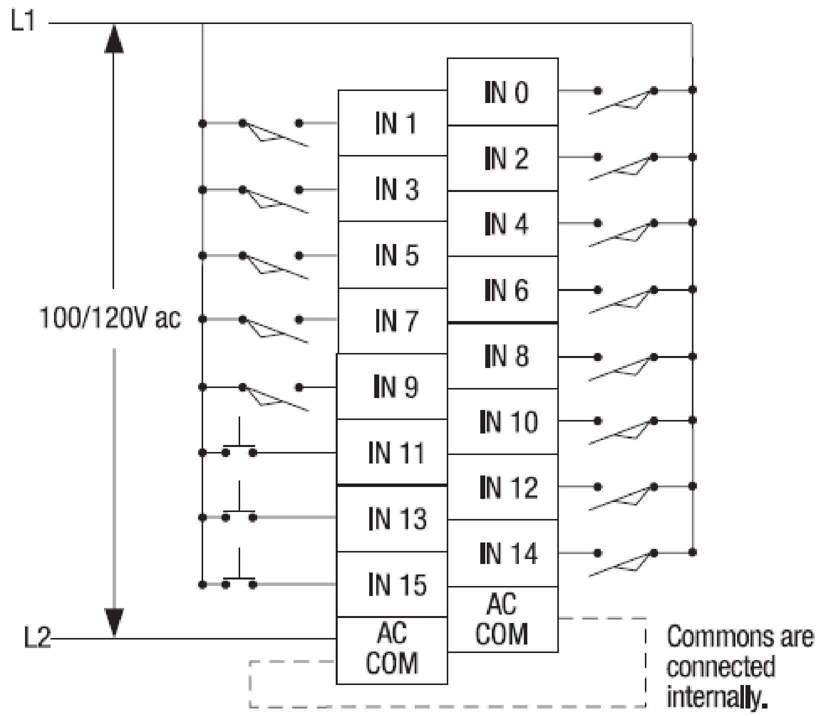
Shock		
Operating (Non-Relay)	**Relay Operation**	**Non-Operating**
30G panel mounted (20G DIN rail mounted)	7.5G panel mounted (5G DIN rail mounted)	40G panel mounted (30G DIN rail mounted)

Vibration		**Temperature range**		
Operating	**Relay Operation**	**Operating**	**Storage**	**Humidity**
10 to 500Hz, 5G, 0.030 in. max. peak-to-peak	2G	0 to +60 °C (32 to 140 °F)	-40 to +85 °C (-40 to 185 °F)	5 to 95% without condensation

Digital I/O Module

Allen Bradley, CompactLogix, 100/120V AC

Wiring Diagram



Digital I/O Module

Part # 2701834

Allen Bradley, CompactLogix, Relay Output

Cat. No. 1769-OW16

Allen Bradley CompactLogix Programmable Logic Controllers feature input filtering, optical isolation, and build-in surge protection to enhance the reliability of operation in noisy industrial environments. Certified to C-UL (under CSA C22.2 No. 142), UL 508, CE. Features include:

- Terminal identification diagrams on each module
- LEDs indicate the status of each I/O point
- Digital and field circuits are isolated
- Class 1 Div2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No 213)

Voltage Category	Operating Voltage Ranges	Number of Outputs	Points per Common	Bus Current Draw	
				5V	24V
AC/DC normally open relay	5 to 265 VAC 5 to 125 VDC	16	8	205mA	180mA

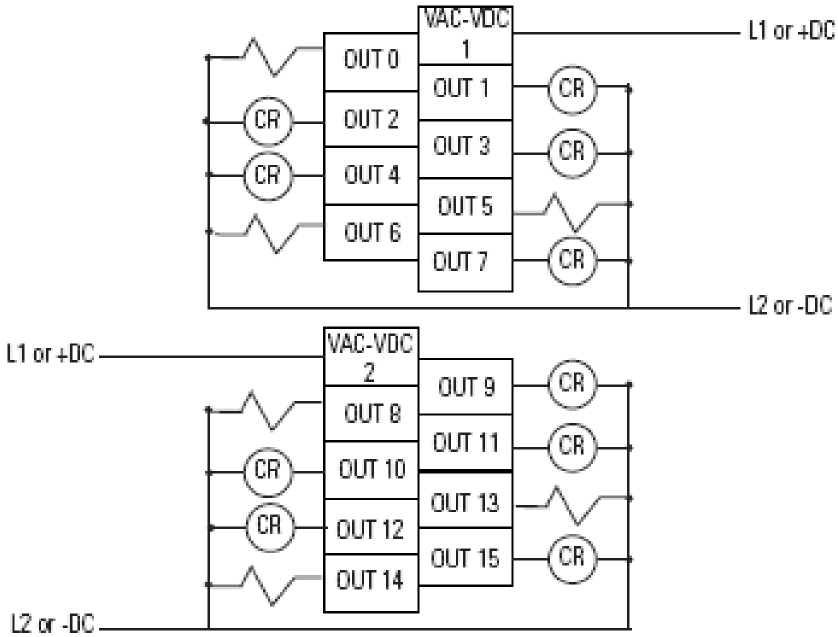
Off-State Leakage, max	On-State Current Min.	Power Supply Distance, max.
0 mA	10mA at 5 VDC	8

Continuous Current per Point (max)	Continuous Current per Common (max)	Continuous Current per Module (max)	Signal Delay, Max
2.5A	10A	20A	turn on = 10ms turn off = 10ms

Shock		
Operating	Relay Operation	Non-Operating
30G panel mounted (20G DIN rail mounted)	10G panel mounted (5G DIN rail mounted)	40G panel mounted (30G DIN rail mounted)

Vibration		Temperature range		
Operating	Relay Operation	Operating	Storage	Humidity
10 to 500Hz, 5G, 0.030 in. max. peak-to-peak	2G	0 to +60 °C (32 to 140 °F)	-40 to +85 °C (-40 to 185 °F)	5 to 95% without condensation

Wiring Diagram



Analog Input Module
Part # 2701835

Allen Bradley, CompactLogix

Cat. No. 1769-IF8

Allen Bradley CompactLogix Programmable Logic Controllers feature input filtering, optical isolation, and build-in surge protection to enhance the reliability of operation in noisy industrial environments. Certified to C-UL (under CSA C22.2 No. 142), UL 508, CE. Features include:

- Terminal identification diagrams on each module
- LEDs indicate the status of each I/O point
- Digital and field circuits are isolated
- Class 1 Div2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No 213)

Operating Ranges	Full Scale Analog Ranges	Number of Inputs	Bus Current Draw	
			5V	24V
±10VDC 0 to 10VDC 0 to 5VDC 1 to 5 VDC 0 to 20mA 4 to 20mA	±10.5VDC 0 to 10.5VDC 0 to 5.25VDC .5 to 5.25 VDC 0 to 21mA 3.2 to 21mA	8	120mA	70mA

Response Speed per Channel	Overall Accuracy
Filter and configuration dependent in software	Voltage Terminal: ±0.2% full scale at 25 °C Current Terminal: ±0.35% full scale at 25 °C

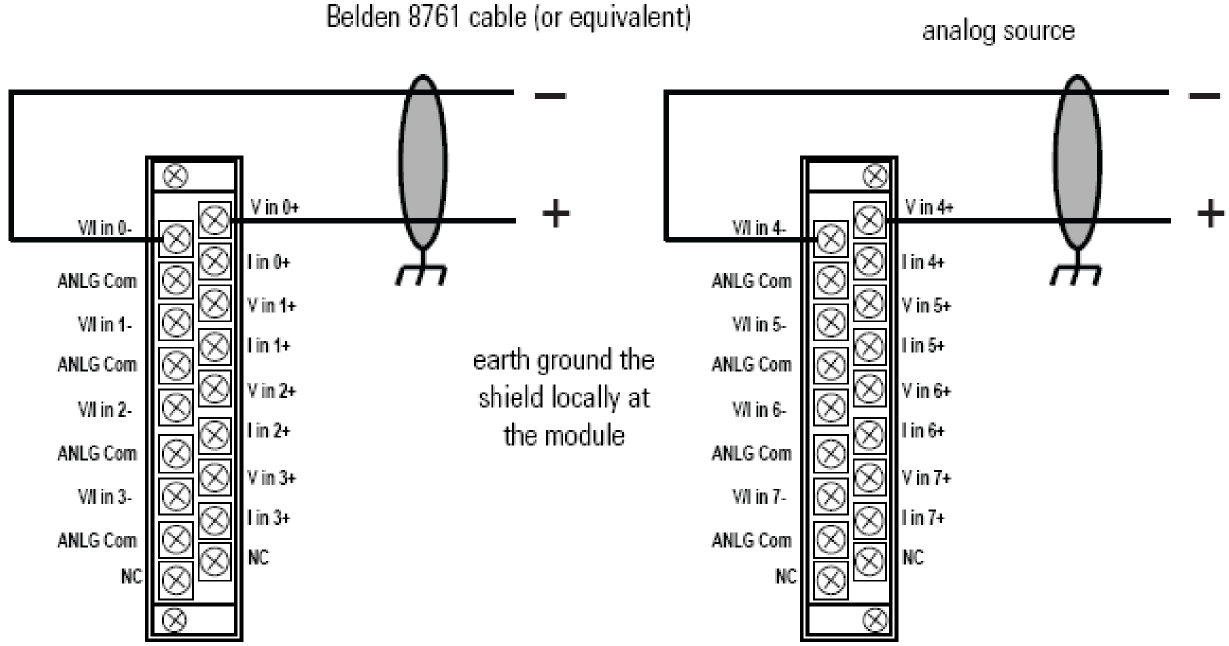
Input Impedance	Shock	
	Operating	Non-Operating
Voltage Terminal: 220K Ohm (typical) Current Terminal: 250 Ohm	30G panel mounted (20G DIN rail mounted)	40G panel mounted (30G DIN rail mounted)

Vibration, Operating	Temperature range		Humidity, Operating
	Operating	Storage	
10 to 500Hz, 5G, 0.030 in. max. peak-to-peak	0 to +60 °C (32 to 140 °F)	-40 to +85 °C (-40 to 185 °F)	5 to 95% without condensation

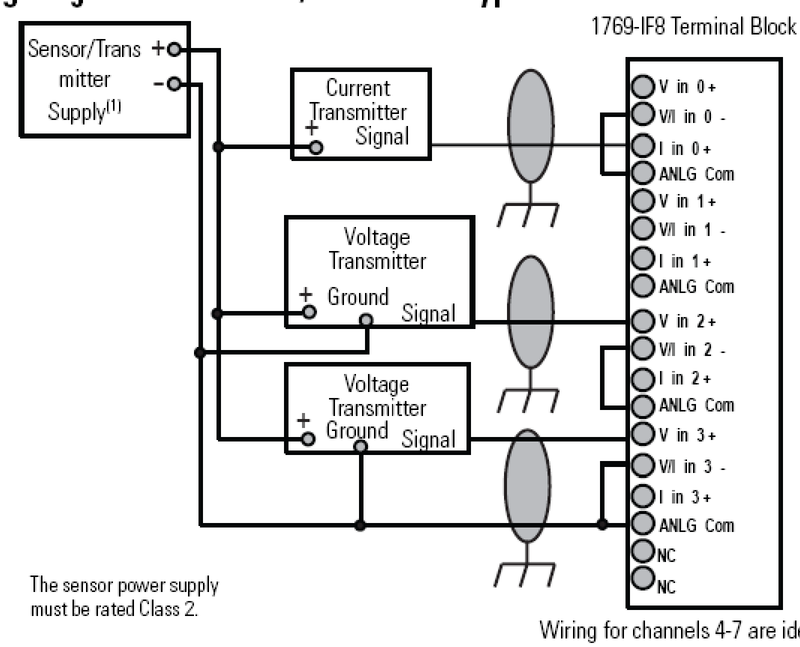
Wiring Diagrams

Analog Input Module

Allen Bradley, CompactLogix



Wiring Single-Ended Sensor/Transmitter Types

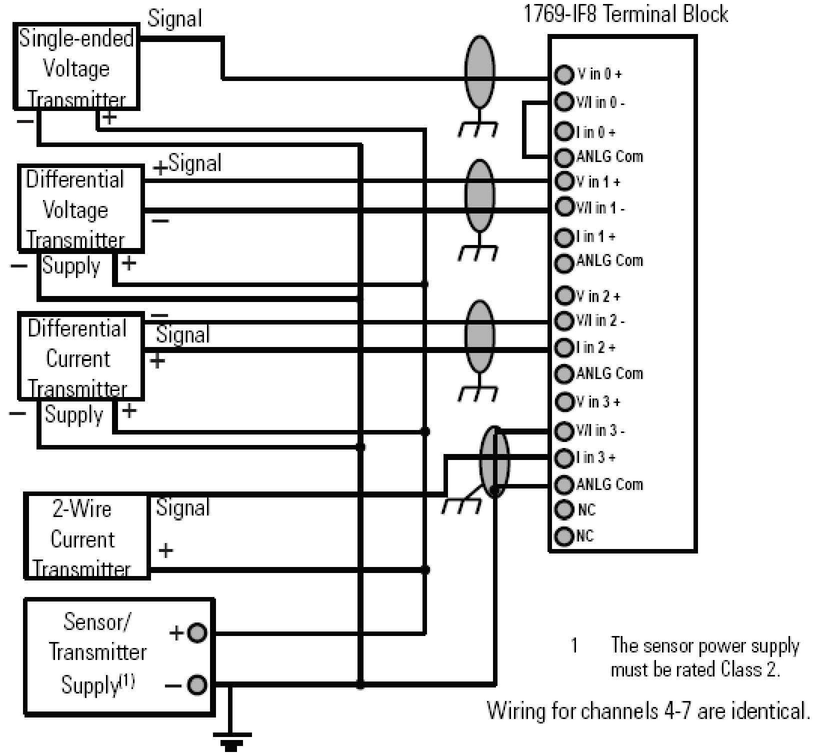


1 The sensor power supply must be rated Class 2.

Wiring for channels 4-7 are identical.

Allen Bradley, CompactLogix

Wiring Mixed Transmitter Types



Analog Output Module

Part # 2702282

Allen Bradley, CompactLogix

Cat. No. 1769-OF8C

Allen Bradley CompactLogix Programmable Logic Controllers feature input filtering, optical isolation, and build-in surge protection to enhance the reliability of operation in noisy industrial environments. Certified to C-UL (under CSA C22.2 No. 142), UL 508, CE. Features include:

- Terminal identification diagrams on each module
- LEDs indicate the status of each I/O point
- Digital and field circuits are isolated
- Class 1 Div2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No 213)

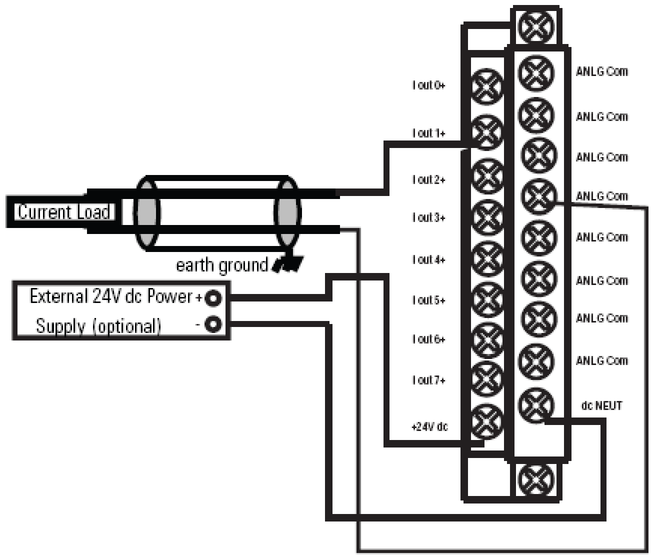
Operating Ranges	**Full Scale Analog Ranges**	**Number of Outputs**	**Bus Current Draw**	
			5V	**24V**
0 to 20mA 4 to 20mA	0 to 21mA 3.2 to 21mA	8	145mA	160mA

Conversion Rate (all channels) max.	**Step Response to 63%**	**Overall Accuracy**	**Digital Resolution Across Full Range**
5ms	<2.9ms	±0.35% full scale at 25°C	+4 to +20mA: 15.59 bits, 0.323μA/bit 0 to +20mA: 15.91 bits, 0.323μA/bit

Resistive Load on Current Output	**Max. Inductive Load**	**Shock**	
		Operating	**Non-Operating**
0 to 500 Ohm (includes wire resistance)	0.1mH	30G panel mounted (20G DIN rail mounted)	40G panel mounted (30G DIN rail mounted)

Vibration, Operating	**Temperature range**		**Humidity, Operating**
	Operating	**Storage**	
10 to 500Hz, 5G, 0.030 in. max. peak-to-peak	0 to +60 °C (32 to 140 °F)	-40 to +85 °C (-40 to 185 °F)	5 to 95% without condensation

Wiring Diagram



POWER SUPPLY

Power Supply Part # 2751312

Allen Bradley

Cat. No. 1606-XLP100E

Allen-Bradley Power Supply units provide a large amount of highly reliable power flow for a very small unit size. Features include:

- Quick mounting and connecting
- World-wide industry approvals
- Very compact design (WxHxD = 73x75x103mm)
- Output voltage adjustable to DC 28V
- 100…240V Auto Select Input (AC 85…264V permitted)
- 1.9 times nominal current

• Input	
Input voltage	AC 100...120/220...240V (Auto Select), 47...63 Hz (AC 85...132V / AC 184...264V, DC 220...375V)
Input current	<2.1A (@ AC 100V_{in}, 100W P_{out}) <1A (@ AC 220V_{in}, 100W P_{out})
External fusing	Unit has internal (not accessible) input fuse. No other protection required. In order to meet local requirements, please consult local codes and regulations for proper installation.
Transient immunity	Transient resistance acc. to VDE 0160 / W2 (750V/ 1.3 ms), over entire load range
Hold-up time (see diagram below)	>40 ms @ AC 230V, 24.5V / 4.2A >20 ms @ AC 196V, 24.5V / 4.2A >20 ms @ AC 100V, 24.5V / 4.2A

• Efficiency, Reliability	
Efficiency	typ. 90% (AC 230V, 24.5V / 4.2A) (see also diagram below)
Losses	typ. 11.4W (AC 230V, 24.5V / 4.2A)
MTBF (Reliability)	appr. 500.000 h acc. to Siemensnorm SN 29500 (24.5V / 4.2A, AC 230V, T_{amb} = +40 °C)

Prior to shipment, *every* unit undergoes the following tests in order to isolate any defective units which might suffer an early failure:

- Run-in / burn-in (Full load, T_{amb} = +60°C, on/off cycle)
- Functional test (100 %)

• Construction, Mechanics, Installation

Robust plastic housing (US Patent No. D442, 923S), fine ventilation grid on three housing sides to keep out small parts (e.g. screws), IP20

Dimensions and weight	
• W x H x D	73 mm x 75 mm x 103 mm (+ DIN rail) Depth incl. terminals: 98 mm (+ DIN rail)
• Weight	360 g
Mounting orientation	 ,  or  (cf. 'Output')
Ventilation/Cooling	Normal convection, no fan required
• Free space f. cooling	recom'd.: 25 mm on sides with ventilation grid

Easy snap-on mounting onto the DIN-rail (TS35/7,5 or TS35/15).
Unit sits safely and firmly on the rail; no tools required even to remove

Connection	by Spring Clamp terminals; uniformly firm hold, vibration-resistant and maintenance-free: 2 terminals per output
• Wire strip length	6 mm (0.24 in) recommended
• Wire Size Input/Output	Stranded 28...12 AWG (0.3...2.5 mm²), Solid 28...12 AWG (0.3...4 mm²)

Design details – for your advantage:

- All terminals are easy to reach as mounted on the front panel.
- Input and output are strictly apart from each other (input below, output above) and so cannot be mixed up.
- **Mounting *and* connection do not require any screwdriver**

→ Easy, quick, durable and reliable installation.

• Output	
Output voltage • preset	DC 24...28V (adj. by front panel potentiometer) 24.5V ± 0.5% @ 4.2A
Voltage regulation	static <1% V_{out} (Jumper in pos. 'Single Use') static <3% V_{out} (Jumper in pos. 'Parallel Use'), dynamic ±1.5% V_{out} over all
Ripple/Noise	<50mV$_{PP}$ (20 MHz bandwidth, 50 Ω measurement)
Overvoltage prot. (OVP)	<36V
Output noise suppression	Radiated EMI values below EN50081-1, even when using long (>2m), unscreened output cables
Rated continuous loading	up to 4.2A @ 24.5V / 3.6A @ 28V (convection cooling), depending on built-in orientation, V_{in} and T_{amb} For details see derating diagram below
Overload behavior	No switch-off at overload/short-circuit, instead: up to 1.9 · $I_{rated.}$ So you need no oversizing to start awkward loads.
Protection	Unit is protected against (also permanent) short-circuit, overload and open-circuit.
Derating	depending on built-in orientation; see diagram below
Parallel operation	yes (selectable by front panel jumper)
Power back immunity	35V
Operating indicator	Green LED

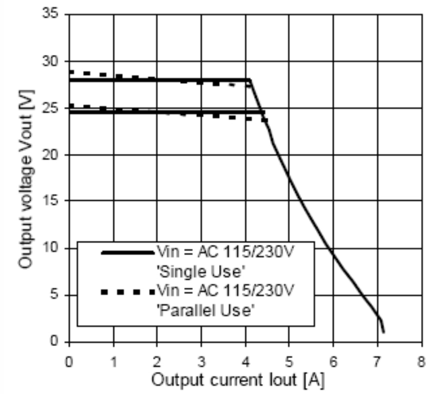
• Environmental Data, EMC, Safety

Ambient temperature range (measured 25 mm below unit)	
• storage/transport	-25°C ... +85°C
• operation	-10°C ... +70°C (for derating see diagram below)
Humidity	max. 95% (without condensation)
Electromagnetic emissions (EME)	EN 50081-1 (includes EN 50081-2) Class B (EN 55011, EN 55022) incl. Annex A thanks to noise suppression EN 61000-3-2 (PFC)
Electromagnetic immunity (EMI)	EN 61000-6-2 (includes EN 55024)
Safe low voltage:	SELV (EN 60950, VDE0100/T.410), PELV (EN 50178)
Prot. class/degree:	Class 1 (EN 60950) / IP20 (EN 60529)

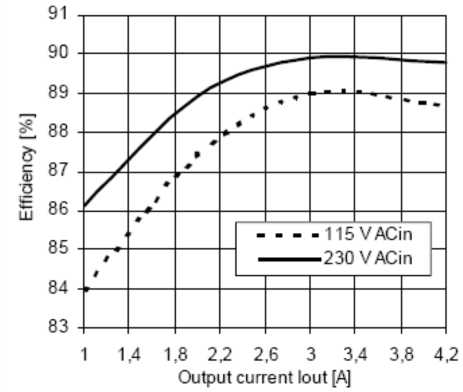
The PSU complies with all major **safety approvals** for EU (EN 60 950, EN 60204-1, EN 50178), USA (UL 60950, E137006, UL508 LISTED, E198865), Canada (CAN/CSA-C22.2 No 60950 [CUR], CAN/CSA-C22.2 No. 14 [CUL]).

Operation on IT networks: The unit is designed to operate on IT networks. The unit may still deliver a hazardous voltage after the fuses are tripped.

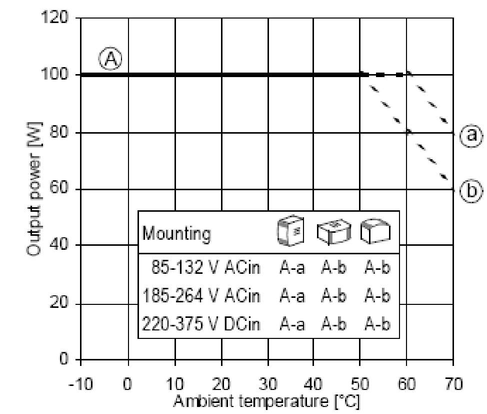
Output characteristic V_{out}/I_{out} (min.)



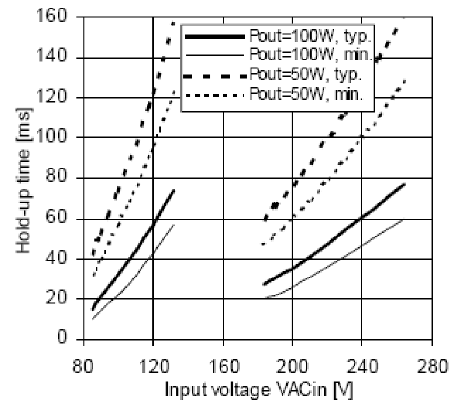
Efficiency (@ V_{out} = 24.5V, typ.)



Derating of output power



Hold-up time with ACin (at V_{out} = 24.5V, typ. + min.)



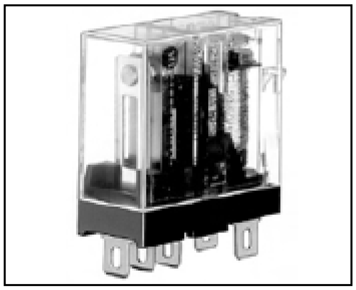
RELAY CONTROL

Relay

Part # **2700940**

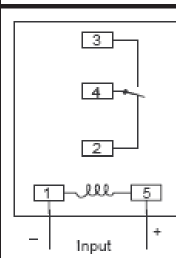
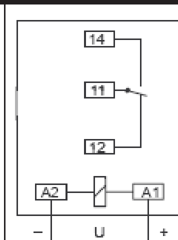
Allen Bradley 700-HK36A1-4, 120VAC Coil, SPDT w/Indicating LED

Cat. No. 700-HK36A1-4



Allen Bradley Interposing/Isolation Relays feature small size as well as a reduction in time, resulting an extremely efficient overall electrical circuit.

Type	Interposing/Isolation Relay
Features	Optional Pilot Light, Built-in Retainer Clip, Low Switching Capacity
Contact Ratings	
Contact Form	SPDT, DPDT
Contact Type	Single
Contact Material	AgCdO, AgCd+Gold
Max. operating current under resistive load	5 A (DPDT), 10 A (SPDT)
Min. permissible load	10V 50 mA (Silver), 5V 10 mA (Gold)
Coil Ratings	
Coil Voltage	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V
Permissible Coil Voltage Variation	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC
Electrical Ratings	
Dielectric Withstand Voltage	Pole-to-pole: 1500V AC Contact-to-coil: 1500V AC Contact-to-frame: 1500V AC
Electric Service Life (cycles)	100,000 minimum
Reference	
Approvals	CE, UL, UR, CSA
Socket Type	700-HN121 700-HN122
Page Number	page 9-46

Description	**Contact Rating**	**Wiring Diagrams**	
		U.S./Canada	**International**
SPDT 1 Pole 1 Form C AgCdO Contacts Socket	10A	 *700-HN121*	 *700-HN121*

Relay   Part # **2700940**

Allen Bradley 700-HK36A1-4, 120VAC Coil, SPDT w/Indicating LED

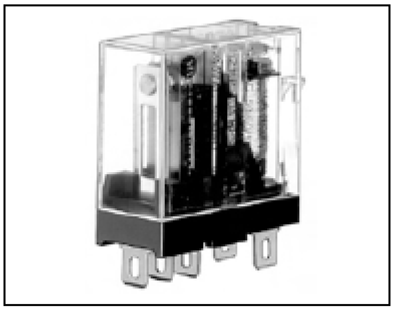
		Cat. No. 700-HK...					
Electrical Ratings							
Pilot Duty Rating†		B300					
Rated Thermal Current (I_{th})		1-Pole — 10 A			2-Pole — 5 A		
Rated Insulation Voltage (U_i)		250V IEC, 300V UL/CSA					
Contacts	Inductive	1-Pole		HP	2-Pole		HP
Contacts		▶][◀	◀][▶		▶][◀	◀][▶	
Contacts	120V AC, 1-phase	30 A	3 A	1/3	30 A	3 A	1/6
Contacts	240V AC, 1-phase	15 A	1.5 A	1/2	15 A	1.5 A	1/3
Contacts	General Purpose	10 A, 240V AC			5 A, 240V AC		
Contacts	Resistive	10 A, 30V DC			5 A, 30V DC		
Min. Permissible Contact Ratings		700-HK = 500 mW, 700-HKX = 50 mW					
Permissible Coil Voltage Variation		80…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC					
Sealed Power Consumption ±10%	AC Coils	Max. Allowable Leakage OFF 25% of VA‡					
Sealed Power Consumption ±10%	AC Coils	1.1 VA 50 Hz 0.9 VA 60 Hz					
Sealed Power Consumption ±10%	DC Coils	Max. Allowable Leakage of 10% of W 0.53 W					
Design Specification/Test Requirements							
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500V AC					
Dielectric Withstand Voltage	Contact to Coil (VRMS)	1500V AC					
Mechanical							
Degree of Protection		Open Type (Sockets)					
Mechanical Life Operations		5 x 10^6					
Switching Frequency Operations		1800/hr.					
Coil Voltages		See Overview/Product Selection					
Operating Time at Nominal Voltage at 20 °C (ms)	Pickup	15					
Operating Time at Nominal Voltage at 20 °C (ms)	Dropout	15					
Maximum Operating Rate		3 Ops/s					
Vibration	Mechanical	10…55 Hz, 1.50 mm (0.6 in.) double amplitude					
Vibration	Malfunction	10…55 Hz, 1.50 mm (0.6 in.) double amplitude					
Shock	Mechanical	100 G					
Shock	Malfunction	20 G (energized) 10 G (de-energized)					
Max. Socket Torque		0.8 Nm (7 lb. - in.)					
Environmental							
Temperature	Operating	–30…+55 °C (–22…+131 °F)					
Temperature	Storage	–55…+85 °C (–67…+185 °F)					
Altitude		2000 m (6560 ft)					
Construction							
Insulating Material		Molded High Dielectric Material					
Enclosure		Transparent Dust Cover					
Contact Material		Silver Cad. Ox., (AgCdO), Silver Cad. + Gold (AgCd + Au)					
Terminal Markings on Socket		In accordance with EN50 0005					
Sockets		**1-Pole**			**2-Pole**		
Sockets		700-HN121			700-HN122		
Approvals							
Certifications		CSA Certified, File LR75086, UL Recognized, File E3125 Guide NLDX 2,UL Listed, with Allen-Bradley Sockets, CE-Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC)					
Standards		IEC 255-1-00, IEC 255-23, CSA 22.2, UL 508					

Relay

Part # 2701127

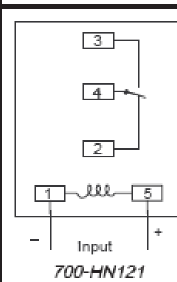
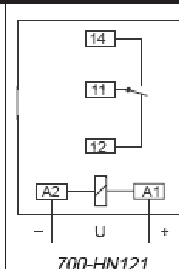
Allen Bradley, 24VDC, SPDT W/ Indicating LED

Cat. No. 700-HK36Z24-4



Allen Bradley Interposing/Isolation Relays feature small size as well as a reduction in time, resulting an extremely efficient overall electrical circuit.

Type	Interposing/Isolation Relay
Features	Optional Pilot Light, Built-in Retainer Clip, Low Switching Capacity
Contact Ratings	
Contact Form	SPDT, DPDT
Contact Type	Single
Contact Material	AgCdO, AgCd+Gold
Max. operating current under resistive load	5 A (DPDT), 10 A (SPDT)
Min. permissible load	10V 50 mA (Silver), 5V 10 mA (Gold)
Coil Ratings	
Coil Voltage	**AC:** 6V, 12V, 24V, 120V, 240V **DC:** 6V, 12V, 24V, 48V, 110V
Permissible Coil Voltage Variation	85…110% of Nominal Voltage at 50 Hz 85…110% of Nominal Voltage at 60 Hz 80…110% of Nominal Voltage at DC
Electrical Ratings	
Dielectric Withstand Voltage	Pole-to-pole: 1500V AC Contact-to-coil: 1500V AC Contact-to-frame: 1500V AC
Electric Service Life (cycles)	100,000 minimum
Reference	
Approvals	CE, UL, UR, CSA
Socket Type	700-HN121 700-HN122
Page Number	page 9-46

Description	Contact Rating	Wiring Diagrams	
		U.S./Canada	International
SPDT 1 Pole 1 Form C AgCdO Contacts Socket	10A		

Relay

Part # 2701127

Allen Bradley, 24VDC, SPDT W/ Indicating LED

		Cat. No. 700-HK...					
Electrical Ratings							
Pilot Duty Rating†		B300					
Rated Thermal Current (I_{th})		1-Pole — 10 A			2-Pole — 5 A		
Rated Insulation Voltage (U_i)		250V IEC, 300V UL/CSA					
Contacts	Inductive	1-Pole		HP	2-Pole		HP
		▶][◀	◀][▶		▶][◀	◀][▶	
	120V AC, 1-phase	30 A	3 A	1/3	30 A	3 A	1/6
	240V AC, 1-phase	15 A	1.5 A	1/2	15 A	1.5 A	1/3
	General Purpose	10 A, 240V AC			5 A, 240V AC		
	Resistive	10 A, 30V DC			5 A, 30V DC		
Min. Permissible Contact Ratings		700-HK = 500 mW, 700-HKX = 50 mW					
Permissible Coil Voltage Variation		80...110% of Nominal Voltage at 50 Hz 85...110% of Nominal Voltage at 60 Hz 80...110% of Nominal Voltage at DC					
Sealed Power Consumption ±10%	AC Coils	Max. Allowable Leakage OFF 25% of VA‡					
		1.1 VA 50 Hz 0.9 VA 60 Hz					
	DC Coils	Max. Allowable Leakage of 10% of W 0.53 W					
Design Specification/Test Requirements							
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500V AC					
	Contact to Coil (VRMS)	1500V AC					
Mechanical							
Degree of Protection		Open Type (Sockets)					
Mechanical Life Operations		5×10^6					
Switching Frequency Operations		1800/hr.					
Coil Voltages		See Overview/Product Selection					
Operating Time at Nominal Voltage at 20 °C (ms)	Pickup	15					
	Dropout	15					
Maximum Operating Rate		3 Ops/s					
Vibration	Mechanical	10...55 Hz, 1.50 mm (0.6 in.) double amplitude					
	Malfunction	10...55 Hz, 1.50 mm (0.6 in.) double amplitude					
Shock	Mechanical	100 G					
	Malfunction	20 G (energized) 10 G (de-energized)					
Max. Socket Torque		0.8 Nm (7 lb. - in.)					
Environmental							
Temperature	Operating	–30...+55 °C (–22...+131 °F)					
	Storage	–55...+85 °C (–67...+185 °F)					
Altitude		2000 m (6560 ft)					
Construction							
Insulating Material		Molded High Dielectric Material					
Enclosure		Transparent Dust Cover					
Contact Material		Silver Cad. Ox., (AgCdO), Silver Cad. + Gold (AgCd + Au)					
Terminal Markings on Socket		In accordance with EN50 0005					
Sockets		**1-Pole**			**2-Pole**		
		700-HN121			700-HN122		
Approvals							
Certifications		CSA Certified, File LR75086, UL Recognized, File E3125 Guide NLDX 2,UL Listed, with Allen-Bradley Sockets, CE-Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC)					
Standards		IEC 255-1-00, IEC 255-23, CSA 22.2, UL 508					

Relay Socket

Part # 2751476

Allen Bradley

Cat. No. 700-HN221

These sockets provide a convenient mounting and wiring means for the Allen Bradley relays.

Features include:

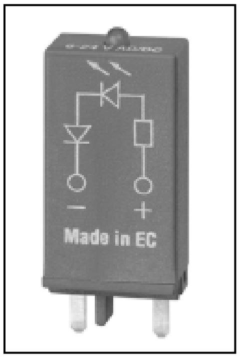
- Panel or DIN mounting
- Screw terminal type
- 5 pin blade
- For use with 1 pole 700-HK relays
- Finger-safe terminals

Surge Suppressor

Part # 2750942

Allen Bradley

Cat. No. 700-AR2



These Allen Bradley surge suppressors are designed to be used with 700-HN153 sockets.

Features include:

- R-C type suppressor
- 110…240V AC/DC

TERMINAL BLOCK & ACCESSORIES

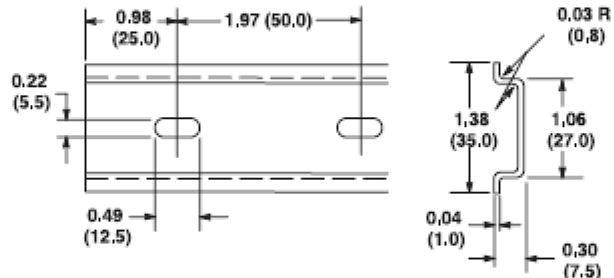
Terminal Block Accessory Part # **2609910**

Allen Bradley 1492-DR5

Cat. No. 1492-DR5

Symmetrical Rail
35 mm x 7.5 mm
2.26” (57.4 mm) high
3.28’ (1 m) long
Copper-Free
Aluminum

For 1492 Terminal Blocks Only

Pcs./Pkg.	Dimensions*
10	 #12–24 or M5 Recommended Maximum Mounting Screw Size

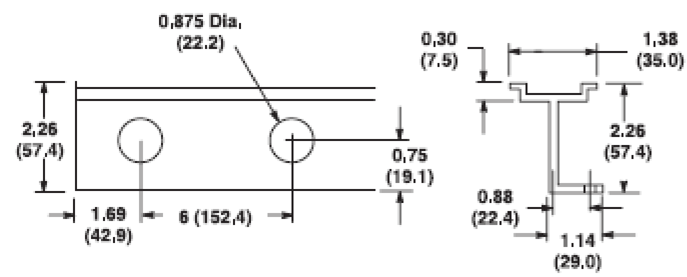
Terminal Block Accessory

Allen Bradley

Cat. No. 1492-DR6

Symmetrical Rail
35 mm x 7.5 mm
2.26” (57.4 mm) high
3.28’ (1 m) long
Copper-Free
Aluminum

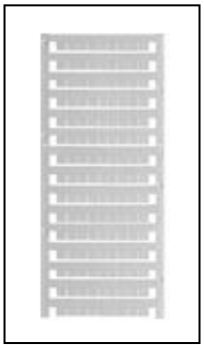
For 1492 Terminal Blocks Only

Pcs./Pkg.	Dimensions*
2	 Wire insulator plug for wire access through rail — use Heyco UB875

IEC Terminal Block Accessory Part # 2751199

Allen Bradley, Snap-In Marker

Cat. No. 1492-M6X12



Allen Bradley Terminal Block Snap-In Marker:

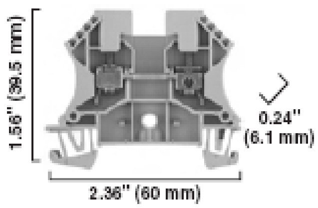
- 5 Pcs / Pkg
- Used with 1492-J, L
- 120 Markers per Card
- White

Terminal Block

Part # 2751299

Allen Bradley, Screw Connection

Cat. No. 1492-J4



Allen Bradley Screw Connection Terminal Block:

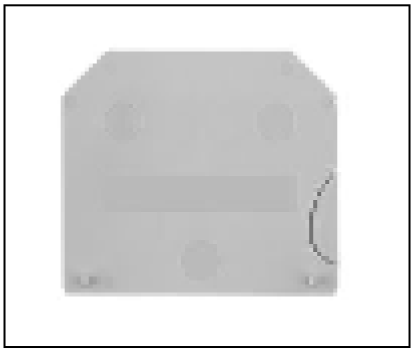
100 Pcs. / Pkg.

Specifications	*Feed-Through Terminal Block*			
Certifications	UR	CSA	IEC	EEx e II
Voltage Rating	600V AC/DC		800V AC/DC	750V AC/DC
Maximum Current	35 A		32 A	26 A
Wire Range (Rated Cross Section)	22… 10 AWG		4 mm²	4 mm² (20… 12 AWG)
Wire Strip Length	0.39 in (10 mm)			
Recommended Tightening Torque	4.4…8.8 lb•in (0.5…1.0 Nm)			
Density (Blocks per ft/meter)	49 per ft/163 per meter			
Housing Temperature Range	–58…+248 °F (–50…+120 °C)			

IEC Terminal Block Accessory Part # 2751302

Allen Bradley, End Barrier

Cat. No. 1492-EBJ3



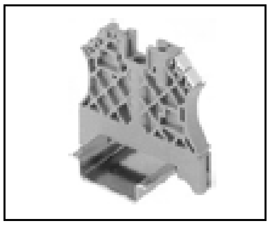
Allen Bradley Terminal Block End Barrier:

- 50 Pcs / Pkg
- Gray
- Used with 1492-J3, J4, J6, J10, J2Q, J3TW, J4M, J3F, JG2Q, JG3, JG3TW, JKD3, JKD3TP, J3P, J3PTP, JTC3…
- Dimensions Width x Length x Height: 0.06 x 1.31 x 2.36in.
  (1.5 x 33.35 x 60 mm)

IEC Terminal Block Accessory Part # 2751304

Allen Bradley, End Anchor

Cat. No. 1492-EAJ35



Allen Bradley Terminal Block End Anchor:

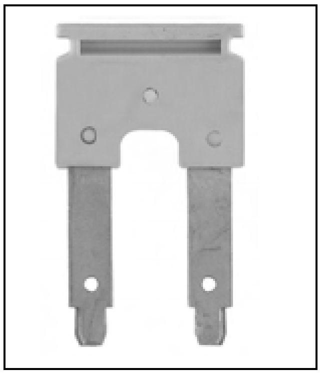
- 100 Pcs / Pkg
- Gray

Dimensions Width x Length x Height	Tightening Torque	Markers	Used With
0.31 x 2.20 x 1.85 in (8 x 56 x 47 mm)	4.4 lb•in (0.5 Nm)	1492-M7X12 1492-M8X5	199-DR1, 199-DR2, 1492-DR4, 1492-DR5, 1492-DR6, 1492-DR7, 1492-DR8, 1492-DR9

IEC Terminal Block Accessory Part # 2751329

Allen Bradley, Screwless Center Jumper

Cat. No. 1492-CJLJ6-10



Pictured representation:
2 pole model, 1492-CJLJ6-2

Allen Bradley Terminal Block Screwless Center Jumper:

- 20 Pcs. / Pkg.
- Used on 1492-J4, J4M
- 10 Pole

UPS-UNINTERRUPTIBLE POWER SUPPLY

Uninterruptable Power Supply Part # 2754116

Schneider Electric, APC - SMT1500C

1500 VA UPS provides back-up AC power to connected control circuits.

Markings:

- UL - Investigated to ANSI / UL 1778 2nd Ed
- cULus

Specifications:

Main	
Main Input Voltage	120 V
Other Input Voltages	110 V - 125 V
Main Output Voltage	120 V
Other Output Voltages	110 V - 125 V
Kilowatt Rating	1000 W
Rated Power	1440 VA
Input Connection Type	NEMA 5 - 15P
Output Connection Type	8 NEMA 5 - 15R
Cable Length	6 ft (1.8 m)
Battery Type	Lead-acid battery
Communication Port Type	SmartConnect Ethernet port, SmartSlot

Batteries and Runtime	
Battery Slots	None
Typical Recharge Time	3 hours
RBC Quantity	1
Battery Life	3 - 5 year(s)
Replacement battery	RBC7
Battery Charge Power (Watts)	136 W rated

General	
Number of power module filled slots	0
Number of power module free slots	0
product web sub-family	Cloud-enabled monitoring
Redundant	No

Uninterruptable Power Supply **Part # 2754116**

Schneider Electric, APC - SMT1500C

Physical	
Height	8.6 in (21.9 cm)
Width	6.7 in (17.1 cm)
Depth	17.3 in (43.9 cm)
Net Weight	54.2 lb_m (24.6 kg)
Mounting Mode	Not rack-mountable
USB compatible	Yes
Input	
Efficiency at full load	75 V - 154 V adjustable (82 V - 144 V)
Input Frequency	50/60 Hz ± 3 Hz auto-sensing
Output	
Harmonic Distortion	Less than 5%
Maximum Configurable Power	1440 VA (1000 W)
Transfer Time	6 ms typical (10 ms maximum)
Topology	Line Interactive
Waveform Type	Sine wave
Output Frequency	50/60 Hz ± 3 Hz sync to mains
Conformance / Environmental	
Product Certifications	cULus, ENERGY STAR V2.0 (USA)
Online Thermal Dissipation	225 Btu/h
Ambient Air Temperature for Operation	32 °F - 104 °F (0 °C - 40 °C)
Relative Humidity	0% - 95%
Communications & Management	
Control panel	Multi-function LCD status and control console
Free slots	1
Alarms	Alarm when on battery, distinctive low batt alarm
Surge Protection and Filtering	
Surge Energy Rating	680 J
Filtering	• Full time multi-pole noise filtering • 0.3% IEEE surge let-through • zero clamping response time

UPS Management Card   Part # 2754115

Schneider Electric, APC - AP9613

UPS management SmartSlot Card with dry contact (relay) support to monitor external UPS environmental sensor triggers and initiate actions on external devices.

<u>Specifications</u>:

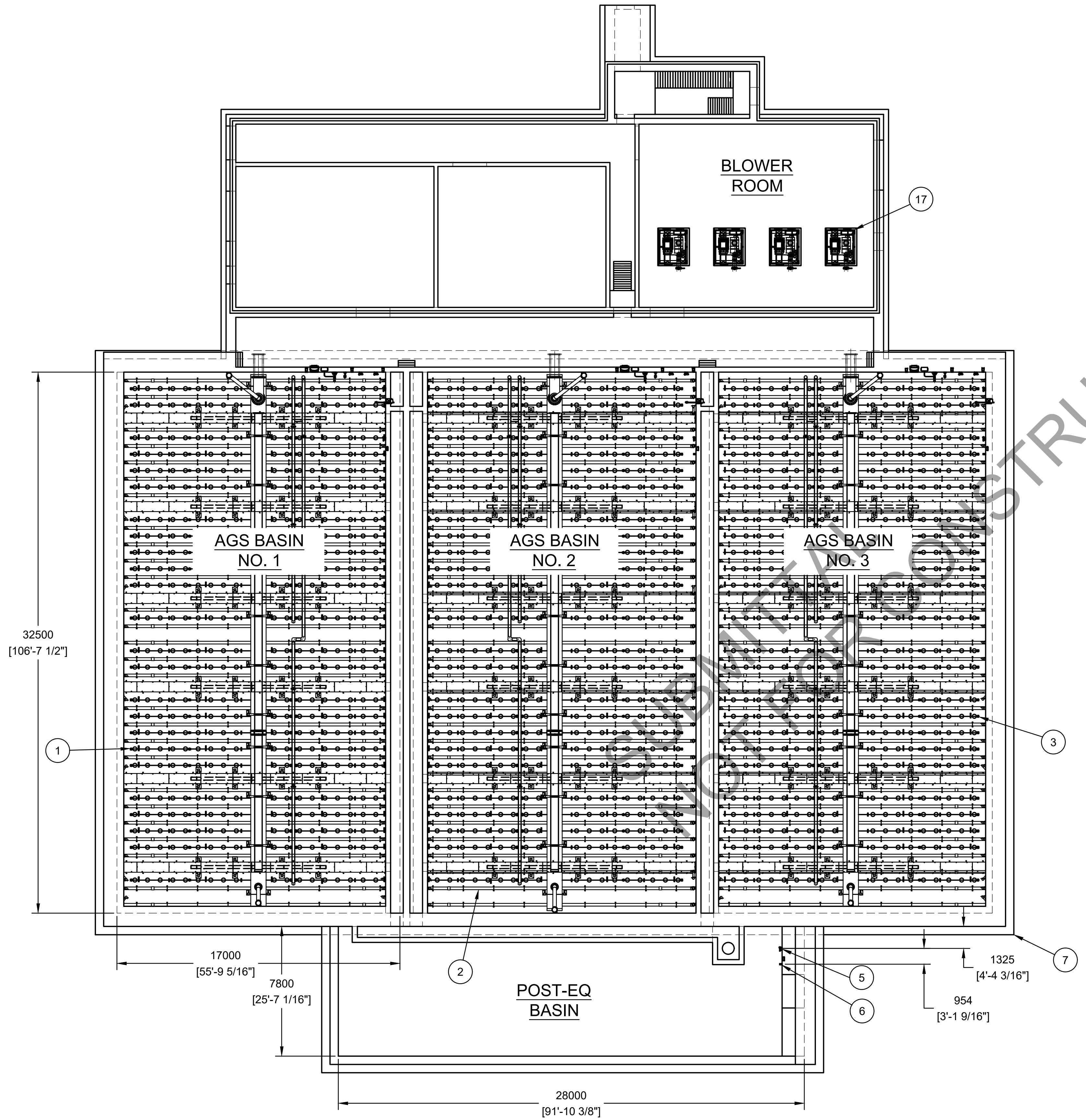
Product or Component Type	Dry contact
Product Weight	0.46 lb_m (0.21 kg)
Conformance Standards	FCC Part 15 class A
Ambient Air Temperature for Operation	32 °F - 104 °F (0 °C - 40 °C)
Relative Humidity	0% - 95%
Operating altitude	0 ft - 10,000 ft
Ambient Air Temperature for Storage	5 °F - 149 °F (-15 °C - 65 °C)

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

MAINTENANCE AND TROUBLESHOOTING

THIS SECTION IS LEFT BLANK AND WILL BE INCLUDED IN THE OPERATION & MAINTENANCE MANUAL.

MECHANICAL DRAWINGS



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.
4. ALL LOCAL ELECTRICAL DISCONNECTS / JUNCTION BOXES HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND LOCATED BY OTHERS.
5. ALL INFLUENT, EFFLUENT DECANT AND SLUDGE WASTE PIPING HAS BEEN SHOWN FOR REFERENCE ONLY AND SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
6. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. MUST ALLOW ACCESS TO ALL AGS AND POST-EQ EQUIPMENT.
7. VALVE AND LINE SIZES ARE TO BE VERIFIED BY THE ENGINEER BASED ON ACTUAL LINE LOSSES.
8. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.
9. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
10. CONTROL PANEL, NOT SHOWN, TO BE LOCATED AND INSTALLED BY OTHERS. REFER TO CONTROL PANEL INSTALLATION DRAWING FOR DETAILS.
11. THESE ITEMS ARE SUPPLIED FOR INSTALLATION OF THE ADHESIVE ANCHORS.
12. THE JOB SITE O&M MANUAL CONTAINING (1) "B" SIZE SET OF INSTALLATION DRAWINGS WILL BE LOCATED INSIDE OF THE PROJECT HARDWARE BOX.

	ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
	17	1	9704419A30012	BLOWER AND AIR VALVE INSTL	-	Y
NOTE 11	16	114	2613400	REFILL PACK - ADHESIVE HIT-RE 500 V3 11.1 OZ	-	-
NOTE 11	15	38	2616653	MIXING NOZZLE, RE-M	-	-
NOTE 11	14	2	2608020	ADHESIVE DISPENSER, HDM 500/BLACK	-	-
NOTE 10	13	1	9704419A30910	AQUANEREDA NETWORK COMPUTER ASSEMBLY	-	Y
NOTE 10	12	1	9704419A30600	AQUANEREDA CONTROL PANEL INSTALLATION	-	Y
	11	1	9704419A30401	HACH SERVICE PACKAGE - 704419A	-	-
	10	1	9704419A30036	HYDRAULIC PROFILE	-	Y
NOTE 12	9	1	9704419A30035	JOB SITE O&M MANUAL - 704419A	-	-
	8	1	9704419A30034	PROCESS FLOW DIAGRAM	-	Y
	7	1	9704419A30001	AGS BASIN LAYOUT	-	Y
	6	1	2962926	HIGH LEVEL ALARM FLOAT SWITCH INSTL	-	Y
	5	1	9704419A30025	LEVEL SENSOR INSTL, POST-EQ	-	Y
	4	1	9704419A30000-4	GENERAL LIST, SLUDGE BUFFER/INFLUENT/PUMP ROOM	-	Y
	3	1	9704419A30000-3	GENERAL LIST, AGS BASIN 3	-	Y
	2	1	9704419A30000-2	GENERAL LIST, AGS BASIN 2	-	Y
	1	1	9704419A30000-1	GENERAL LIST, AGS BASIN 1	-	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-22	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUANEREDA
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: SYSTEM PLAN VIEW & GENERAL LIST
DRAWING NUMBER: 9704419A30000
SCALE: 1/150 SIZE: D

GENERAL PROJECT NOTES

A. VERIFICATION OF ALL DIMENSIONS GIVEN AND WATER LEVELS DETAILED ON THESE DRAWINGS TO ENSURE ACCURATE FABRICATION OF EQUIPMENT IS BY OTHERS.

B. UNLESS IDENTIFIED ON A DRAWING BILL OF MATERIAL, ALL PIPING, SUPPORTS, GASKETS, HARDWARE, ELECTRICAL WIRING AND SUPPLY POWER BEYOND AQUA-AEROBIC SYSTEMS, INC. EQUIPMENT TERMINATIONS ILLUSTRATED ON THESE DRAWINGS IS SHOWN FOR REFERENCE ONLY. SIZING, LOCATION AND SUPPLY ARE TO BE DETERMINED BY OTHERS.

C. SOME GASKETS SUPPLIED WITH THIS EQUIPMENT MAY BE MADE OF STYRENE BUTADIENE / "RED RUBBER", URETHANE, OR EPDM. VERIFICATION THAT THESE MATERIALS ARE COMPATIBLE WITH THE CHEMICALS THAT WILL BE PRESENT IN THIS APPLICATION ARE BY OTHERS.

D. MOUNTING HARDWARE FOR THE CONTROL PANEL WILL BE PROVIDED BY OTHERS. FIELD INSTALLATION OF FLOOR AND/OR WALL MOUNTED CONTROL PANELS IS THE RESPONSIBILITY OF OTHERS.

E. DIMENSIONS ON THESE DRAWINGS ARE FINAL UNLESS CHANGED IN WRITING BY OTHERS. SPECIFIC NOTATION MUST BE SHOWN IN RED INK TO CHANGE ANY DIMENSIONS, COMPONENT PARTS, OR EQUIPMENT DETAILS. UNLESS CHANGES ARE SHOWN HEREON, AQUA-AEROBIC SYSTEMS, INC. SHALL NOT BE RESPONSIBLE FOR COSTS REQUIRED TO MODIFY OR CHANGE ITEMS AS A RESULT OF UNMARKED CHANGES OR CHANGES AFTER REVIEW. MANUFACTURED PRODUCTS WILL BE SHIPPED AS DIMENSIONED AND DESCRIBED WITHIN THIS MANUAL.

F. AQUA-AEROBIC SYSTEMS, INC. DOES NOT ASSUME THE RESPONSIBILITY OF COORDINATING THE CIVIL, MECHANICAL, OR DESIGN ENGINEERING THAT MAY BE REQUIRED.

G. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES, AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.

H. REFER TO SECTION 1 OF THE OPERATION & MAINTENANCE MANUAL FOR A COMPLETE LIST OF RECOMMENDED SPARE PARTS OR THOSE PROVIDED FOR THIS PROJECT.

I. NO SPECIAL TOOLS ARE REQUIRED FOR NORMAL INSTALLATION OR ROUTINE MAINTENANCE OF EQUIPMENT TO BE FURNISHED.

J. COMPLETE FACTORY ASSEMBLY AND INSTALLATION DRAWINGS WITH PARTS LIST WILL BE PROVIDED WITHIN EACH OPERATION & MAINTENANCE MANUAL. OPERATION & MAINTENANCE MANUALS WILL BE MAILED PRIOR TO SHIPMENT OF EQUIPMENT. REVIEW ALL FACTORY ASSEMBLY AND INSTALLATION DRAWINGS PRIOR TO COMMENCING FINAL ASSEMBLY.

K. WHEN RECEIVING EQUIPMENT AND CRATES, THE SHIPMENT SHOULD BE COMPLETELY CHECKED TO VERIFY THAT NO TRANSIT DAMAGE HAS OCCURRED. ALL EQUIPMENT AND ACCESSORIES (IF ANY) MUST BE VERIFIED AGAINST THE PACKING LIST AND BILL OF LADING TO ASSURE PROPER CONTENTS.

L. UNLESS OTHERWISE SPECIFIED, ALL WALKWAYS, PLATFORMS, STAIRWAYS, HANDRAILING, ETC. HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. AQUA-AEROBIC SYSTEMS, INC. IS NOT RESPONSIBLE FOR VERIFYING CLEARANCE WITH EQUIPMENT SUPPLIED BY OTHERS.

M. ADHESIVE AND/OR WEDGE ANCHORS ARE PROVIDED FOR ANCHORING EQUIPMENT TO THE BASIN FLOOR AND/OR WALLS. ANCHOR INSTALLATION AND FIELD ATTACHMENT OF EQUIPMENT TO THE BASIN IS THE RESPONSIBILITY OF OTHERS.

N. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.

NEREDA SPECIFIC PROJECT NOTES

A. BLOWER DISCHARGE MANIFOLD AND PIPING LOSSES ARE ASSUMED AT 0.50 PSI FROM THE TERMINATION FLANGE OF THE BLOWER TO THE TERMINATION FLANGE OF THE DIFFUSER DROP PIPE FOR THE NEREDA BASIN.

ENGINEER TO VERIFY ACTUAL MANIFOLD PIPING LOSSES DO NOT EXCEED THE ABOVE. INLET LOSSES ARE 0.25 PSI FOR INLET SILENCER AND A CLEAN FILTER. NO INLET LOSSES HAVE BEEN ASSUMED FOR INLET PIPING AND IT IS ASSUMED THAT THE FILTER IS LOCATED ON EACH BLOWER PACKAGE.

B. THE AIR MANIFOLD PIPING MUST BE PROPERLY SUPPORTED TO PREVENT DAMAGE TO THE BLOWER ASSEMBLIES. THE BLOWER DISCHARGE PIPING MUST NOT BE USED TO SUPPORT THE MANIFOLDS.

C. IF BASINS WITH SLOPED FLOORS ARE UTILIZED, SUPPLY OF MINIMUM 4000 PSI TYPE GROUT PADS BENEATH THE PROPOSED EQUIPMENT (SUCH AS BASE PLATES, BRACKETS, MOORING POSTS, DIFFUSER SUPPORTS / RACKS, ETC.) ARE REQUIRED TO PROVIDE FOR A LEVEL INSTALLATION ELEVATION FOR THE EQUIPMENT. GROUT PADS ARE TO BE PROVIDED BY OTHERS.

D. ELECTRICAL WIRING, RECEIVING FLANGES, JUNCTION BOX / DISCONNECT, GASKETS, AND HARDWARE FOR ALL ELECTRICALLY OPERATED VALVES ARE TO BE SUPPLIED BY OTHERS. VALVES WILL BE SUPPLIED LOOSE FOR INSTALLATION IN PIPING BY OTHERS. VALVE VAULT WITH DRAIN AND / OR PROVISIONS FOR VALVE ACCESS ARE TO BE PROVIDED BY OTHERS.

E. UNLESS OTHERWISE NOTED, ELECTRIC VALVE ACTUATORS SHALL BE SUPPLIED WITH A 12 FT. LONG CORD SET. ELECTRICAL DISCONNECT / JUNCTION BOXES (PROVIDED BY OTHERS) MUST BE LOCATED WITHIN REACH OF THE PROVIDED CORD SET. FIELD WIRING MUST MEET LOCAL CODES FOR ALL ELECTRICALLY OPERATED ACTUATORS TO PREVENT VOLTAGE DROP. ELECTRICAL CABLES PROVIDED BY AQUA-AEROBIC SYSTEMS, INC. WILL TERMINATE AT THE BASIN WALL. ATTACHMENT OF CABLES, SUPPLY OF JUNCTION BOX / DISCONNECTS AT THE BASIN WALL, FIELD WIRING, AND CONDUIT ARE THE RESPONSIBILITY OF OTHERS.

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-22	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

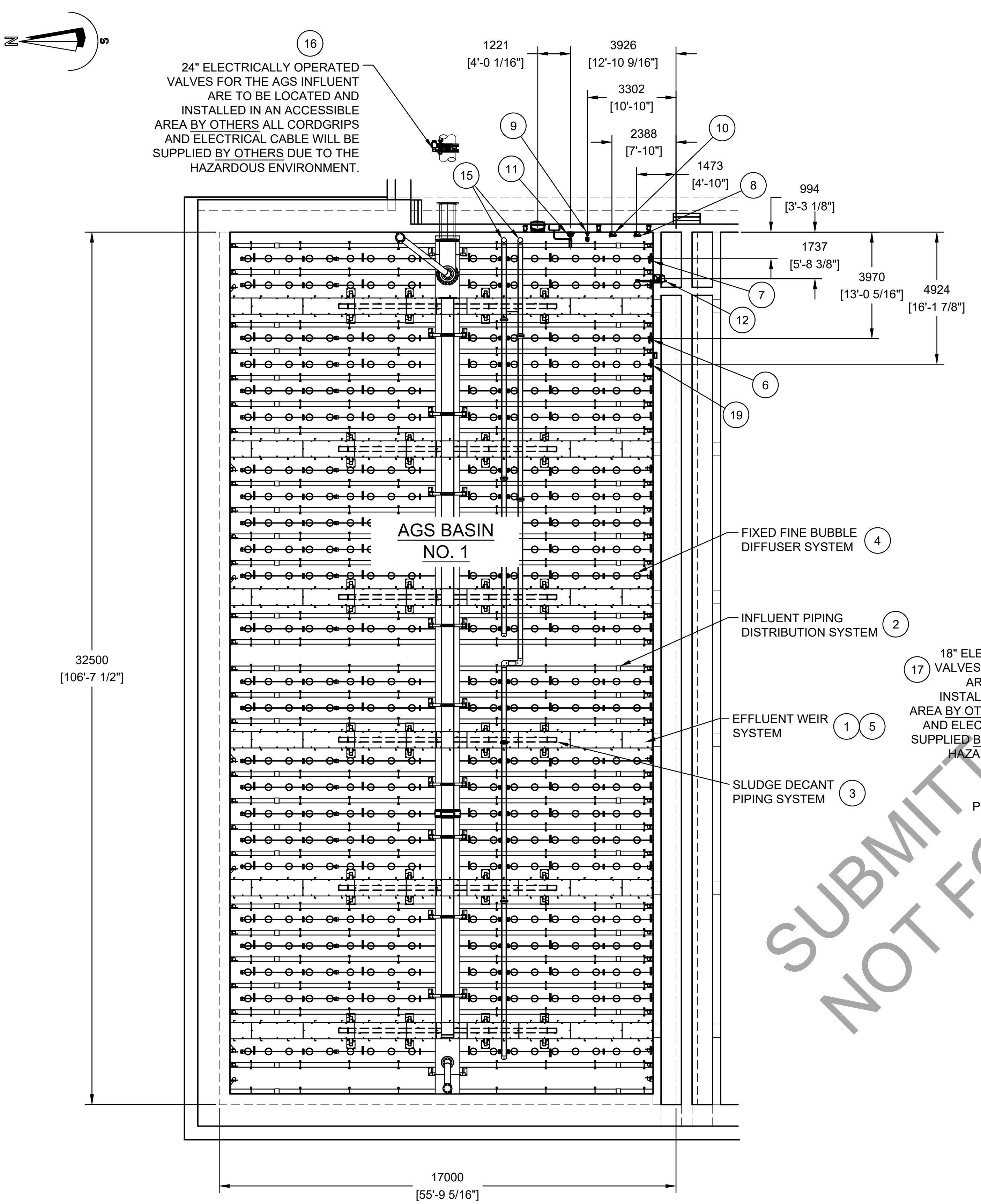
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

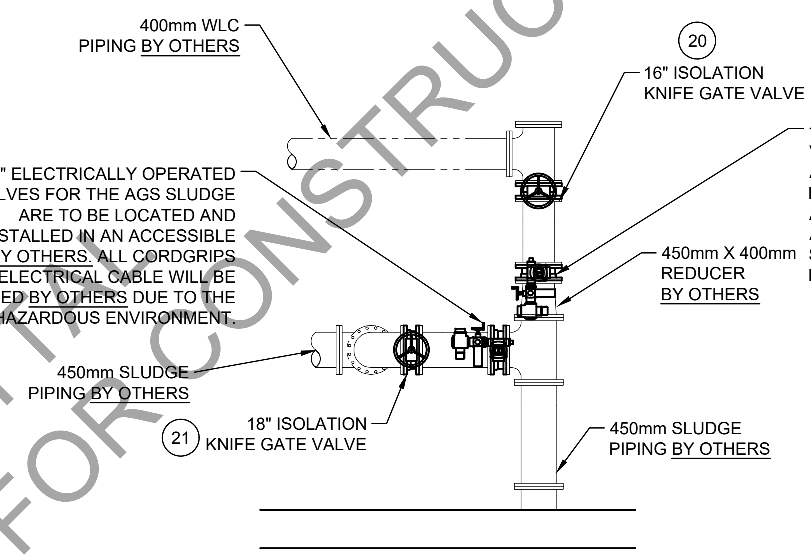
MATERIAL:
SIMILAR TO:
TYPE: AQUANEREDA
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 2 OF 2

CONFIDENTIAL

DRAWING NAME: SYSTEM PLAN VIEW & GENERAL LIST
DRAWING NUMBER: 9704419A30000 SCALE: NTS SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.



AGS SLUDGE VALVE DETAIL
(TYPICAL ARRANGEMENT FOR ALL BASINS)
SCALE: 2X

GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.
4. ALL LOCAL ELECTRICAL DISCONNECTS / JUNCTION BOXES HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND LOCATED BY OTHERS.
5. ALL INFLUENT, EFFLUENT DECANT AND SLUDGE WASTE PIPING HAS BEEN SHOWN FOR REFERENCE ONLY AND SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
6. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. MUST ALLOW ACCESS TO ALL AGS AND POST-EQ EQUIPMENT.
7. VALVE AND LINE SIZES ARE TO BE VERIFIED BY THE ENGINEER BASED ON ACTUAL LINE LOSSES.
8. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.
9. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
10. CONTROL PANEL, NOT SHOWN, TO BE LOCATED AND INSTALLED BY OTHERS. REFER TO CONTROL PANEL INSTALLATION DRAWING FOR DETAILS.
11. THESE ITEMS ARE SUPPLIED FOR INSTALLATION OF THE ADHESIVE ANCHORS.
12. THE JOB SITE O&M MANUAL CONTAINING (1) "B" SIZE SET OF INSTALLATION DRAWINGS WILL BE LOCATED INSIDE OF THE PROJECT HARDWARE BOX.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
22	2	2610904	LOK CEASE 20/20 ANTI-SEIZE LUBRICANT	-	-
21	1	9704419A30364	VALVE, 18", KNIFE GATE, PRATT 77, HW	316 SS	-
20	1	9704419A30365	VALVE, 16", KNIFE GATE, PRATT 77, HW	316 SS	-
19	1	2962926	HIGH LEVEL ALARM FLOAT SWITCH INSTL	-	Y
18	1	9704419A30126	VALVE ASSY, 16", KNIFE GATE, AUMA	-	Y
17	1	9704419A30125	VALVE ASSY, 18", KNIFE GATE, AUMA	-	Y
16	1	9704419A30124	VALVE ASSY, 24", KNIFE GATE, AUMA	-	Y
15	2	2969091	DIFFUSER BLOW-OFF INSTL, AGS	304 SS	-
14	1	2965501-13	NAMEPLATE INSTALLATION, AQUANEREDA	PLASTIC	Y
13	1	9704419A30024-1	HACH INSTRUMENTATION LAYOUT, AGS BASIN 1	-	Y
12	1	9704419A30023	AMMONIA SENSOR INSTL, AGS	-	Y
11	1	9704419A30022	FILTRAX SAMPLING SYSTEM INSTL, AGS	-	Y
10	1	9704419A30021	TSS SENSOR INSTL, AGS	-	Y
9	1	9704419A30020	ORP SENSOR INSTL, AGS	-	Y
8	1	9704419A30019	pH SENSOR INSTL, AGS	-	Y
7	1	9704419A30018	DISSOLVED OXYGEN SENSOR INSTL, AGS	-	Y
6	1	9704419A30016	LEVEL SENSOR INSTL, AGS	-	Y
5	1	9704419A30013	SCUM BAFFLE INSTL, AGS 1	-	Y
4	1	9704419A30011-1	DIFFUSER INSTL, FIXED FB, AGS 1	-	Y
3	1	9704419A30008	SLUDGE DECANTER INSTL, AGS 1	-	Y
2	1	9704419A30005	INFLUENT PIPING INSTL, AGS 1	-	Y
1	1	9704419A30002	EFFLUENT LAUNDER INSTL, AGS 1	-	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-22	CJC	FULL SUBMITTAL

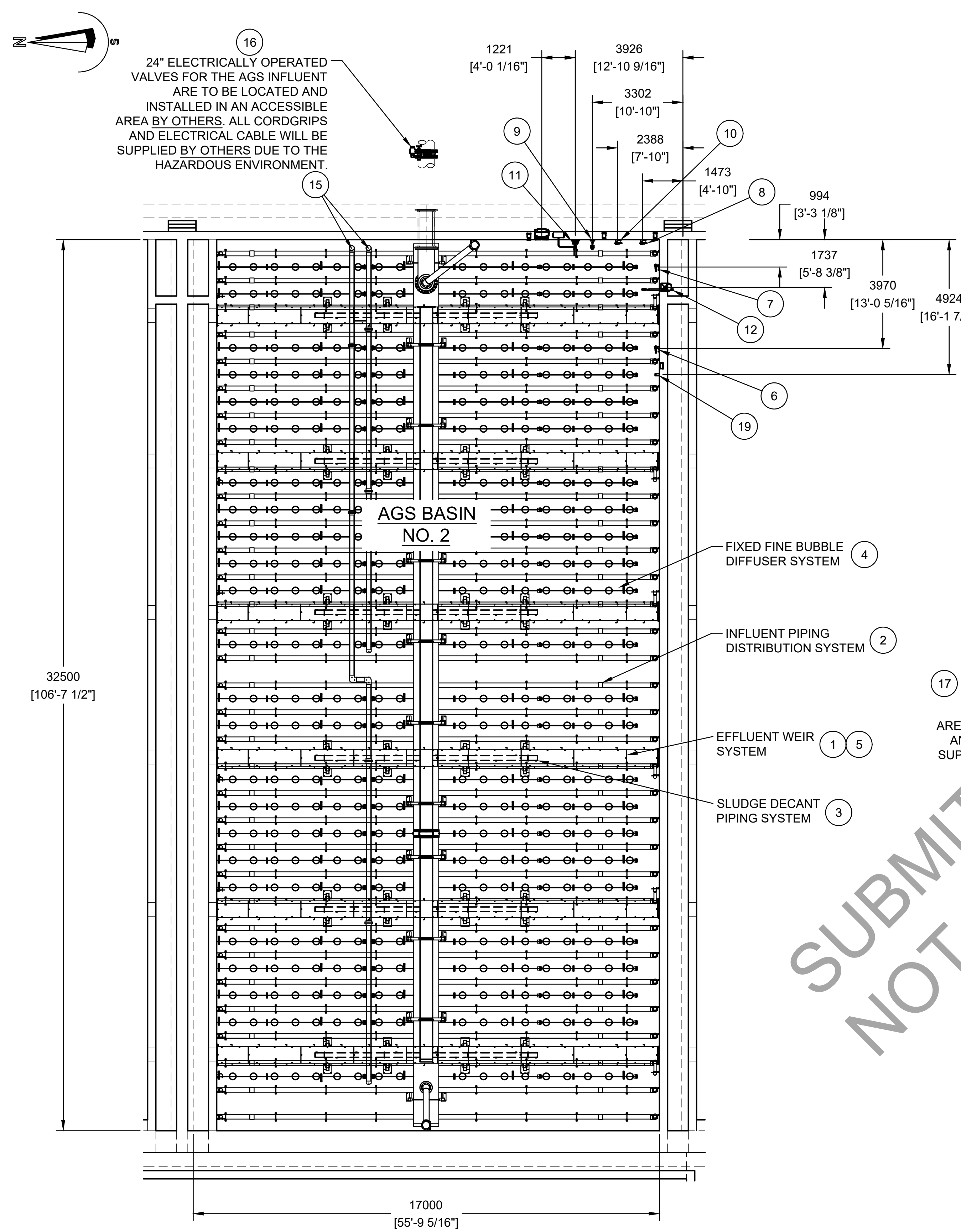
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

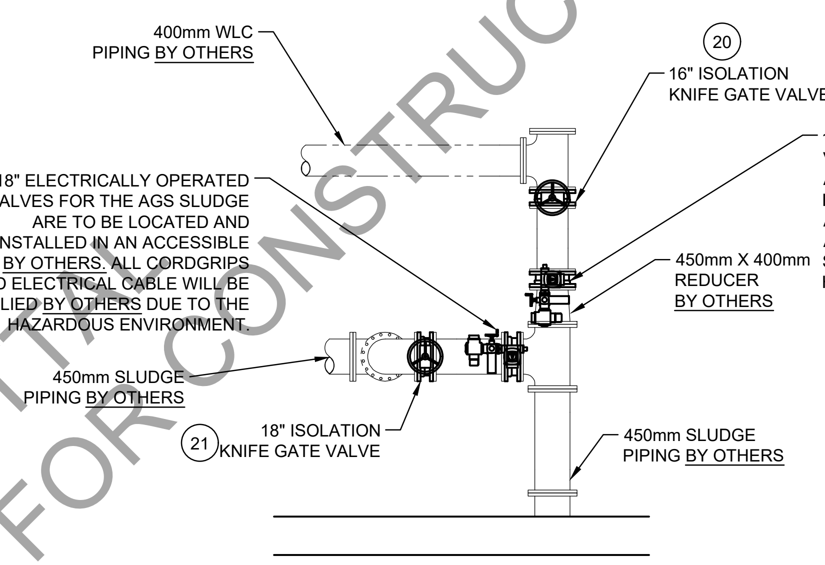
MATERIAL:
SIMILAR TO:
TYPE: AQUANEREDA
DRAWN BY: CJC
DATE: 2024-10-08
WEIGHT:
SHEET: 1 OF 1

CONFIDENTIAL

DRAWING NAME: GENERAL LIST, AGS BASIN 1
DRAWING NUMBER: 9704419A30000-1
SCALE: 1/100
SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.



AGS SLUDGE VALVE DETAIL
(TYPICAL ARRANGEMENT FOR ALL BASINS)
SCALE: 2X

GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.
4. ALL LOCAL ELECTRICAL DISCONNECTS / JUNCTION BOXES HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND LOCATED BY OTHERS.
5. ALL INFLUENT, EFFLUENT DECANT AND SLUDGE WASTE PIPING HAS BEEN SHOWN FOR REFERENCE ONLY AND SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
6. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. MUST ALLOW ACCESS TO ALL AGS AND POST-EQ EQUIPMENT.
7. VALVE AND LINE SIZES ARE TO BE VERIFIED BY THE ENGINEER BASED ON ACTUAL LINE LOSSES.
8. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.
9. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
10. CONTROL PANEL, NOT SHOWN, TO BE LOCATED AND INSTALLED BY OTHERS. REFER TO CONTROL PANEL INSTALLATION DRAWING FOR DETAILS.
11. THESE ITEMS ARE SUPPLIED FOR INSTALLATION OF THE ADHESIVE ANCHORS.
12. THE JOB SITE O&M MANUAL CONTAINING (1) "B" SIZE SET OF INSTALLATION DRAWINGS WILL BE LOCATED INSIDE OF THE PROJECT HARDWARE BOX.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
22	2	2610904	LOK CEASE 20/20 ANTI-SEIZE LUBRICANT	-	-
21	1	9704419A30364	VALVE, 18", KNIFE GATE, PRATT 77, HW	316 SS	-
20	1	9704419A30365	VALVE, 16", KNIFE GATE, PRATT 77, HW	316 SS	-
19	1	2962926	HIGH LEVEL ALARM FLOAT SWITCH INSTL	-	Y
18	1	9704419A30126	VALVE ASSY, 16", KNIFE GATE, AUMA	-	Y
17	1	9704419A30125	VALVE ASSY, 18", KNIFE GATE, AUMA	-	Y
16	1	9704419A30124	VALVE ASSY, 24", KNIFE GATE, AUMA	-	Y
15	2	2969091	DIFFUSER BLOW-OFF INSTL, AGS	304 SS	-
14	1	2965501-13	NAMEPLATE INSTALLATION, AQUANEREDA	PLASTIC	Y
13	1	9704419A30024-2	HACH INSTRUMENTATION LAYOUT, AGS BASIN 2	-	Y
12	1	9704419A30023	AMMONIA SENSOR INSTL, AGS	-	Y
11	1	9704419A30022	FILTRAX SAMPLING SYSTEM INSTL, AGS	-	Y
10	1	9704419A30021	TSS SENSOR INSTL, AGS	-	Y
9	1	9704419A30020	ORP SENSOR INSTL, AGS	-	Y
8	1	9704419A30019	pH SENSOR INSTL, AGS	-	Y
7	1	9704419A30018	DISSOLVED OXYGEN SENSOR INSTL, AGS	-	Y
6	1	9704419A30016	LEVEL SENSOR INSTL, AGS	-	Y
5	1	9704419A30014	SCUM BAFFLE INSTL, AGS 2	-	Y
4	1	9704419A30011-2	DIFFUSER INSTL, FIXED FB, AGS 2	-	Y
3	1	9704419A30009	SLUDGE DECANTER INSTL, AGS 2	-	Y
2	1	9704419A30006	INFLUENT PIPING INSTL, AGS 2	-	Y
1	1	9704419A30003	EFFLUENT LAUNDER INSTL, AGS 2	-	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

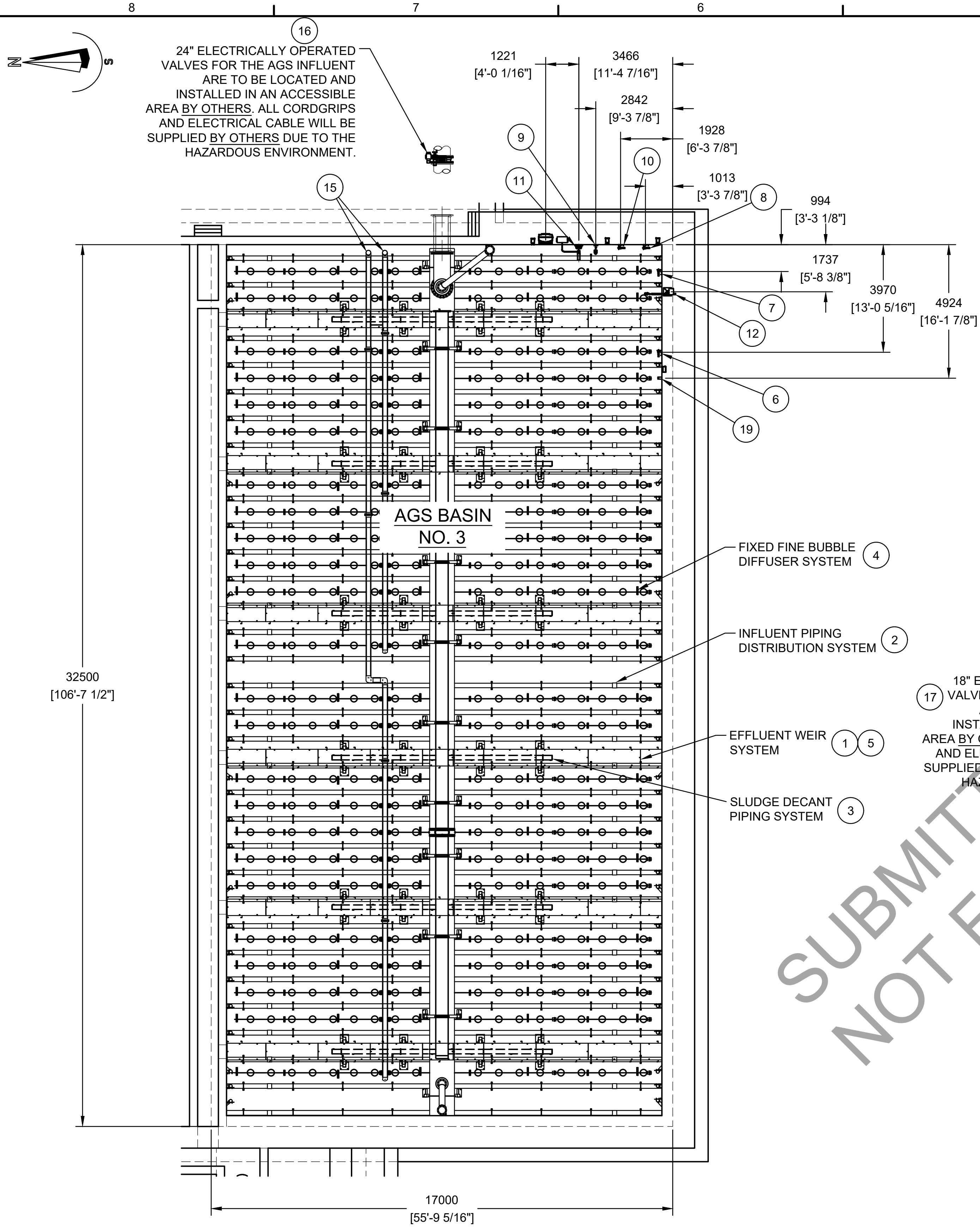
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-22	CJC	FULL SUBMITTAL

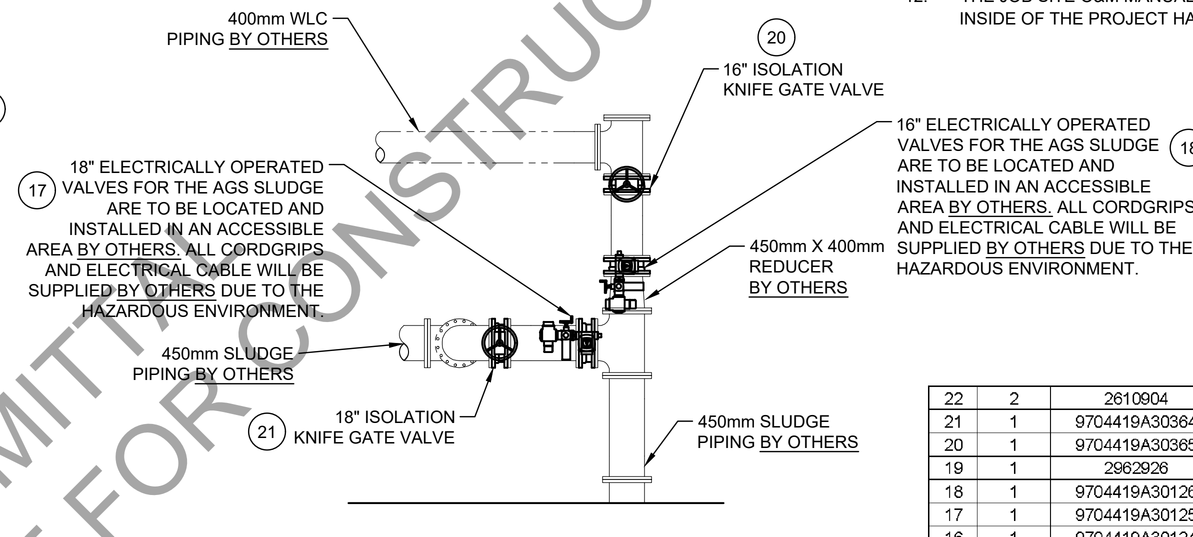
MATERIAL:
SIMILAR TO:
TYPE: AQUANEREDA
DRAWN BY: CJC
DATE: 2024-10-08
WEIGHT:
SHEET: 1 OF 1

CONFIDENTIAL

DRAWING NAME: GENERAL LIST, AGS BASIN 2
DRAWING NUMBER: 9704419A30000-2
SCALE: 1/100
SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.



AGS SLUDGE VALVE DETAIL

(TYPICAL ARRANGEMENT FOR ALL BASINS)
SCALE: 2X

GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.
4. ALL LOCAL ELECTRICAL DISCONNECTS / JUNCTION BOXES HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND LOCATED BY OTHERS.
5. ALL INFLUENT, EFFLUENT DECANT AND SLUDGE WASTE PIPING HAS BEEN SHOWN FOR REFERENCE ONLY AND SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
6. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. MUST ALLOW ACCESS TO ALL AGS AND POST-EQ EQUIPMENT.
7. VALVE AND LINE SIZES ARE TO BE VERIFIED BY THE ENGINEER BASED ON ACTUAL LINE LOSSES.
8. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.
9. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
10. CONTROL PANEL, NOT SHOWN, TO BE LOCATED AND INSTALLED BY OTHERS. REFER TO CONTROL PANEL INSTALLATION DRAWING FOR DETAILS.
11. THESE ITEMS ARE SUPPLIED FOR INSTALLATION OF THE ADHESIVE ANCHORS.
12. THE JOB SITE O&M MANUAL CONTAINING (1) "B" SIZE SET OF INSTALLATION DRAWINGS WILL BE LOCATED INSIDE OF THE PROJECT HARDWARE BOX.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
22	2	2610904	LOK CEASE 20/20 ANTI-SEIZE LUBRICANT	-	-
21	1	9704419A30364	VALVE, 18", KNIFE GATE, PRATT 77, HW	316 SS	-
20	1	9704419A30365	VALVE, 16", KNIFE GATE, PRATT 77, HW	316 SS	-
19	1	2962926	HIGH LEVEL ALARM FLOAT SWITCH INSTL	-	Y
18	1	9704419A30126	VALVE ASSY, 16", KNIFE GATE, AUMA	-	Y
17	1	9704419A30125	VALVE ASSY, 18", KNIFE GATE, AUMA	-	Y
16	1	9704419A30124	VALVE ASSY, 24", KNIFE GATE, AUMA	-	Y
15	2	2969091	DIFFUSER BLOW-OFF INSTL, AGS	304 SS	-
14	1	2965501-13	NAMEPLATE INSTALLATION, AQUANEREDA	PLASTIC	Y
13	1	9704419A30024-3	HACH INSTRUMENTATION LAYOUT, AGS BASIN 3	-	Y
12	1	9704419A30023	AMMONIA SENSOR INSTL, AGS	-	Y
11	1	9704419A30022	FILTRAX SAMPLING SYSTEM INSTL, AGS	-	Y
10	1	9704419A30021	TSS SENSOR INSTL, AGS	-	Y
9	1	9704419A30020	ORP SENSOR INSTL, AGS	-	Y
8	1	9704419A30019	pH SENSOR INSTL, AGS	-	Y
7	1	9704419A30018	DISSOLVED OXYGEN SENSOR INSTL, AGS	-	Y
6	1	9704419A30016	LEVEL SENSOR INSTL, AGS	-	Y
5	1	9704419A30015	SCUM BAFFLE INSTL, AGS 3	-	Y
4	1	9704419A30011-3	DIFFUSER INSTL, FIXED FB, AGS 3	-	Y
3	1	9704419A30010	SLUDGE DECANTER INSTL, AGS 3	-	Y
2	1	9704419A30007	INFLUENT PIPING INSTL, AGS 3	-	Y
1	1	9704419A30004	EFFLUENT LAUNDER INSTL, AGS 3	-	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

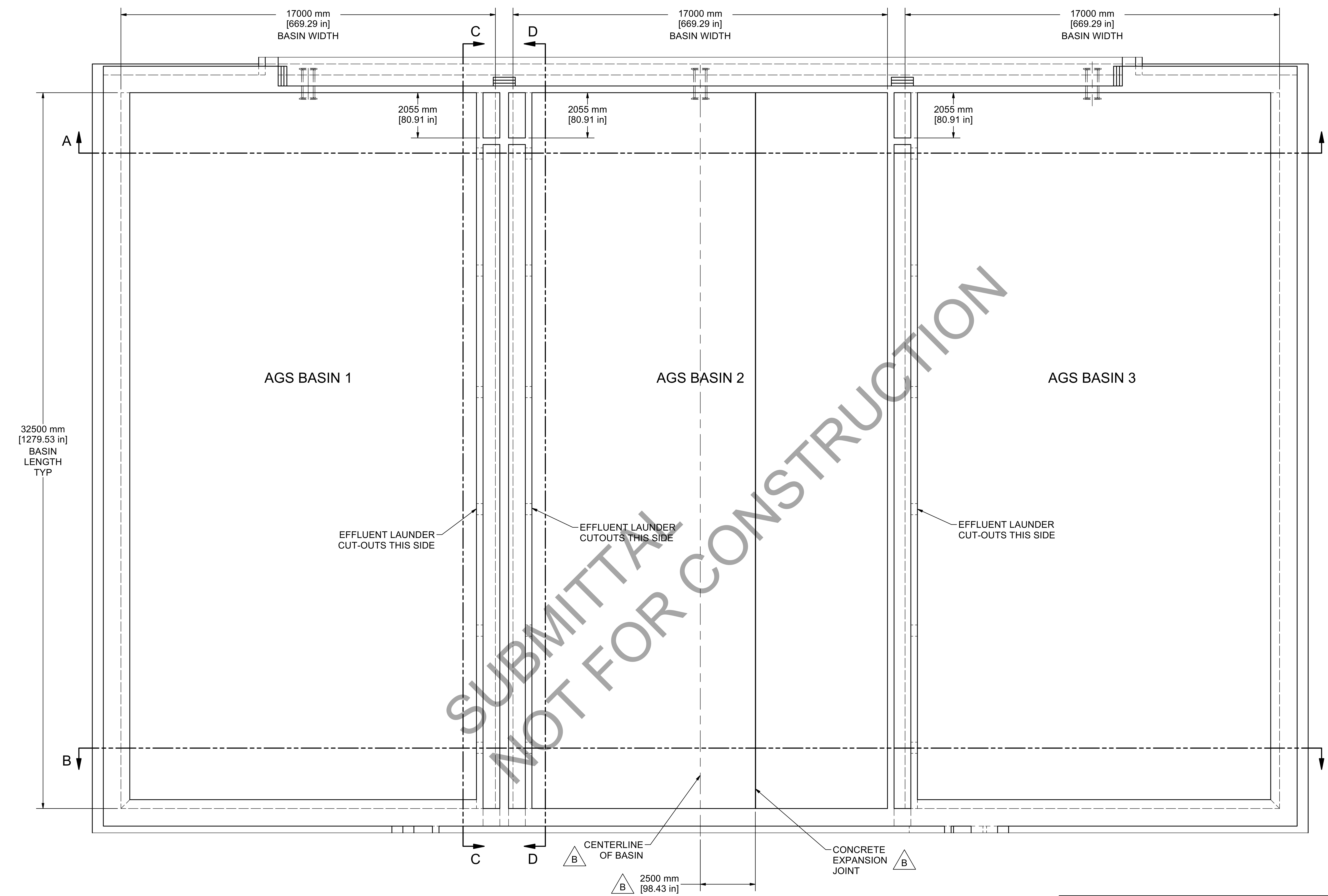
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-22	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO:
TYPE: AQUANEREDA
DRAWN BY: CJC
DATE: 2024-10-08
WEIGHT:
SHEET: 1 OF 1

CONFIDENTIAL

DRAWING NAME: GENERAL LIST, AGS BASIN 3
DRAWING NUMBER: 9704419A30000-3
SCALE: 1/100
SIZE: D



NOTES:

1. ALL DIMENSIONS TO BE VERIFIED BY CUSTOMER / CONTRACTOR.
2. ALL CONCRETE WORK AND PIPING SHOWN IN THE DRAWING TO BE SUPPLIED AND INSTALLED BY OTHERS.
3. WALL SPOOL PIPING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL
B		2025-01-21	CJC	FULL SUBMITTAL

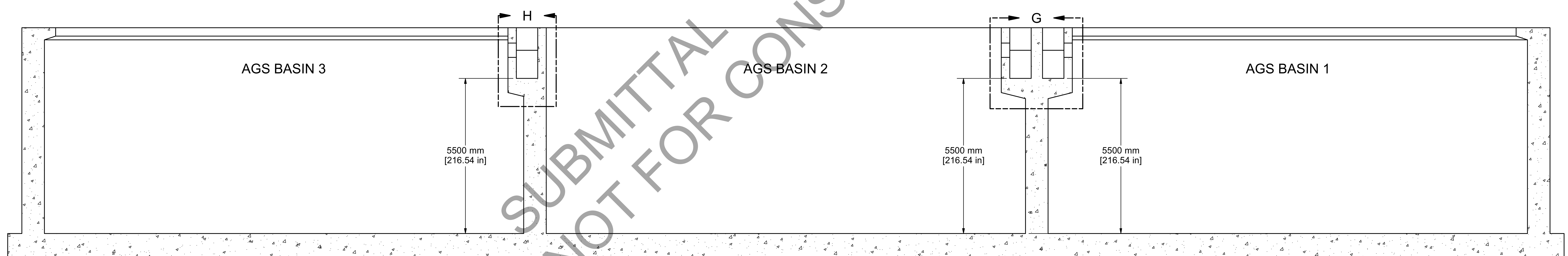
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230003
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-10-08
WEIGHT:
SHEET: 1 OF 5
DRAWING NAME: AGS BASIN LAYOUT
DRAWING NUMBER: 9704419A30001
SCALE: 1:96
SIZE: D

SECTION A-A



SECTION B-B

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-08	JFM	SUBMITTAL
B		2025-01-21	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: AGS BASIN LAYOUT				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

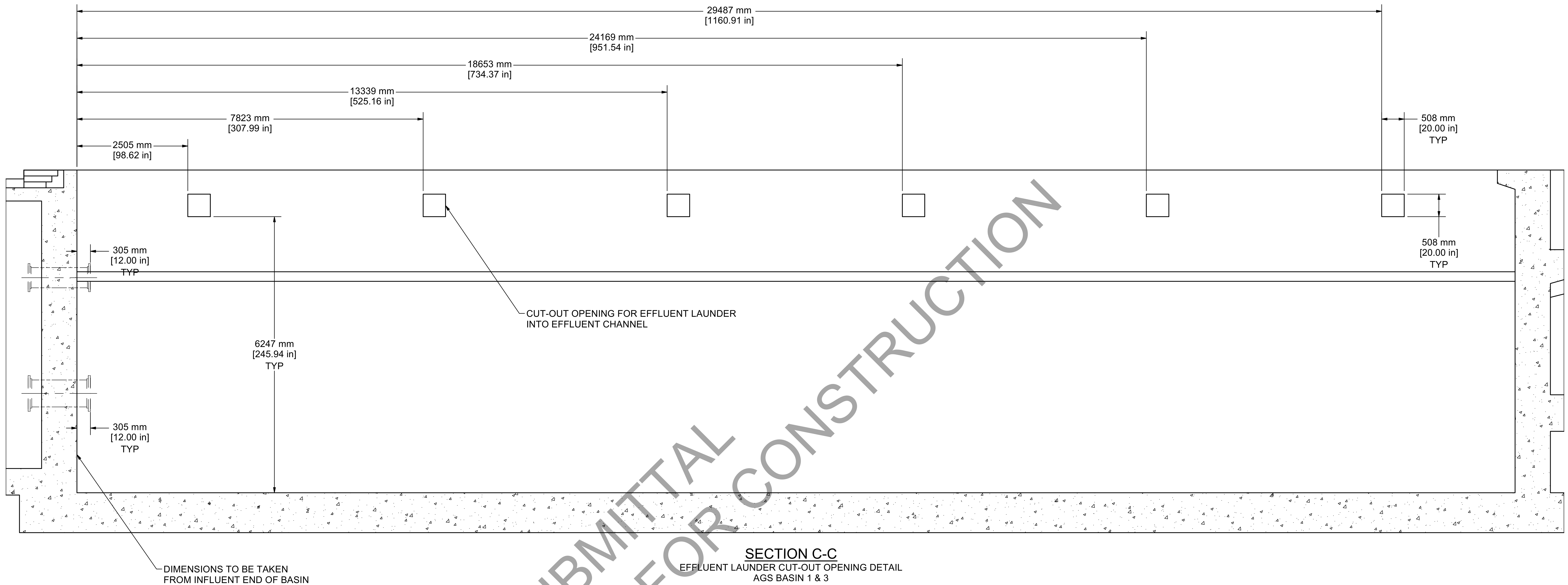
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230003
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-08
WEIGHT: SHEET: 2 OF 5
DRAWING NUMBER: 9704419A30001 SCALE: 1:72 SIZE: D



SECTION C-C
EFFLUENT LAUNDER CUT-OUT OPENING DETAIL
AGS BASIN 1 & 3

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL
B		2025-01-21	CJC	FULL SUBMITTAL

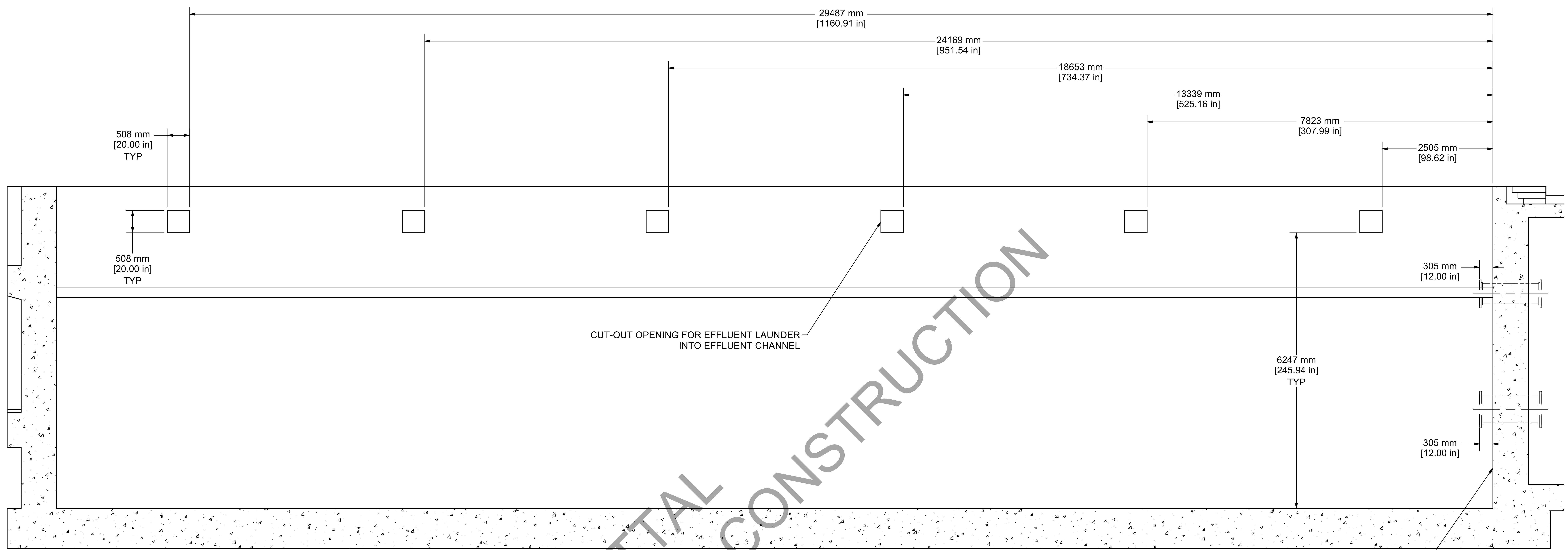
DRAWING NAME: AGS BASIN LAYOUT

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230003
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-08
WEIGHT: SHEET: 3 OF 5
DRAWING NUMBER: 9704419A30001 SCALE: 1:48 SIZE: D



SECTION D-D
EFFLUENT LAUNDER CUT-OUT OPENING DETAIL
AGS BASIN 2

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL
B		2025-01-21	CJC	FULL SUBMITTAL

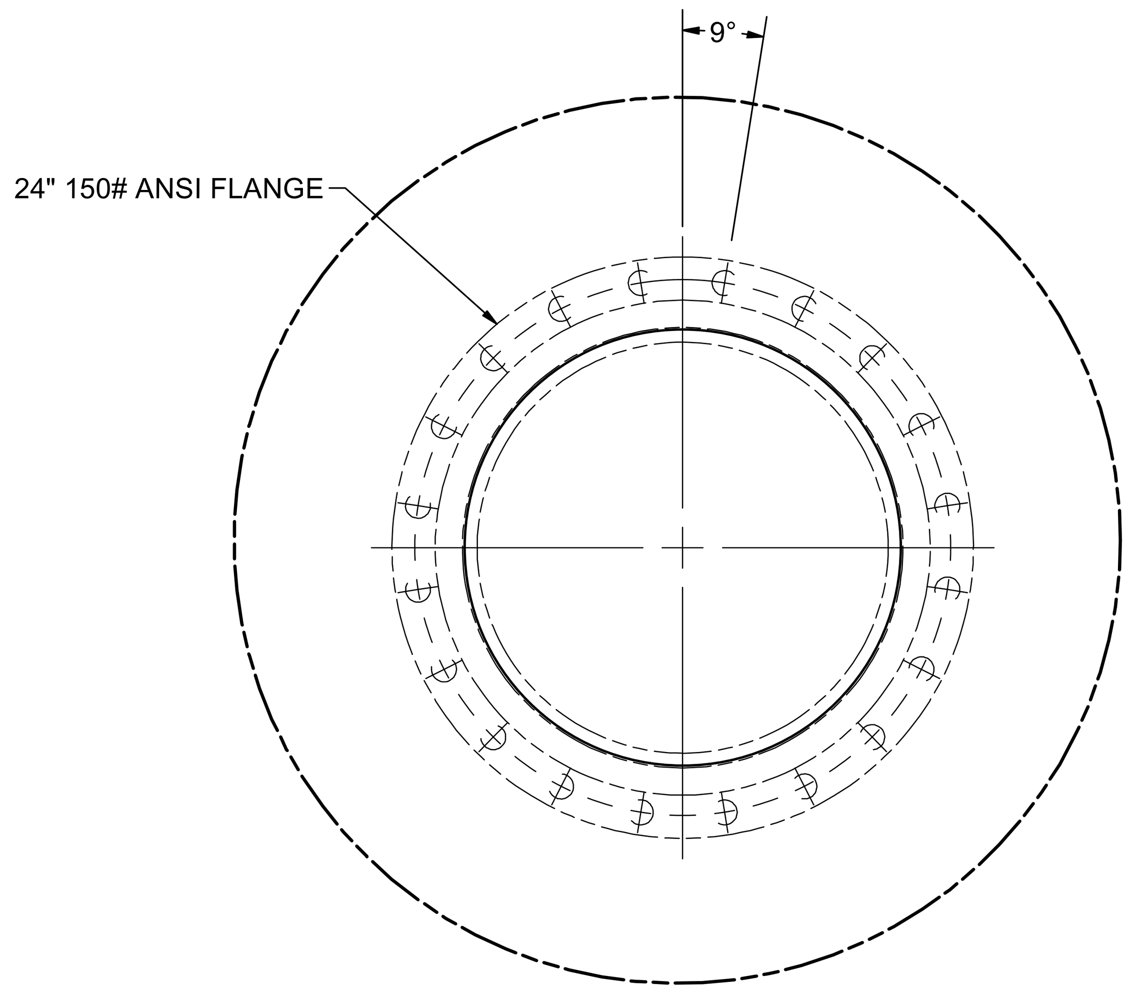
DRAWING NAME: AGS BASIN LAYOUT

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

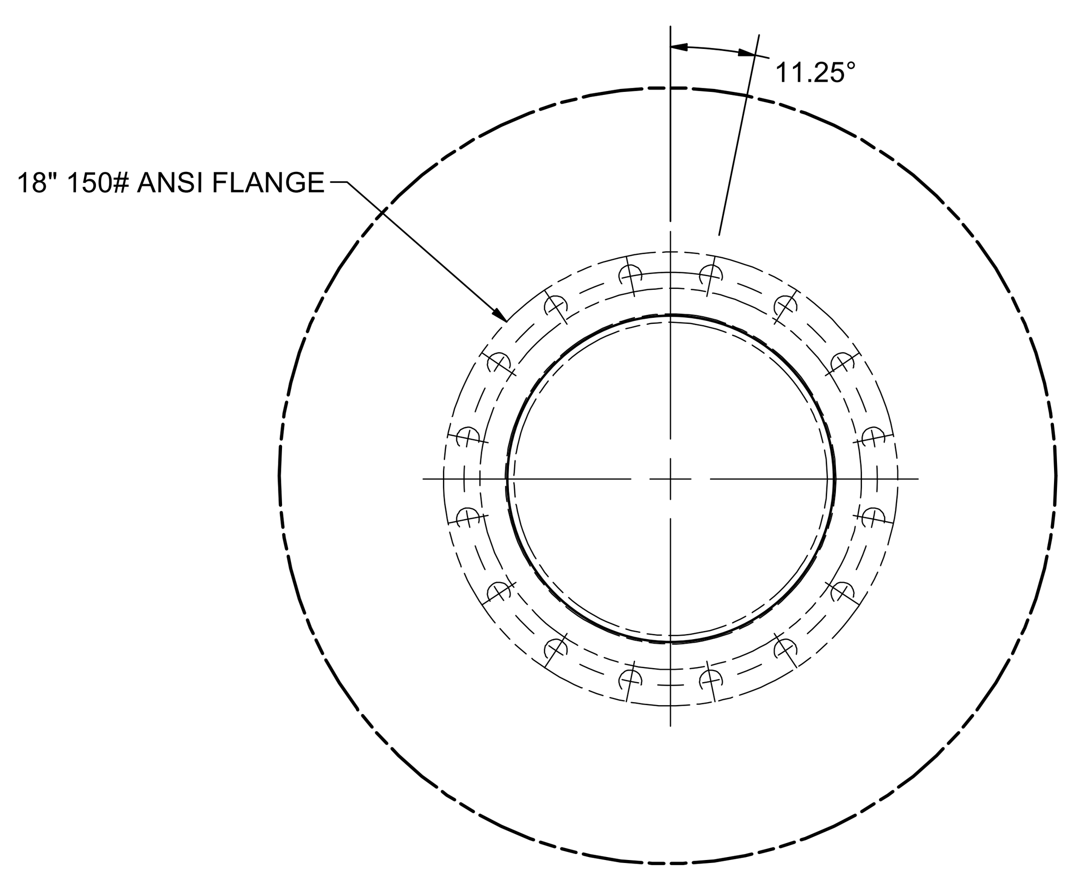
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

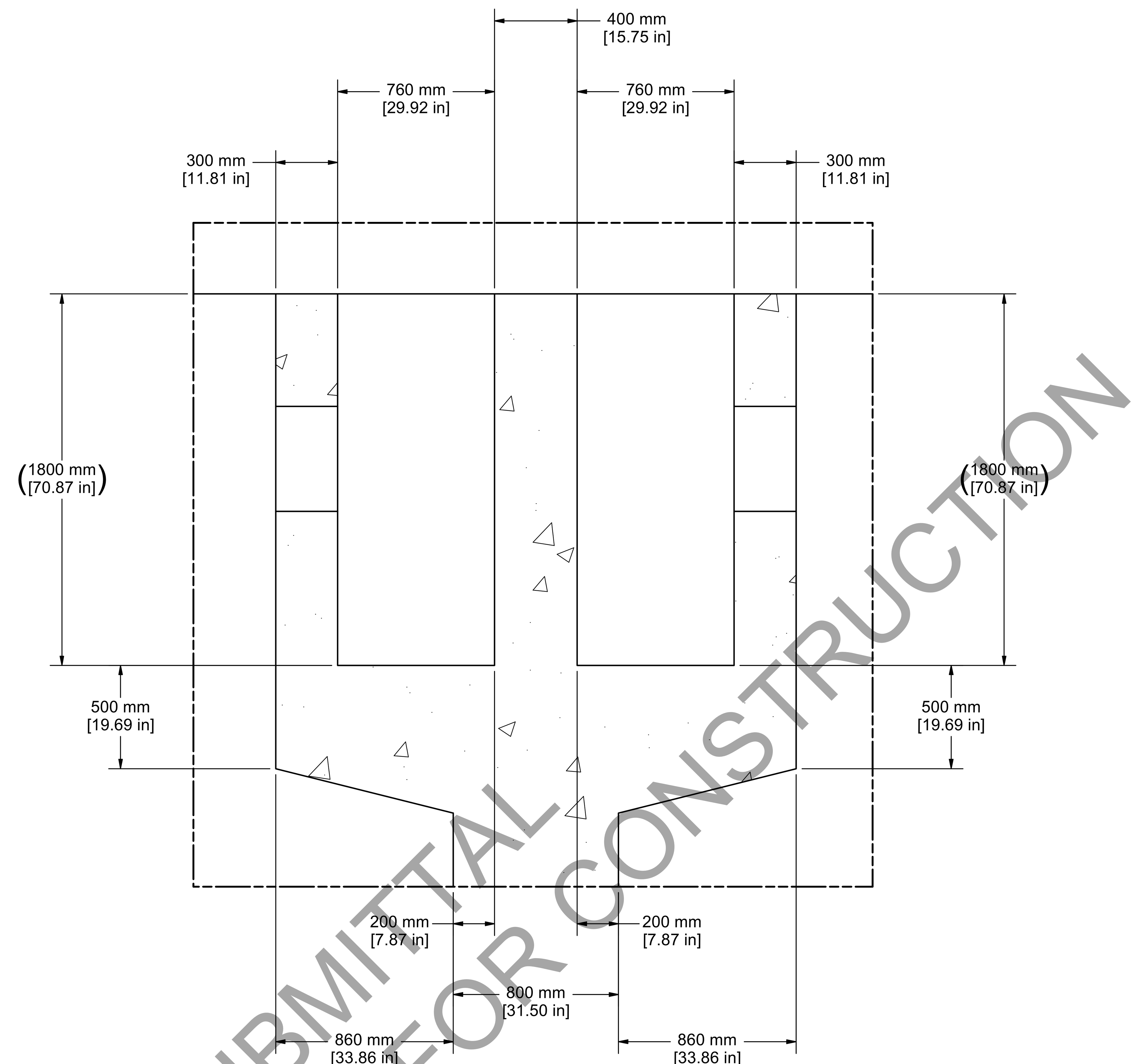
MATERIAL:
SIMILAR TO: 911689230003
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-08
WEIGHT: SHEET: 4 OF 5
DRAWING NUMBER: 9704419A30001 SCALE: 1:48 SIZE: D



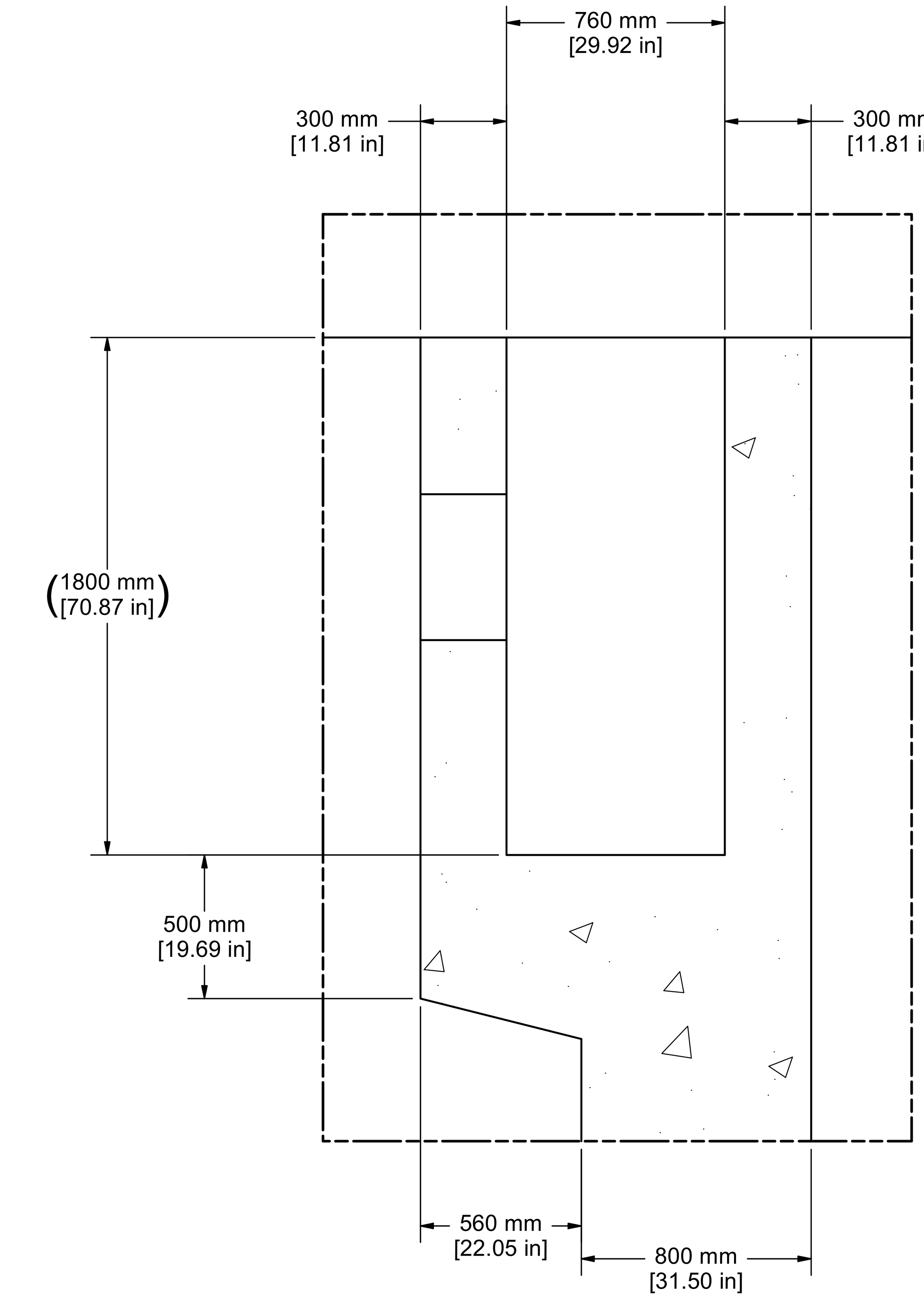
DETAIL E
INFLUENT FLANGE
TYP (3)



DETAIL F
SLUDGE DECANTER FLANGE



DETAIL G
EFFLUENT CHANNEL DETAIL
AGS BASIN 1 & 2



DETAIL H
EFFLUENT CHANNEL DETAIL
AGS BASIN 3

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL
B		2025-01-21	CJC	FULL SUBMITTAL

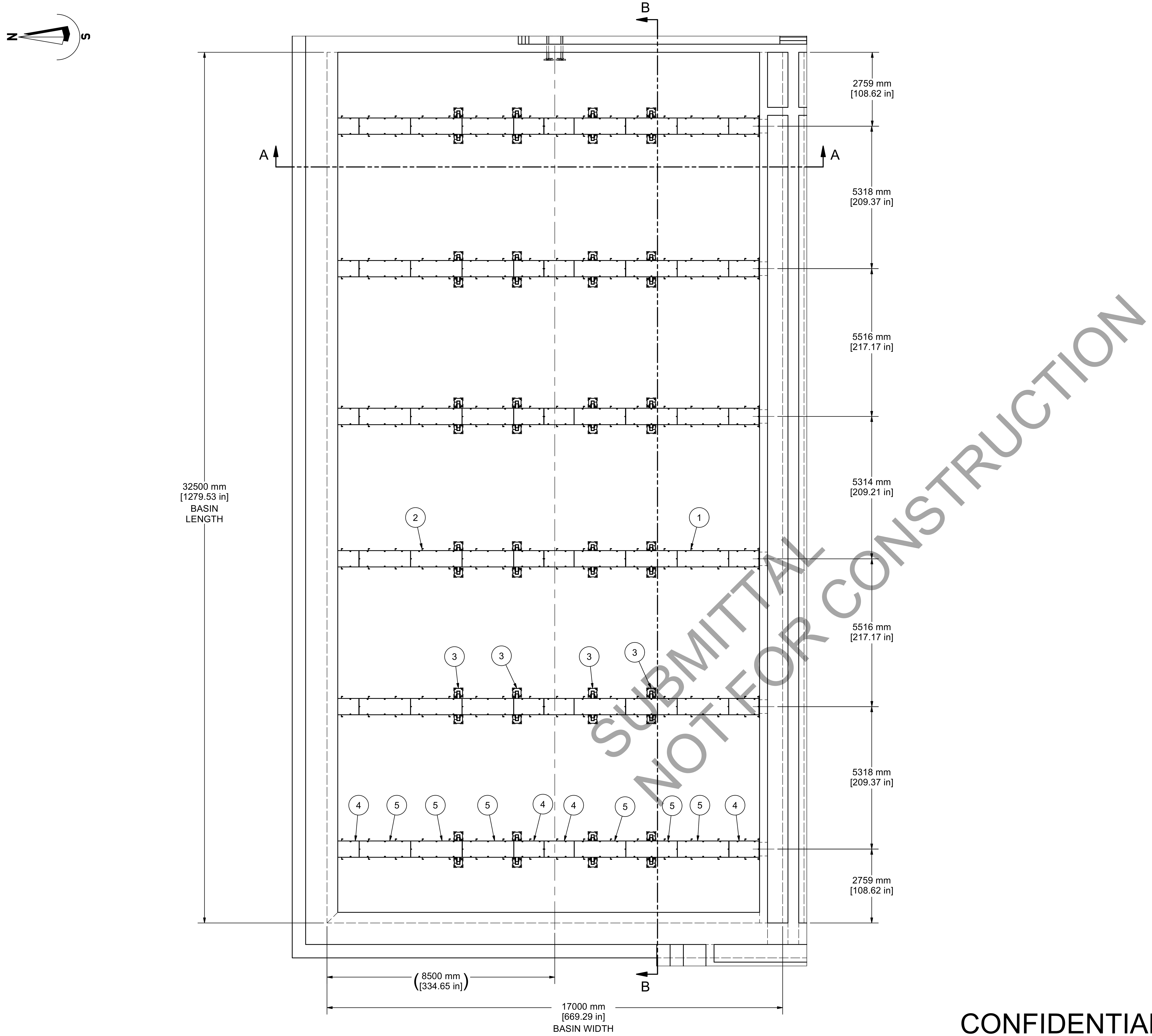
DRAWING NAME: AGS BASIN LAYOUT

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230003
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-08
WEIGHT: | SHEET: 5 OF 5
DRAWING NUMBER: 9704419A30001 | SCALE: 1:18 | SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. EFFLUENT SYSTEM IS NOT DESIGNED AS A WALKWAY, NOR IS IT DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AQUA-AEROBIC SYSTEMS.

9. COMPONENT WEIGHTS:
   - EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE: 272 KG [598 LB]
   - EFFLUENT LAUNDER WELDMENT: 287 KG [632 LB]
   - EFFLUENT LAUNDER SUPPORT WELDMENT: 332 KG [730 LB]
   - EFFLUENT LAUNDER COVER PLATE, SHORT: 12 KG [25 LB]
   - EFFLUENT LAUNDER COVER PLATE, LONG: 20 KG [43 LB]
   - EFFLUENT LAUNDER SLIDING WELDMENT: 27 KG [58 LB]
   - EFFLUENT LAUNDER WALL PLATE: 29 KG [62 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
21	6	2604138	SEALANT, TREMPRO 626, 10.1 OZ	-	-
20	48	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
19	48	2611824	HHCS, 1/2-13 X 2", FULL THREAD	316 SS	-
18	750	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
17	162	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
16	210	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
15	120	2606506	HHCS, 3/8-16 X 2.25"	316 SS	-
14	66	2610502	HHCS, 3/8-16 X 1.5", FULL THREAD	316 SS	-
13	312	2619720	HHCS, 3/8-16 X 1", FULL THREAD	316 SS	-
12	66	2605219	HHCS, 3/8-16 X 0.75", FULL THREAD	316 SS	-
11	60	2522929-SX0	EFFLUENT LAUNDER SLIDE BAR	304 SS	Y
10	6	2522926-SX0	EFFLUENT LAUNDER WALL PLATE	304 SS	Y
9	12	2522801	EFFLUENT LAUNDER GASKET	EPDM	Y
8	6	2916685-SX0	EFFLUENT LAUNDER SLIDING WELDMENT	304 SS	Y
7	192	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
6	66	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
5	36	9704419A30327	COVER PLATE, EFFLUENT LAUNDER, LONG	304 SS	Y
4	24	9704419A30326	COVER PLATE, EFFLUENT LAUNDER, SHORT	304 SS	Y
3	24	9704419A30205	EFFLUENT LAUNDER SUPPORT WELDMENT, 6"	304 SS	Y
2	6	9704419A30204	EFFLUENT LAUNDER WELDMENT	304 SS	Y
1	6	9704419A30203	EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-09-10	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

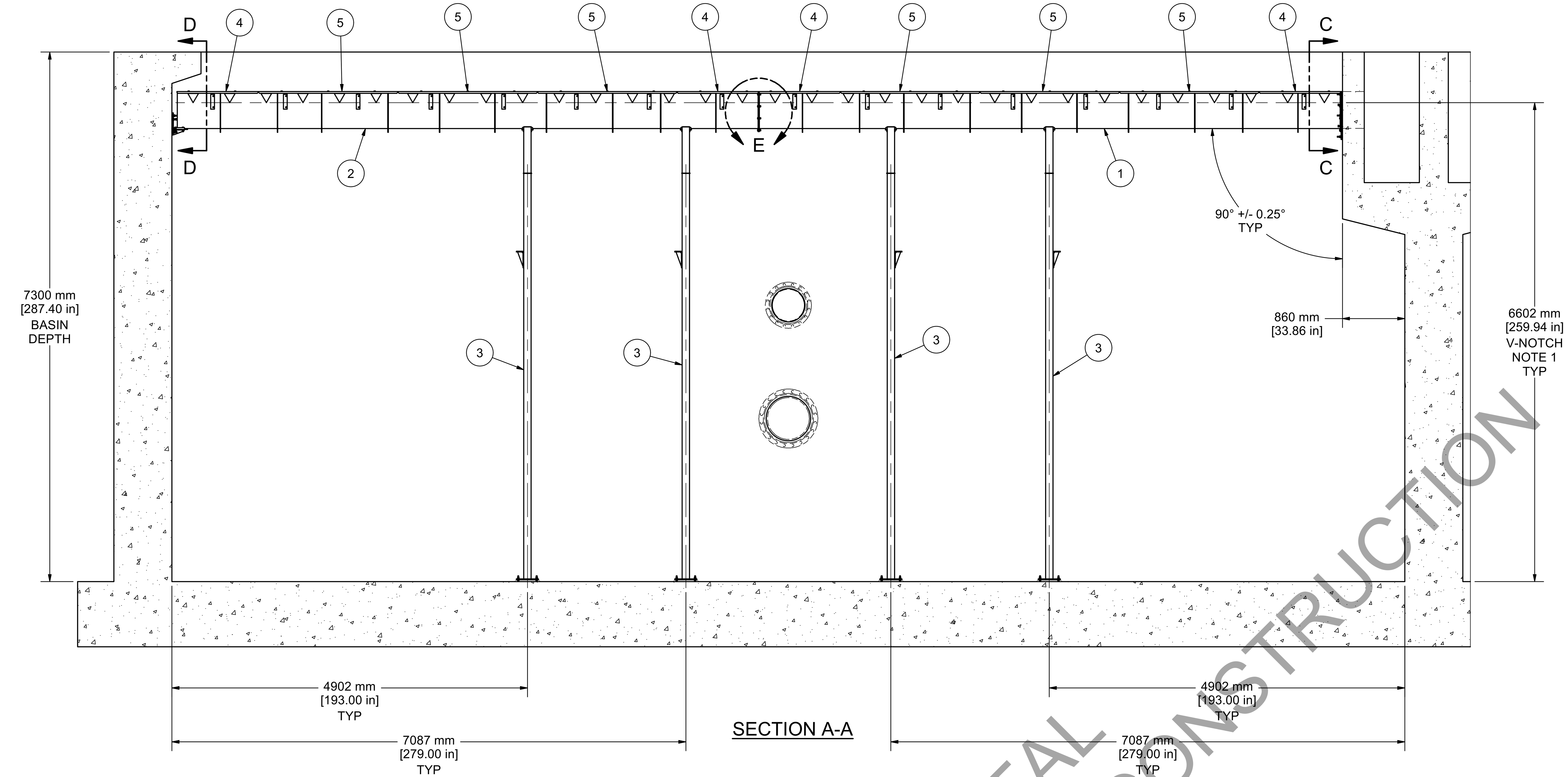
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-09-10
WEIGHT:
SHEET: 1 OF 3

DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 1
DRAWING NUMBER: 9704419A30002
SCALE: 1:78
SIZE: D

CONFIDENTIAL



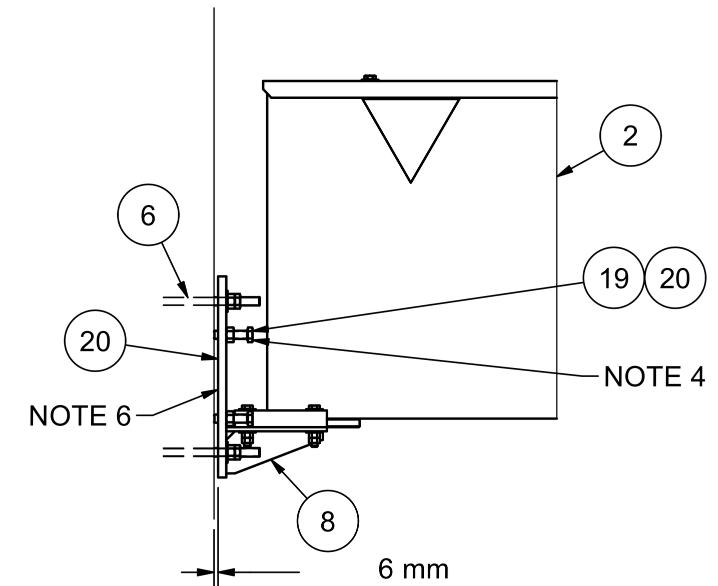
SECTION A-A

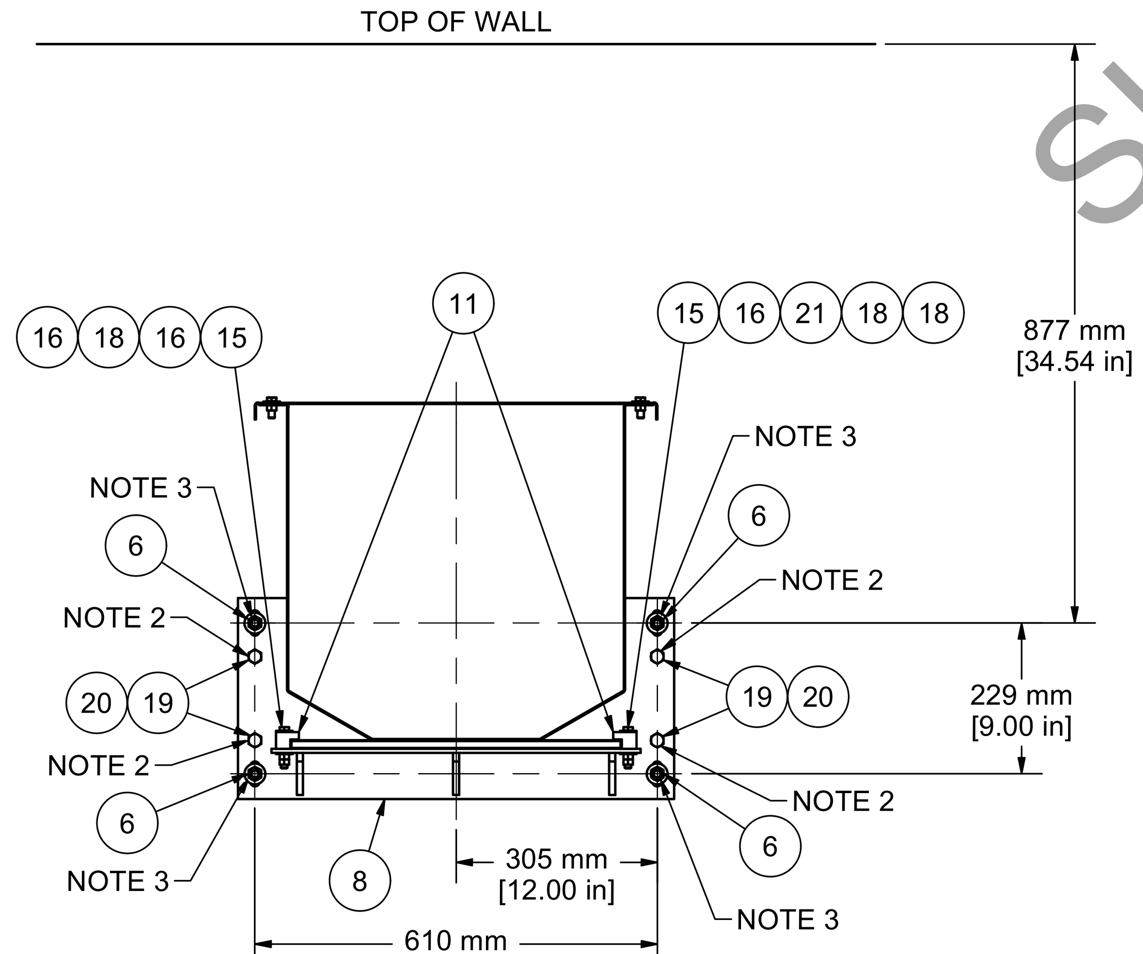
EFFLUENT WALL PLATE INSTALLATION NOTES:

1. ALL V-NOTCHES ARE TO BE LEVEL WITHIN +/- 3/16" ACROSS THE ENTIRE BASIN. USE A LASER GUIDED LEVEL.
2. INSTALL JACK SCREWS AND JAM NUTS IN THE (4) TAPPED HOLES. DO NOT DRILL INTO CONCRETE.
3. USE WALL PLATE AS A TEMPLATE. LOCATE THE WALL PLATE ON THE EFFLUENT END WALL PER DIMENSIONS SHOWN. MARK, DRILL AND INSTALL EVERY OTHER ANCHOR.
4. USE JACK SCREWS TO PLUMB AND SQUARE THE WALL PLATE BY USING A CARPENTERS SQUARE. EFFLUENT WALL PLATE TO BE PLUMB AND SQUARE ± 0.25°. WHEN PLUMB AND SQUARE, TIGHTEN NUTS ON THE JACK SCREWS.
5. DRILL THE REMAINING HOLES AND INSTALL THE REMAINING ANCHORS.
6. LOOSEN ANCHORS ENOUGH TO APPLY SEALANT BEHIND THE WALL PLATE AND AROUND THE EFFLUENT WALL PORT. DO NOT LOOSEN JACK SCREWS.
7. TIGHTEN DOWN ALL ANCHORS. RE-VERIFY PLUMB AND SQUARE, THEN RE-CAULK SIDES OF THE PLATE FILLING UP ALL GAPS IN CONCRETE.

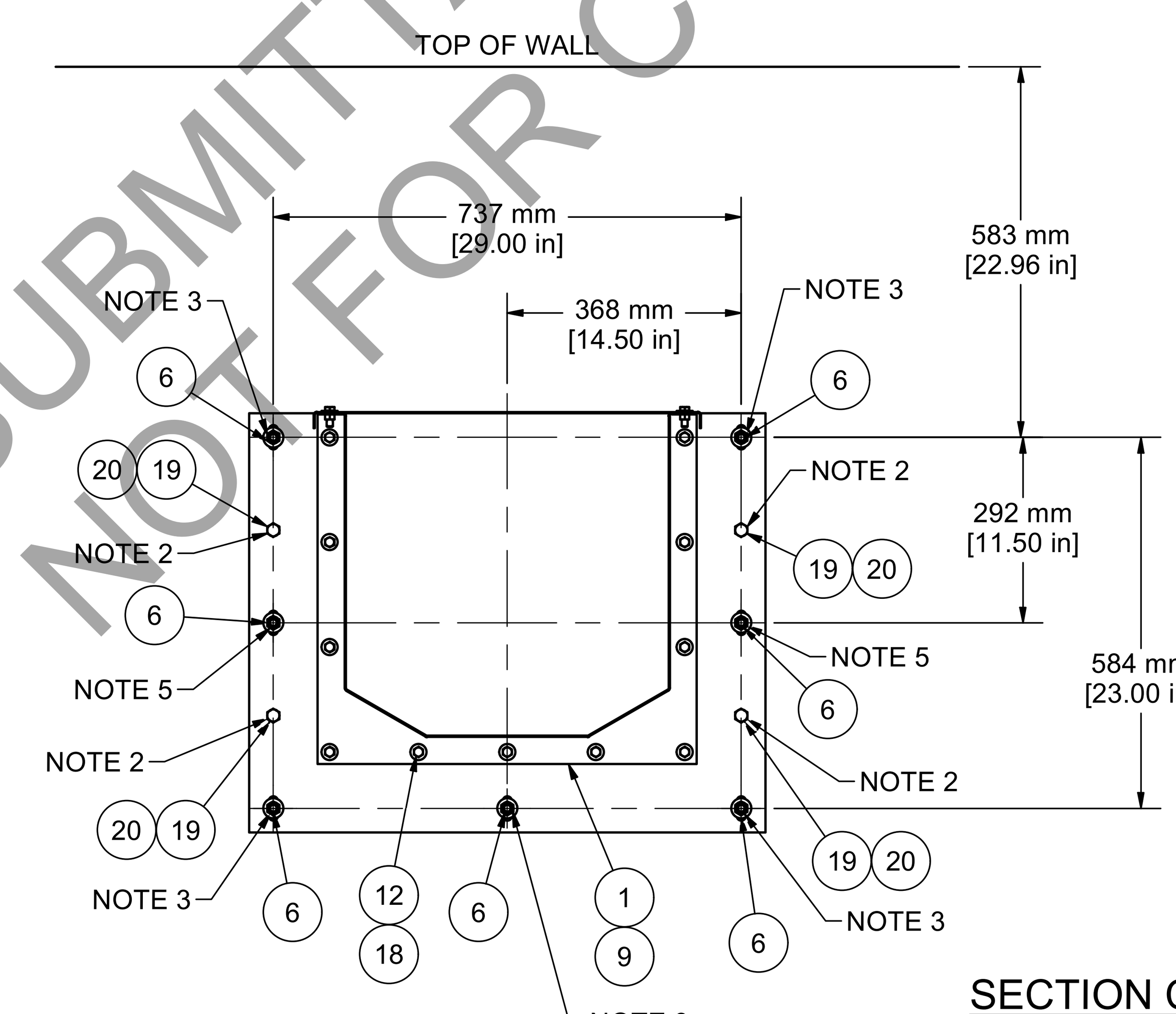
INSTALLATION NOTES:

8. VERTICAL SUPPORT BASE PLATES TO BE USED AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.
9. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR PROPER INSTALLATION.
10. FOR ALL EFFLUENT LAUNDER SLIDE BARS: SPIN FULL NUT UNTIL SLIDE BAR IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH SECOND FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

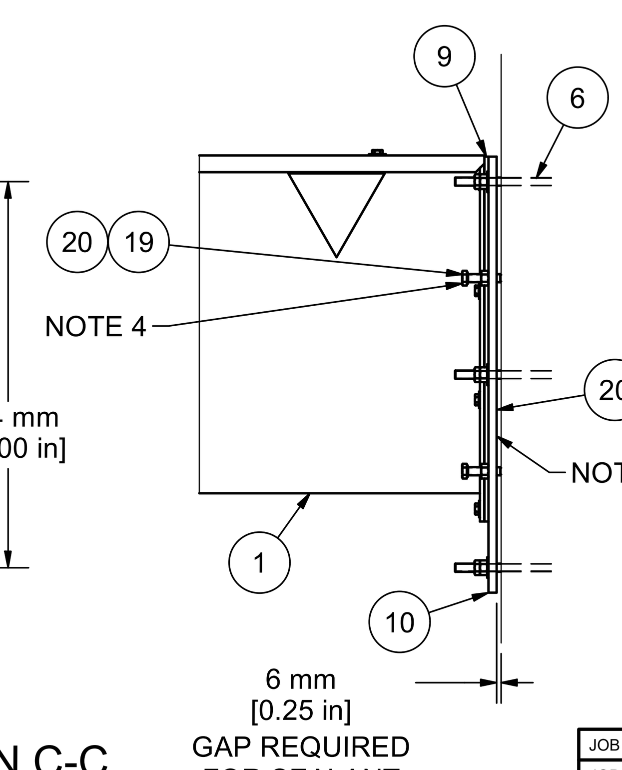


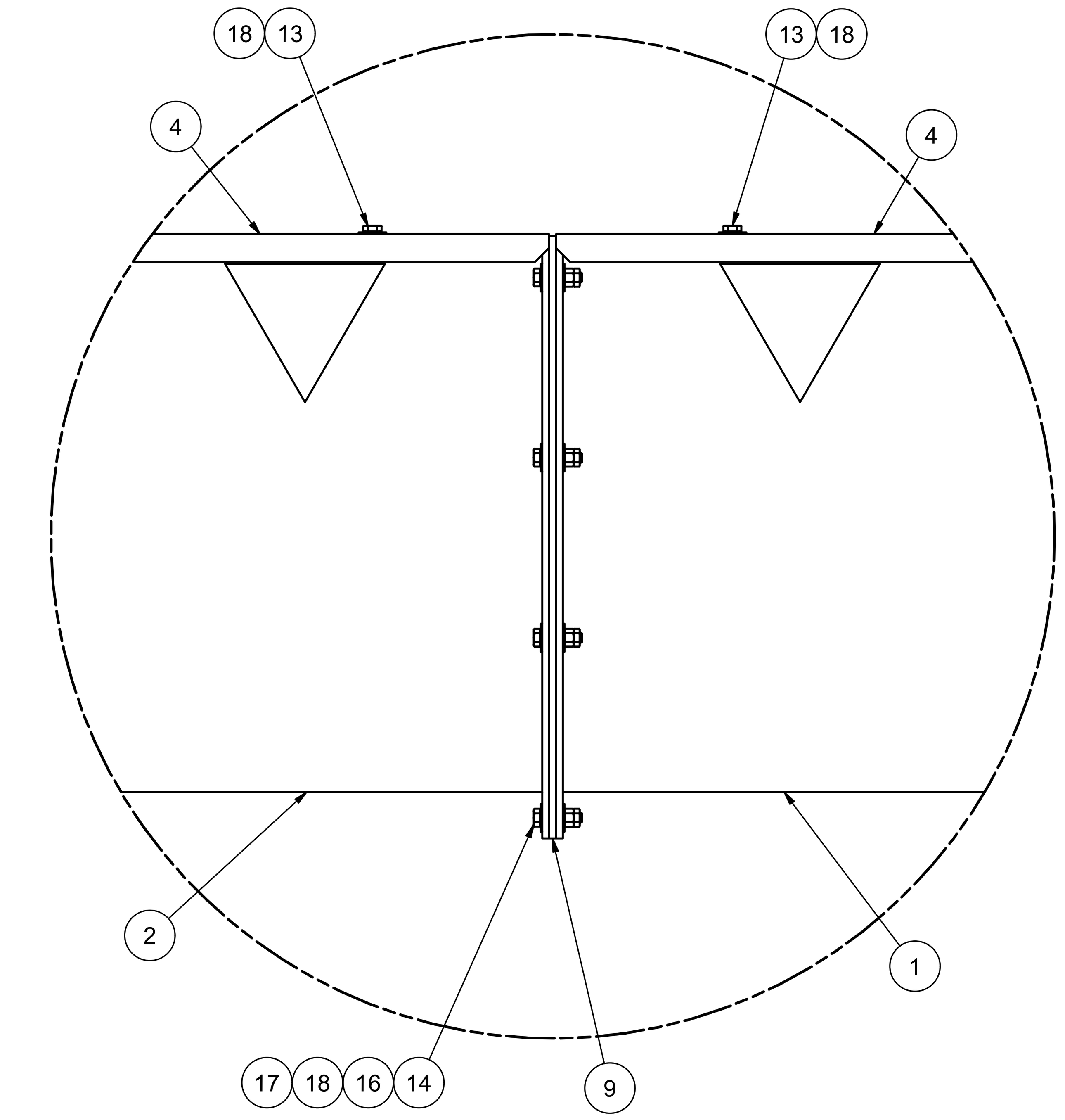


SECTION D-D
TYP (6)



SECTION C-C
TYP (6)





DETAIL E
TYP (6)

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-09-10	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION

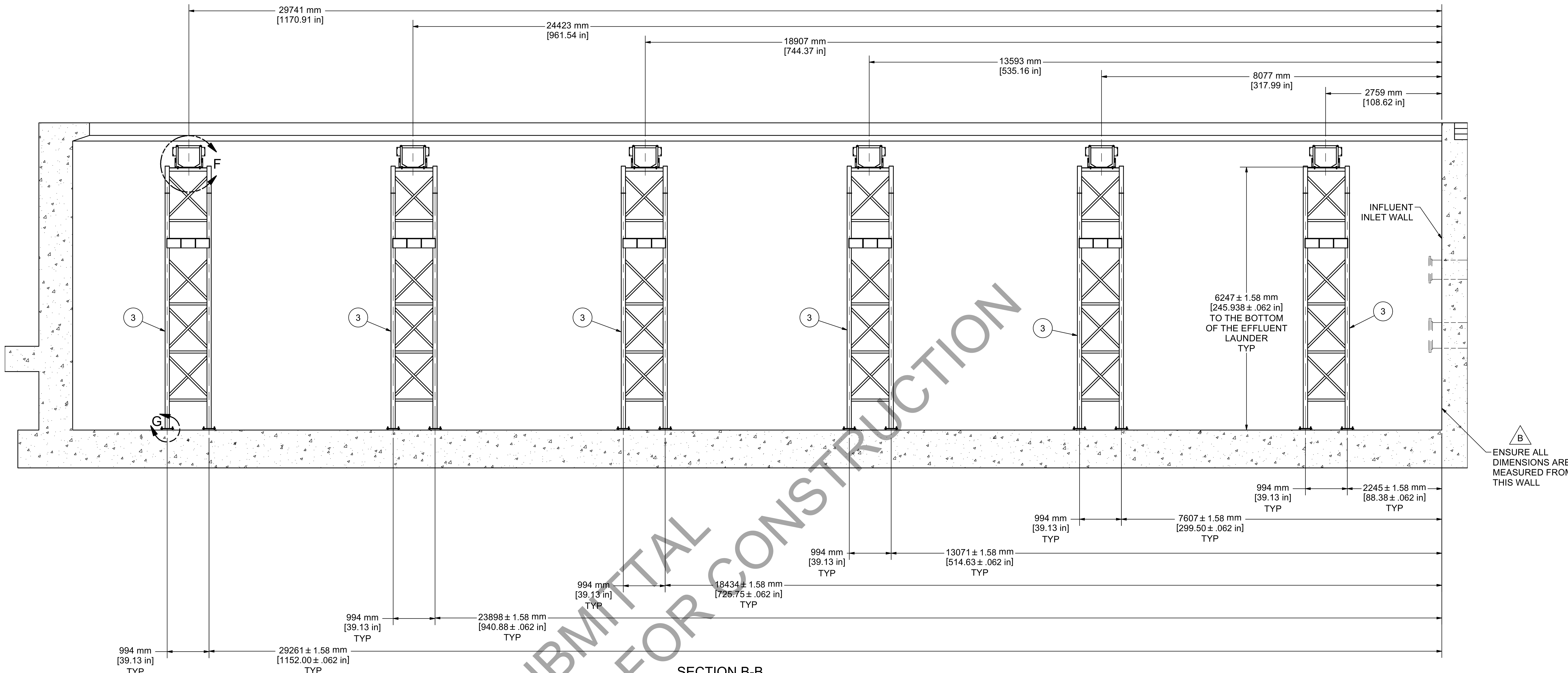
DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 1

AQUA-AEROBIC SYSTEMS, INC.

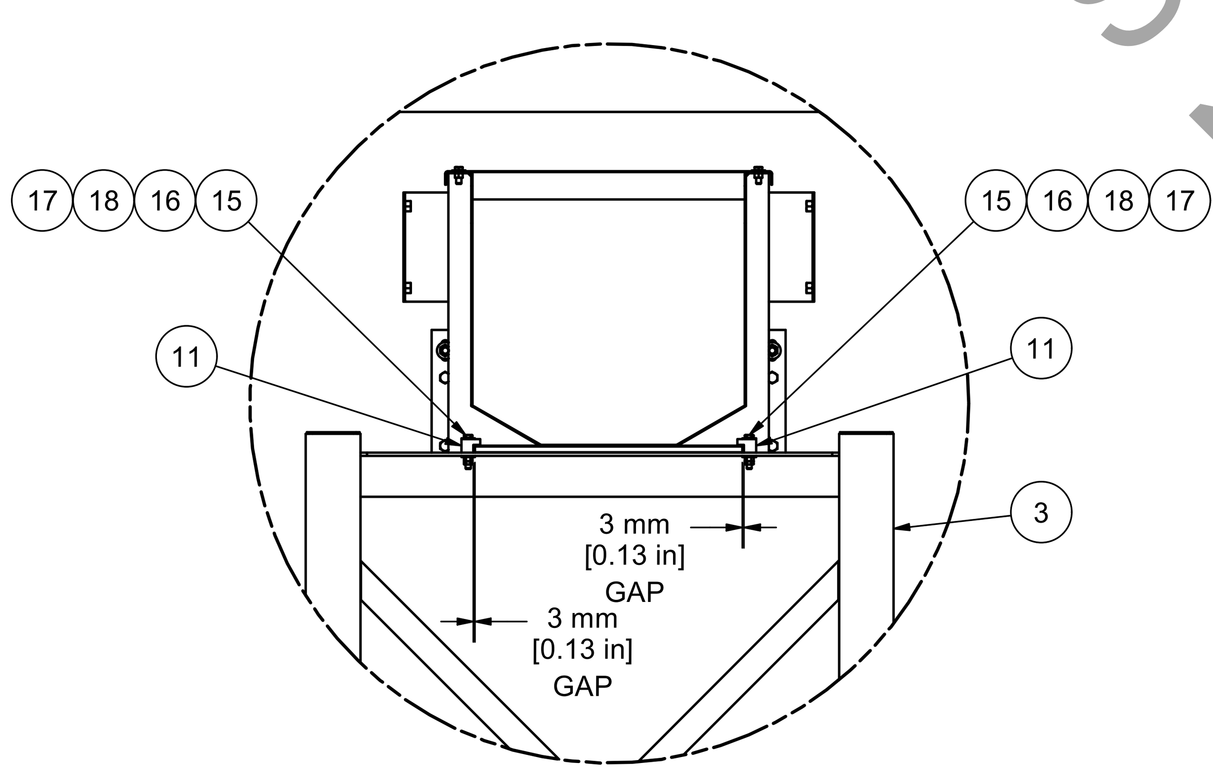
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

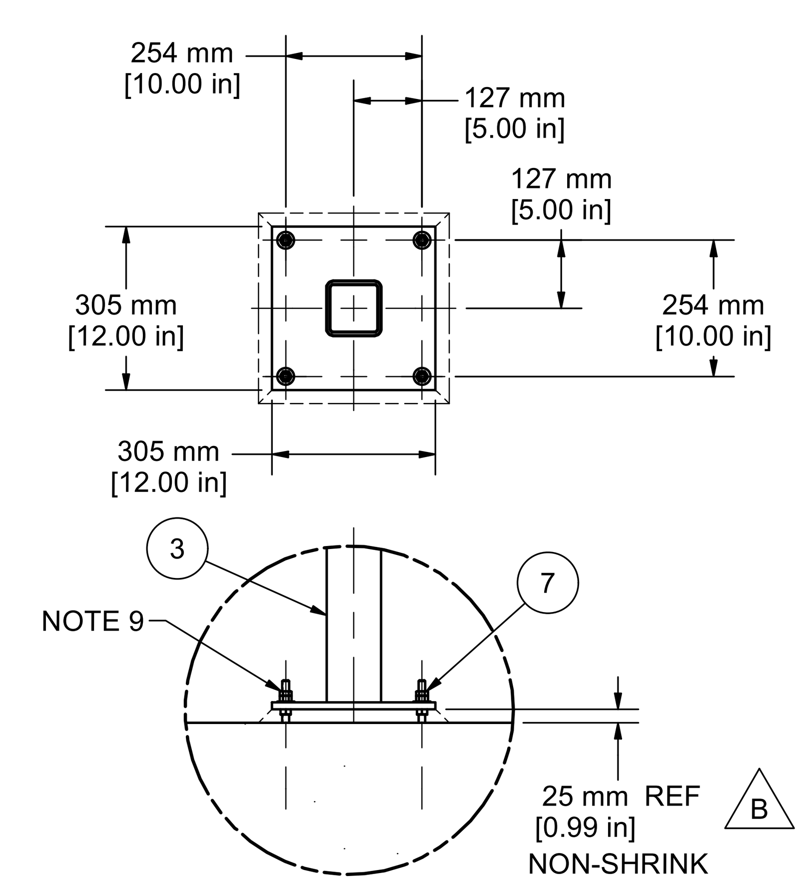
MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-09-10
WEIGHT: SHEET: 2 OF 3
DRAWING NUMBER: 9704419A30002 SCALE: 1:39 SIZE: D



SECTION B-B



DETAIL F
TYP (24)



DETAIL G
TYP (48)

SUBMITTAL
NOT FOR CONSTRUCTION

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-09-10	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION

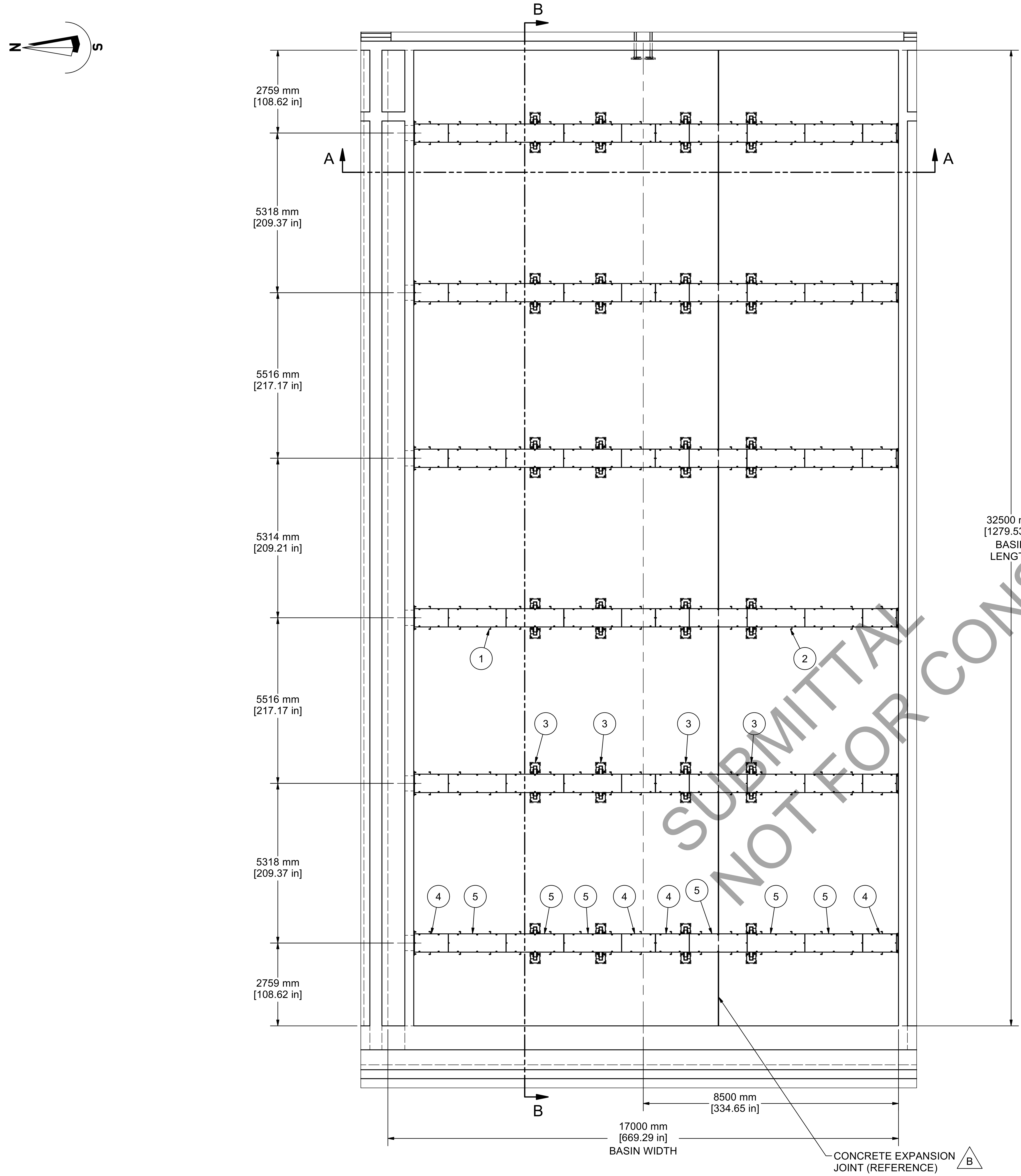
DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 1

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-09-10
WEIGHT: | SHEET: 3 OF 3
DRAWING NUMBER: 9704419A30002 | SCALE: 1:48 | SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. EFFLUENT SYSTEM IS NOT DESIGNED AS A WALKWAY, NOR IS IT DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AQUA-AEROBIC SYSTEMS.

9. COMPONENT WEIGHTS:
   - EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE: 272 KG [598 LB]
   - EFFLUENT LAUNDER WELDMENT: 287 KG [632 LB]
   - EFFLUENT LAUNDER SUPPORT WELDMENT: 332 KG [730 LB]
   - EFFLUENT LAUNDER COVER PLATE, SHORT: 12 KG [25 LB]
   - EFFLUENT LAUNDER COVER PLATE, LONG: 20 KG [43 LB]
   - EFFLUENT LAUNDER SLIDING WELDMENT: 27 KG [58 LB]
   - EFFLUENT LAUNDER WALL PLATE: 29 KG [62 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
21	6	2604138	SEALANT, TREMPRO 626, 10.1 OZ	-	-
20	48	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
19	48	2611824	HHCS, 1/2-13 X 2", FULL THREAD	316 SS	-
18	750	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
17	162	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
16	210	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
15	120	2606506	HHCS, 3/8-16 X 2.25"	316 SS	-
14	66	2610502	HHCS, 3/8-16 X 1.5", FULL THREAD	316 SS	-
13	312	2619720	HHCS, 3/8-16 X 1", FULL THREAD	316 SS	-
12	66	2605219	HHCS, 3/8-16 X 0.75", FULL THREAD	316 SS	-
11	60	2522929-SX0	EFFLUENT LAUNDER SLIDE BAR	304 SS	Y
10	6	2522926-SX0	EFFLUENT LAUNDER WALL PLATE	304 SS	Y
9	12	2522801	EFFLUENT LAUNDER GASKET	EPDM	Y
8	6	2916685-SX0	EFFLUENT LAUNDER SLIDING WELDMENT	304 SS	Y
7	192	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
6	66	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
5	36	9704419A30327	COVER PLATE, EFFLUENT LAUNDER, LONG	304 SS	Y
4	24	9704419A30326	COVER PLATE, EFFLUENT LAUNDER, SHORT	304 SS	Y
3	24	9704419A30205	EFFLUENT LAUNDER SUPPORT WELDMENT, 6"	304 SS	Y
2	6	9704419A30204	EFFLUENT LAUNDER WELDMENT	304 SS	Y
1	6	9704419A30203	EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-09-11	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

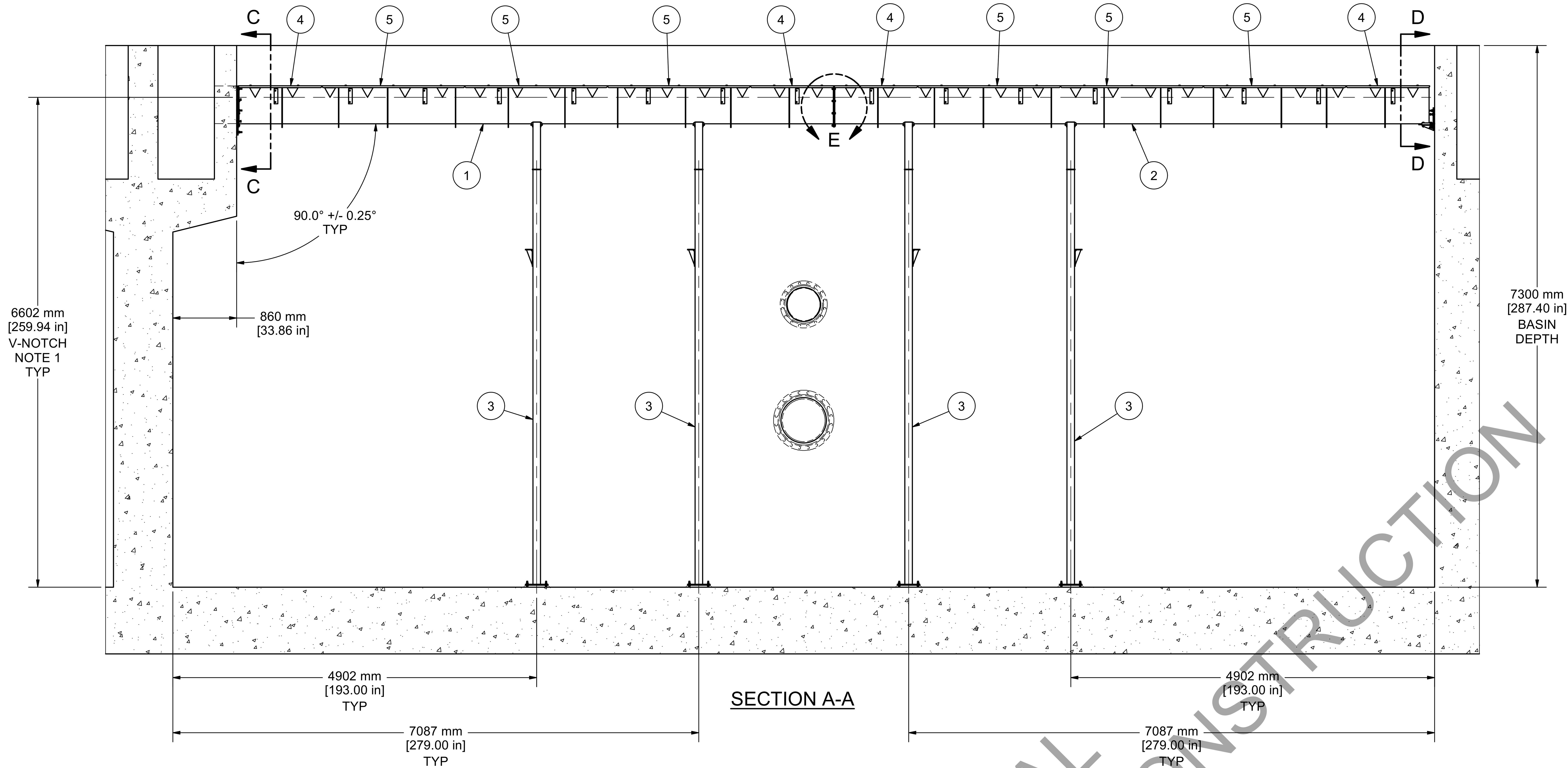
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-09-10
WEIGHT: SHEET: 1 OF 3

DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 2
DRAWING NUMBER: 9704419A30003 SCALE: 1:78 SIZE: D

CONFIDENTIAL



SECTION A-A

EFFLUENT WALL PLATE INSTALLATION NOTES:

1. ALL V-NOTCHES ARE TO BE LEVEL WITHIN +/- 3/16" ACROSS THE ENTIRE BASIN. USE A LASER GUIDED LEVEL.

2. INSTALL JACK SCREWS AND JAM NUTS IN THE (4) TAPPED HOLES. DO NOT DRILL INTO CONCRETE.

3. USE WALL PLATE AS A TEMPLATE. LOCATE THE WALL PLATE ON THE EFFLUENT END WALL PER DIMENSIONS SHOWN. MARK, DRILL AND INSTALL EVERY OTHER ANCHOR.

4. USE JACK SCREWS TO PLUMB AND SQUARE THE WALL PLATE BY USING A CARPENTERS SQUARE. EFFLUENT WALL PLATE TO BE PLUMB AND SQUARE ± 0.25°. WHEN PLUMB AND SQUARE, TIGHTEN NUTS ON THE JACK SCREWS.

5. DRILL THE REMAINING HOLES AND INSTALL THE REMAINING ANCHORS.

6. LOOSEN ANCHORS ENOUGH TO APPLY SEALANT BEHIND THE WALL PLATE AND AROUND THE EFFLUENT WALL PORT. DO NOT LOOSEN JACK SCREWS.

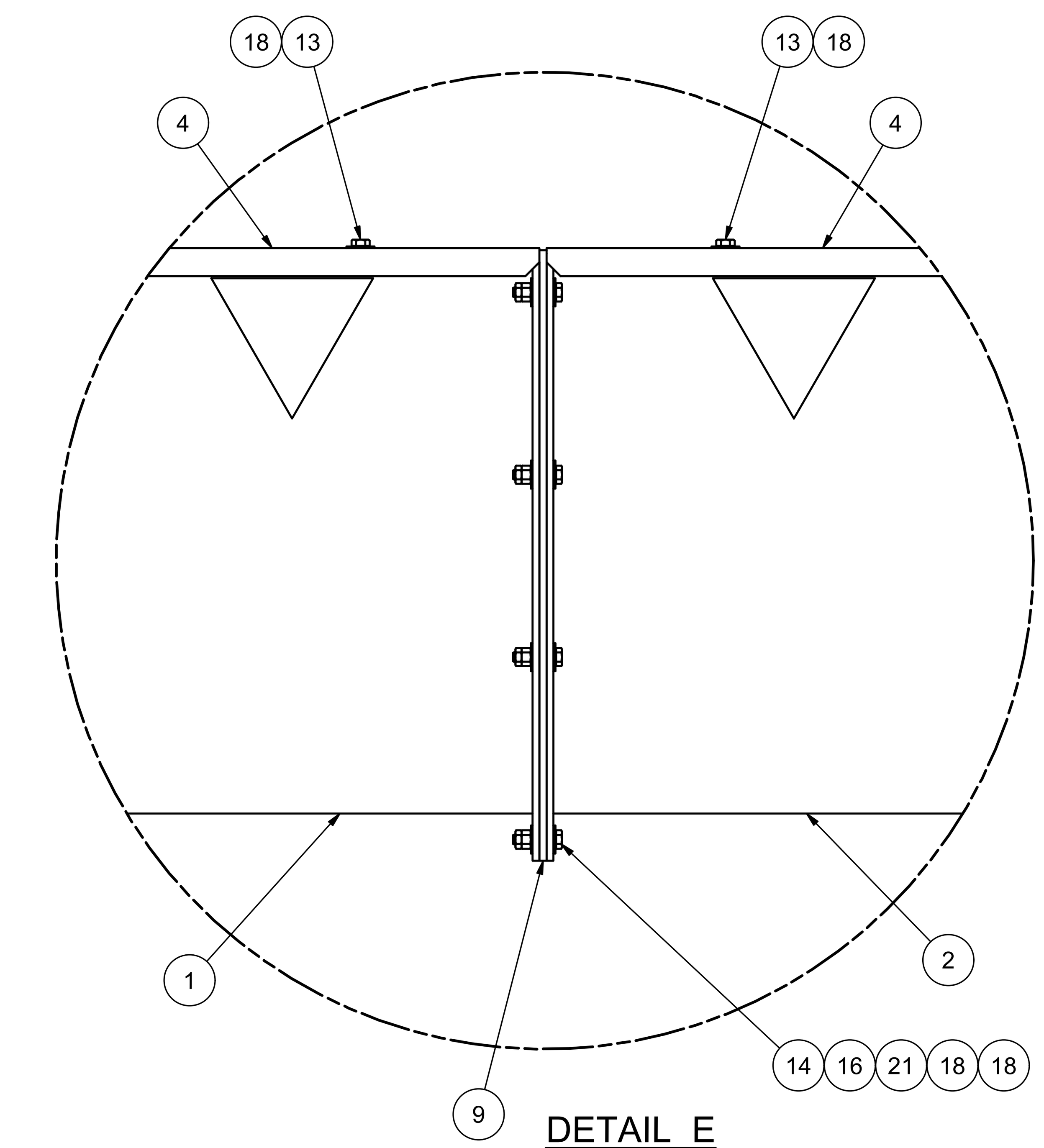
7. TIGHTEN DOWN ALL ANCHORS. RE-VERIFY PLUMB AND SQUARE, THEN RE-CAULK SIDES OF THE PLATE FILLING UP ALL GAPS IN CONCRETE.

INSTALLATION NOTES:

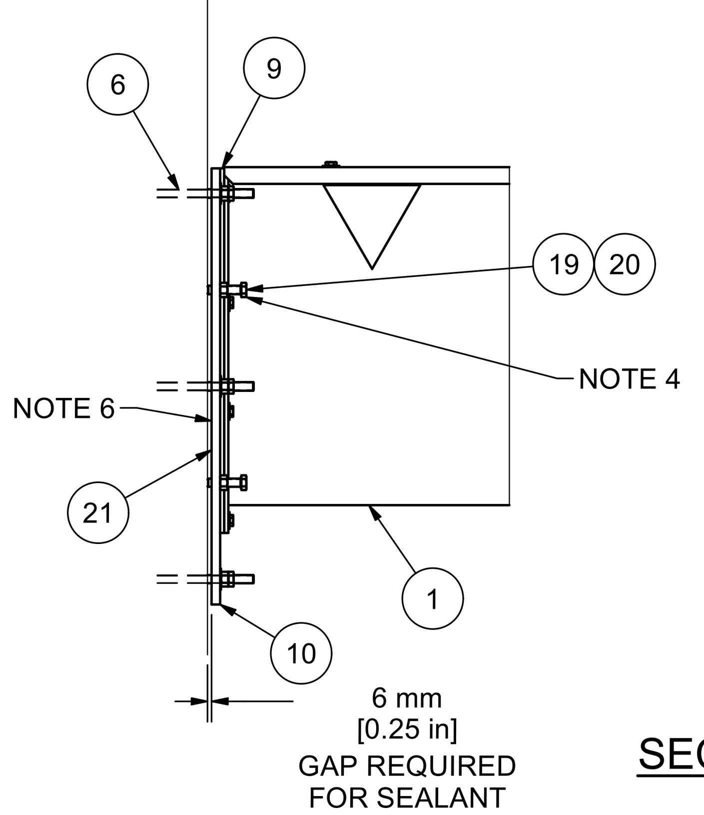
8. VERTICAL SUPPORT BASE PLATES TO BE USED AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.

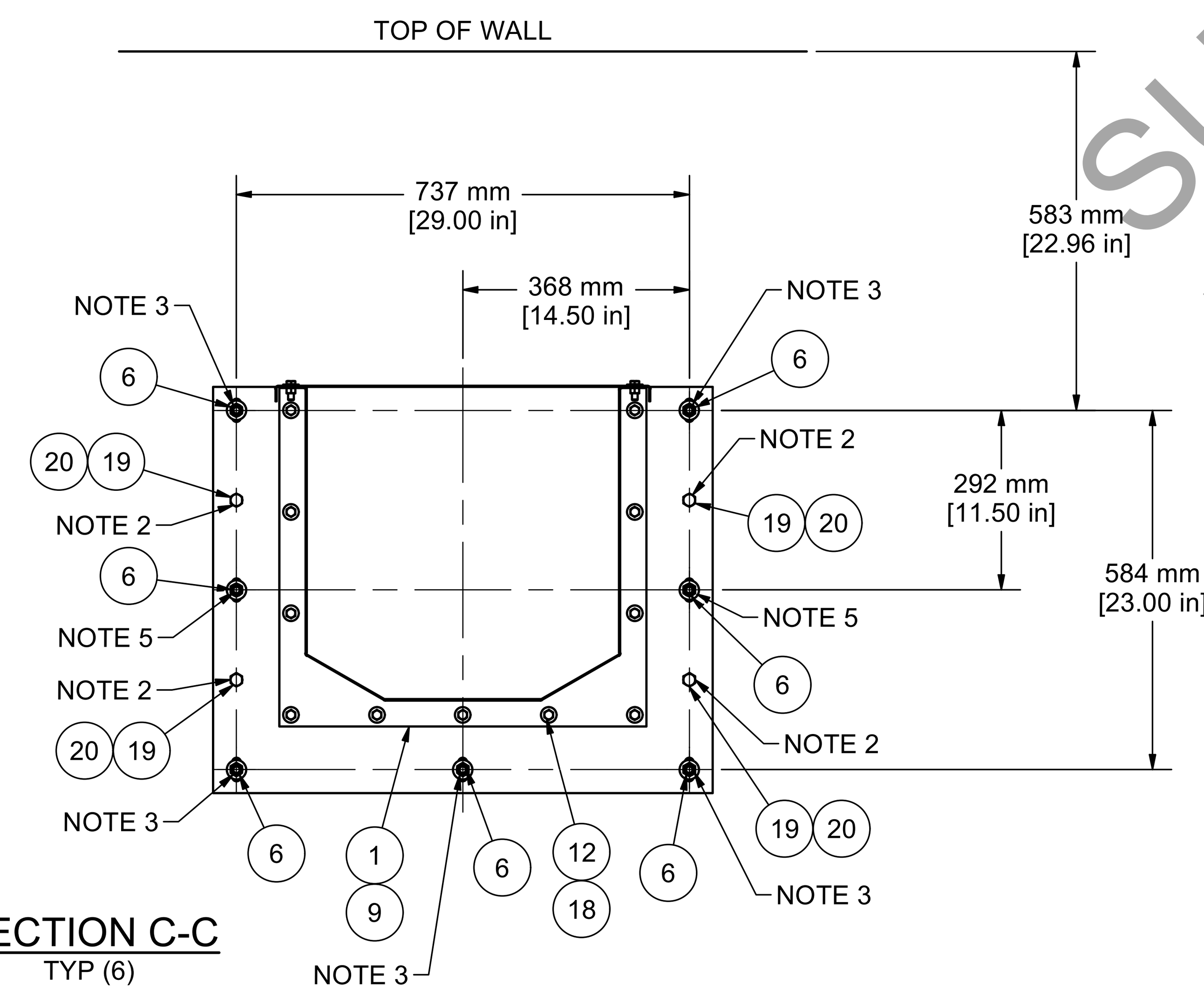
9. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR PROPER INSTALLATION.

10. FOR ALL EFFLUENT LAUNDER SLIDE BARS: SPIN FULL NUT UNTIL SLIDE BAR IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH SECOND FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

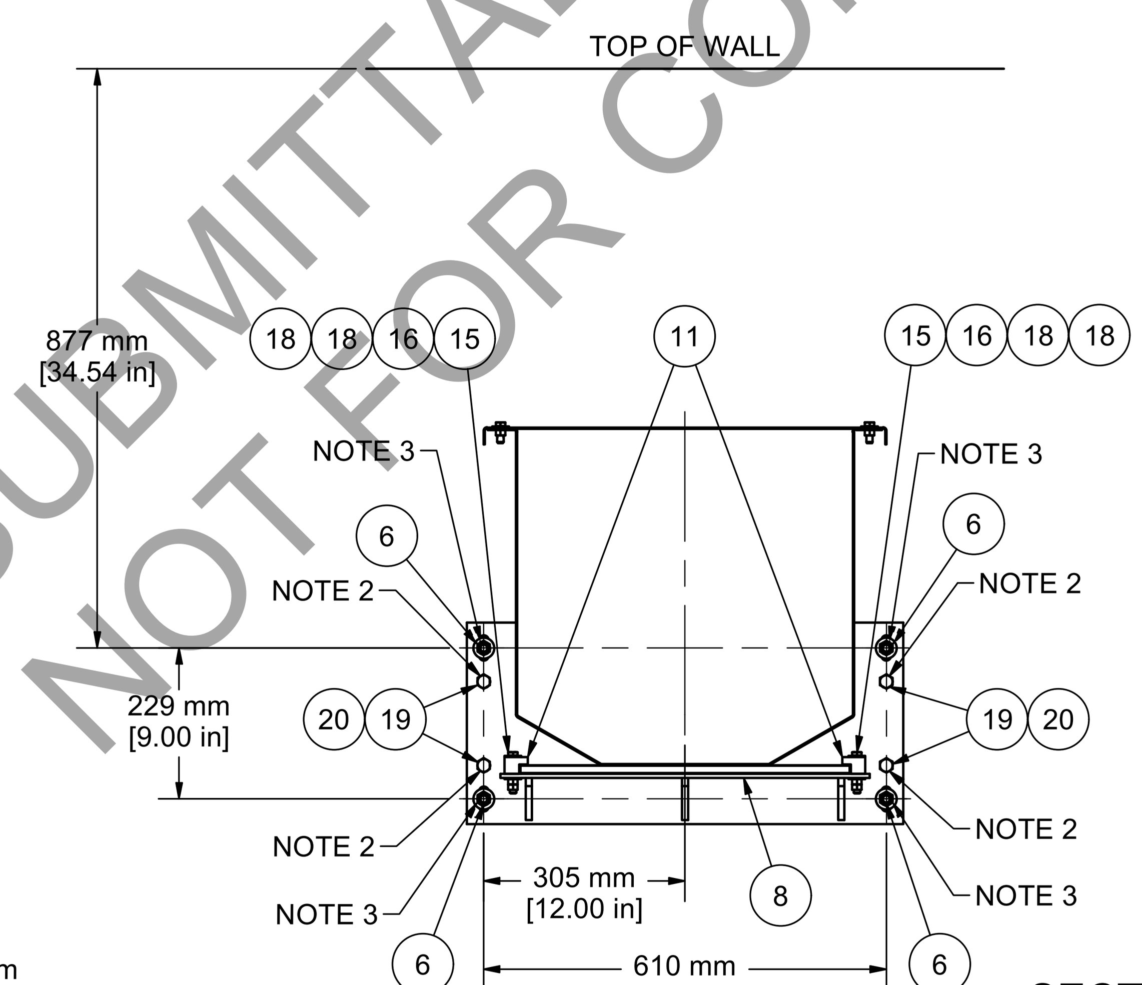


DETAIL E
TYP (6)

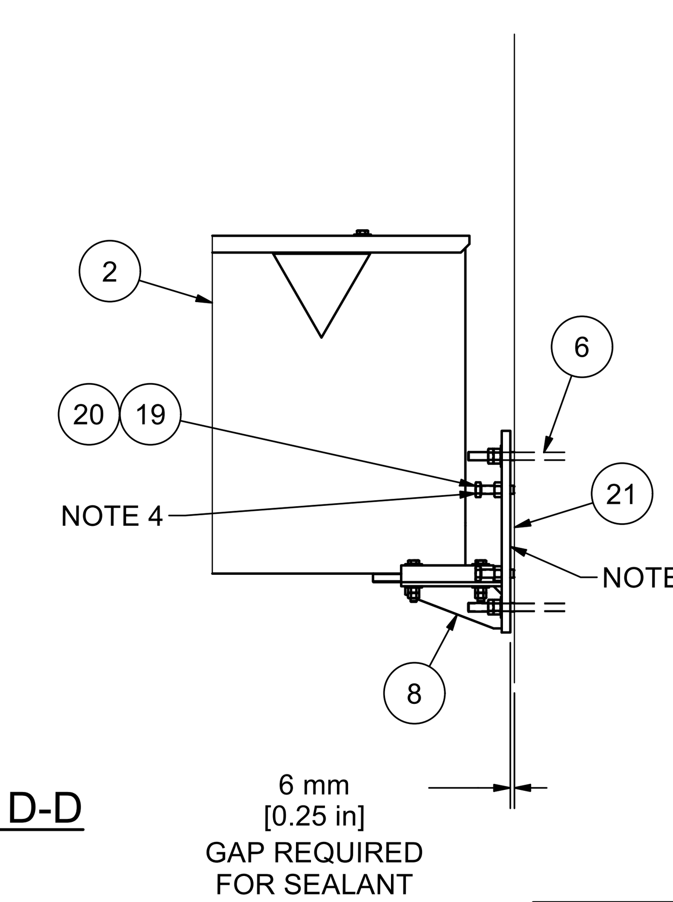




SECTION C-C
TYP (6)



SECTION D-D
TYP (6)



CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-09-11	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION

DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 2

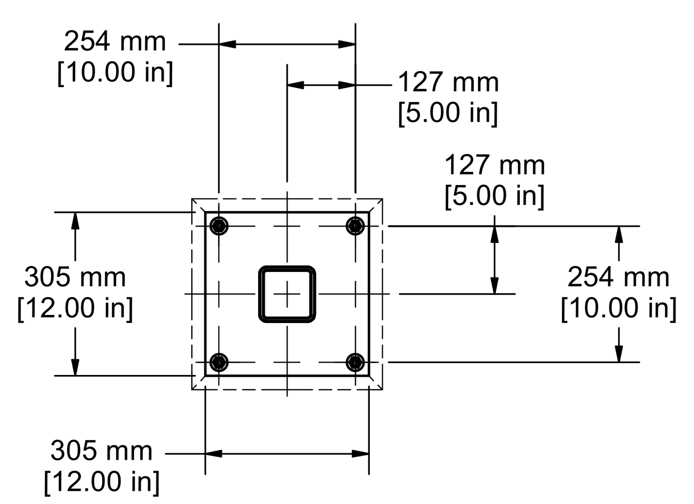
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

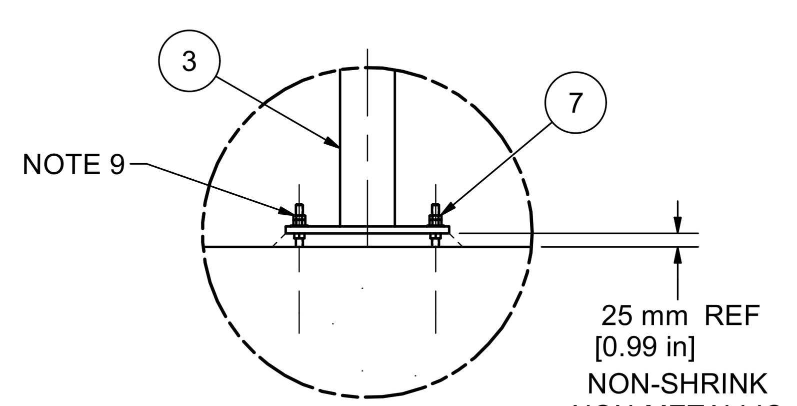
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

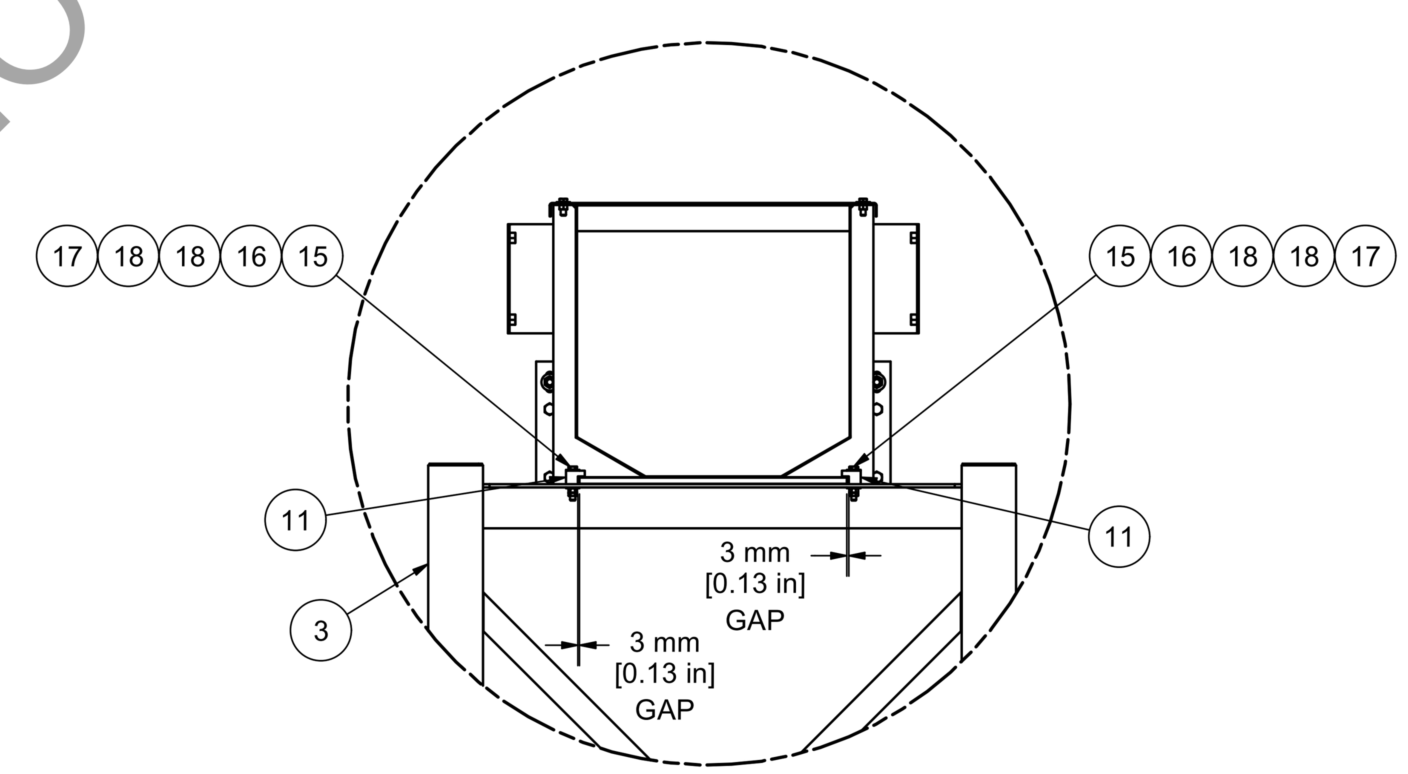
MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-09-10
WEIGHT: SHEET: 2 OF 3
DRAWING NUMBER: 9704419A30003 SCALE: 1:39 SIZE: D

SECTION B-B





DETAIL G
TYP (48)



DETAIL F
TYP (24)

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

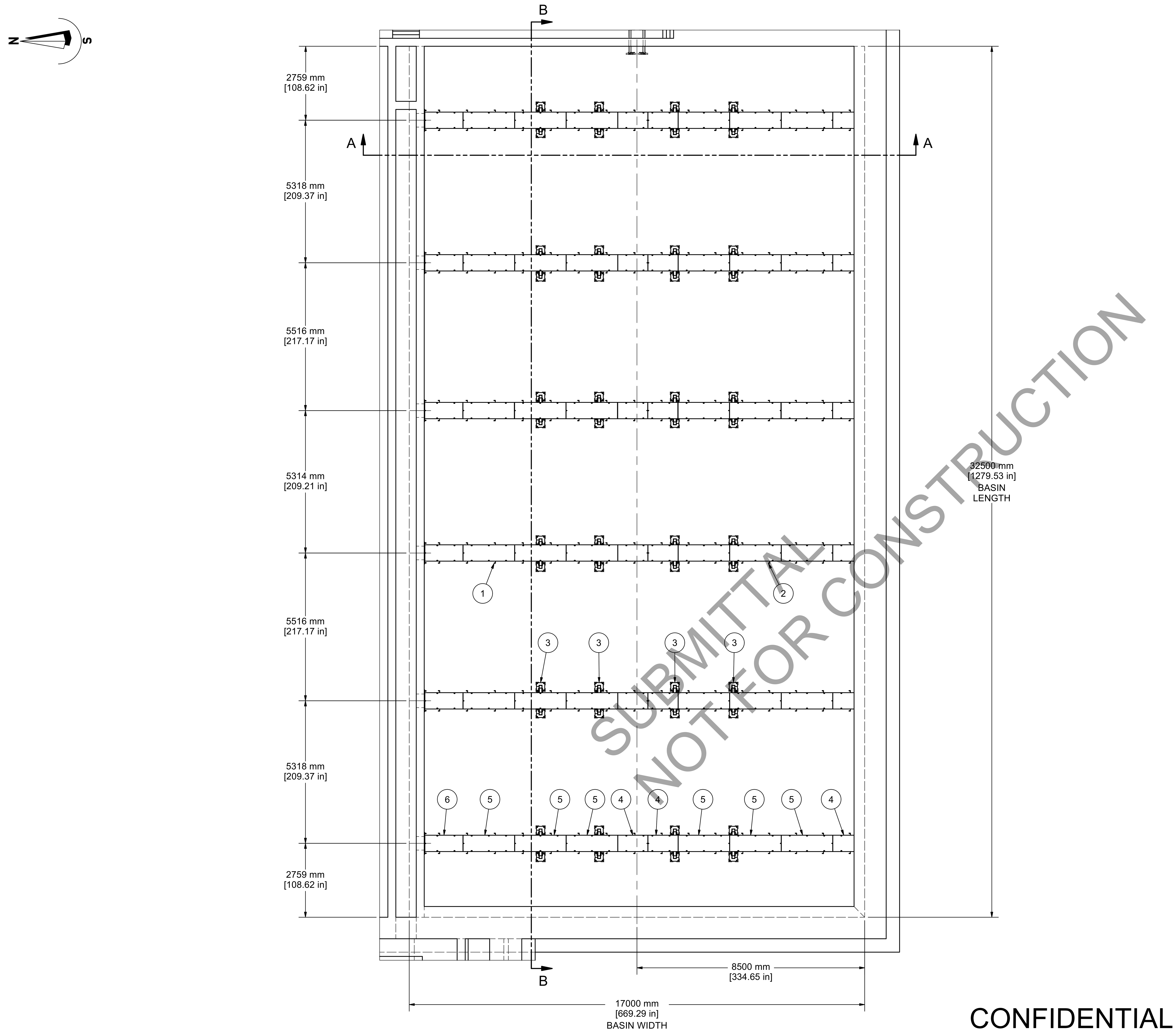
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-09-10
WEIGHT:
SHEET: 3 OF 3

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-09-11	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 2
DRAWING NUMBER: 9704419A30003
SCALE: 1:48
SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. EFFLUENT SYSTEM IS NOT DESIGNED AS A WALKWAY, NOR IS IT DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AQUA-AEROBIC SYSTEMS.

9. COMPONENT WEIGHTS:
- EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE, LONG: 279 KG [614 LB]
- EFFLUENT LAUNDER WELDMENT: 287 KG [632 LB]
- EFFLUENT LAUNDER SUPPORT WELDMENT: 332 KG [730 LB]
- EFFLUENT LAUNDER COVER PLATE, SHORT: 12 KG [25 LB]
- EFFLUENT LAUNDER COVER PLATE, LONG: 20 KG [43 LB]
- EFFLUENT LAUNDER COVER PLATE, END: 15 KG [32 LB]
- EFFLUENT LAUNDER SLIDING WELDMENT: 27 KG [58 LB]
- EFFLUENT LAUNDER WALL PLATE: 29 KG [62 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
22	6	2604138	SEALANT, TREMPRO 626, 10.1 OZ	-	-
21	48	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
20	48	2611824	HHCS, 1/2-13 X 2", FULL THREAD	316 SS	-
19	750	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
18	161	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
17	211	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
16	120	2606506	HHCS, 3/8-16 X 2.25"	316 SS	-
15	66	2610502	HHCS, 3/8-16 X 1.5", FULL THREAD	316 SS	-
14	312	2619720	HHCS, 3/8-16 X 1", FULL THREAD	316 SS	-
13	66	2605219	HHCS, 3/8-16 X 0.75", FULL THREAD	316 SS	-
12	60	2522929-SX0	EFFLUENT LAUNDER SLIDE BAR	304 SS	Y
11	6	2522926-SX0	EFFLUENT LAUNDER WALL PLATE	304 SS	Y
10	12	2522801	EFFLUENT LAUNDER GASKET	EPDM	Y
9	6	2916685-SX0	EFFLUENT LAUNDER SLIDING WELDMENT	304 SS	Y
8	192	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
7	66	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
6	6	9704419A30344	COVER PLATE, EFFLUENT LAUNDER, END, AGS 3	304 SS	Y
5	36	9704419A30327	COVER PLATE, EFFLUENT LAUNDER, LONG	304 SS	Y
4	18	9704419A30326	COVER PLATE, EFFLUENT LAUNDER, SHORT	304 SS	Y
3	24	9704419A30205	EFFLUENT LAUNDER SUPPORT WELDMENT, 6"	304 SS	Y
2	6	9704419A30204	EFFLUENT LAUNDER WELDMENT	304 SS	Y
1	6	9704419A30207	EFFLUENT LAUNDER WELDMENT, CHANNEL SIDE, LONG	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-09-16	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

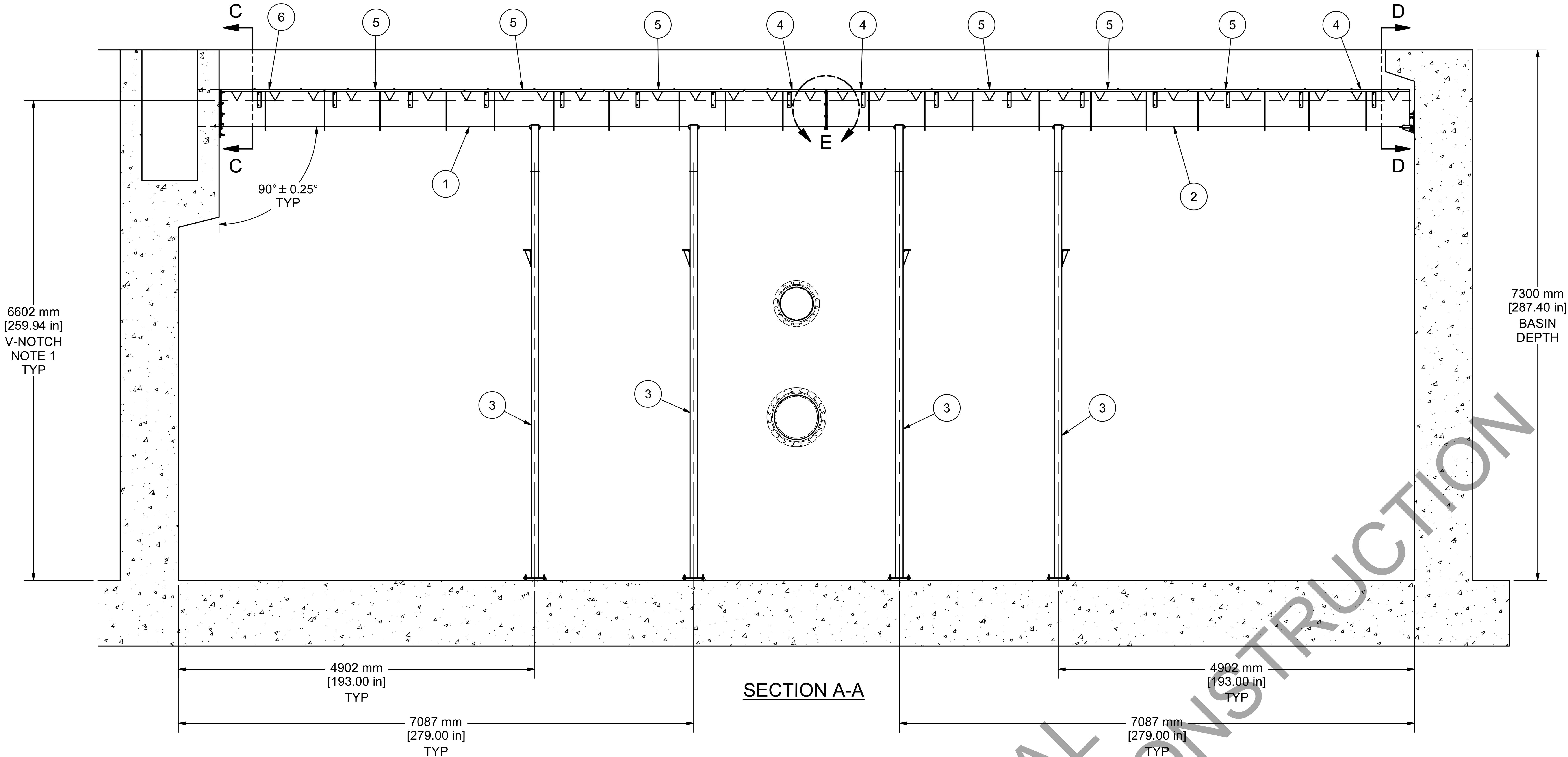
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-09-11
WEIGHT: SHEET: 1 OF 3

DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 3
DRAWING NUMBER: 9704419A30004 SCALE: 1:78 SIZE: D



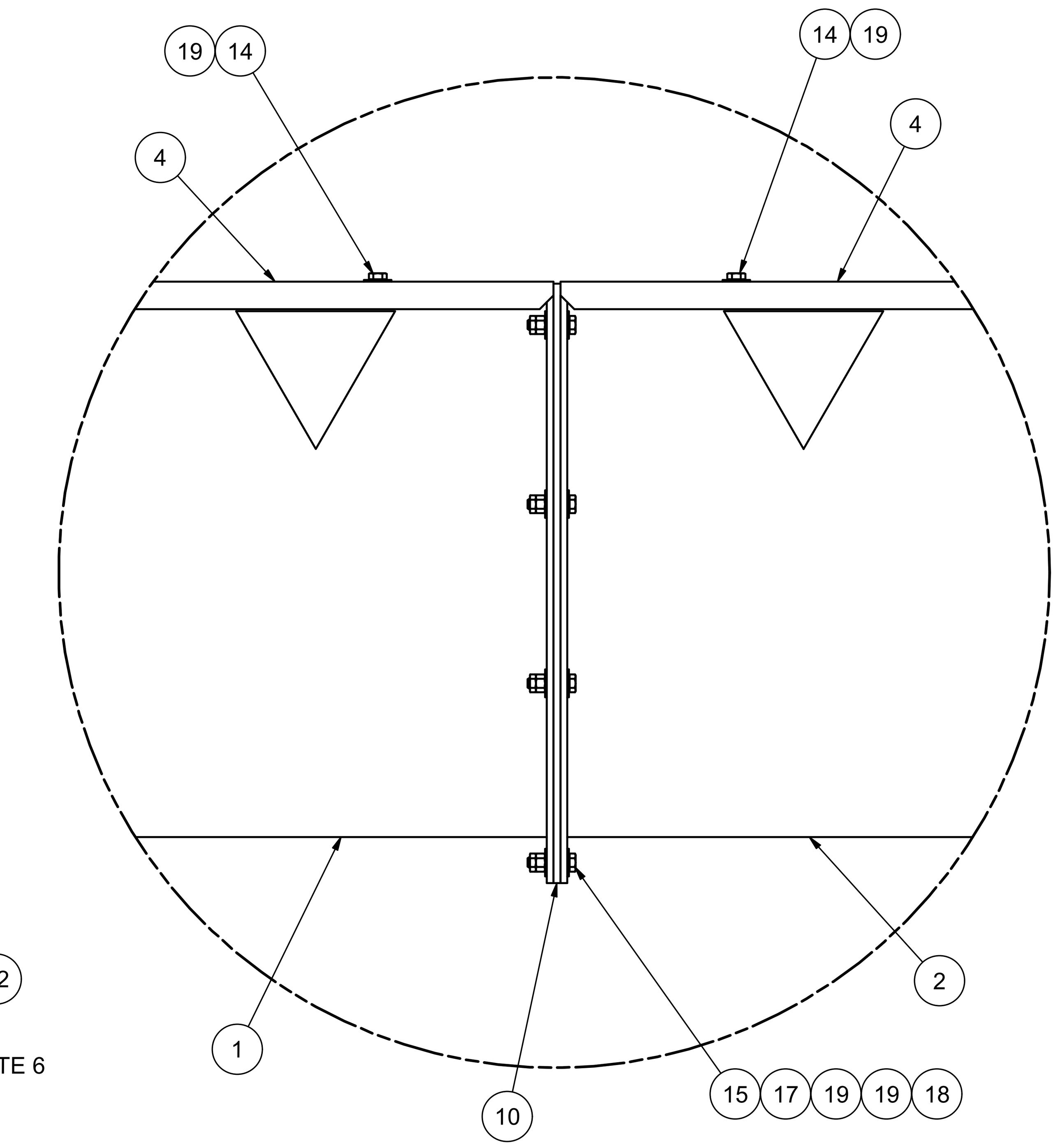
SECTION A-A

EFFLUENT WALL PLATE INSTALLATION NOTES:

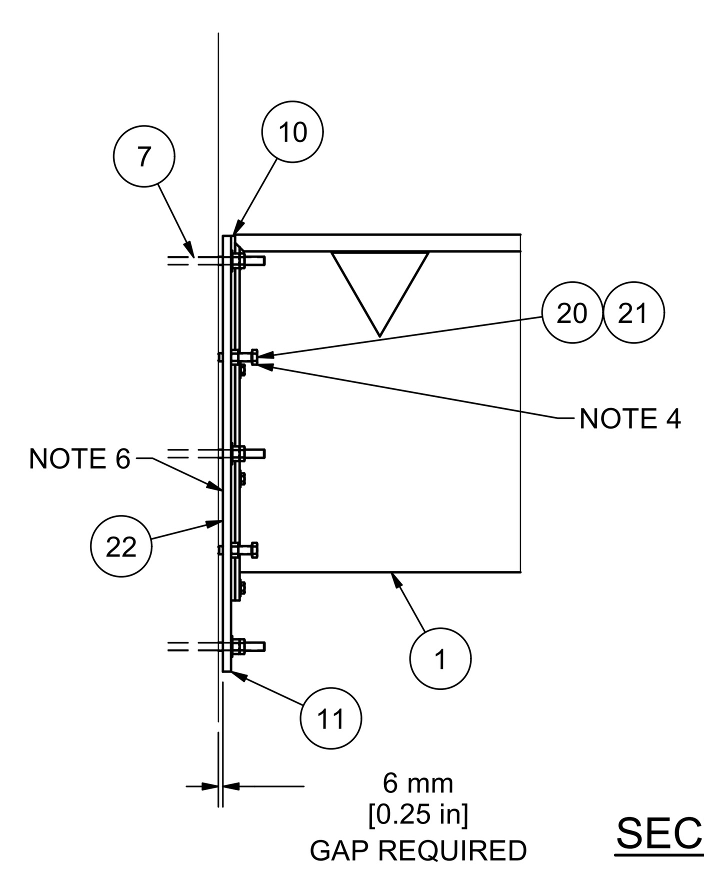
1. ALL V-NOTCHES ARE TO BE LEVEL WITHIN +/- 3/16" ACROSS THE ENTIRE BASIN. USE A LASER GUIDED LEVEL.
2. INSTALL JACK SCREWS AND JAM NUTS IN THE (4) TAPPED HOLES. DO NOT DRILL INTO CONCRETE.
3. USE WALL PLATE AS A TEMPLATE. LOCATE THE WALL PLATE ON THE EFFLUENT END WALL PER DIMENSIONS SHOWN. MARK, DRILL AND INSTALL EVERY OTHER ANCHOR.
4. USE JACK SCREWS TO PLUMB AND SQUARE THE WALL PLATE BY USING A CARPENTERS SQUARE. EFFLUENT WALL PLATE TO BE PLUMB AND SQUARE ± 0.25°. WHEN PLUMB AND SQUARE, TIGHTEN NUTS ON THE JACK SCREWS.
5. DRILL THE REMAINING HOLES AND INSTALL THE REMAINING ANCHORS.
6. LOOSEN ANCHORS ENOUGH TO APPLY SEALANT BEHIND THE WALL PLATE AND AROUND THE EFFLUENT WALL PORT. DO NOT LOOSEN JACK SCREWS.
7. TIGHTEN DOWN ALL ANCHORS. RE-VERIFY PLUMB AND SQUARE, THEN RE-CAULK SIDES OF THE PLATE FILLING UP ALL GAPS IN CONCRETE.

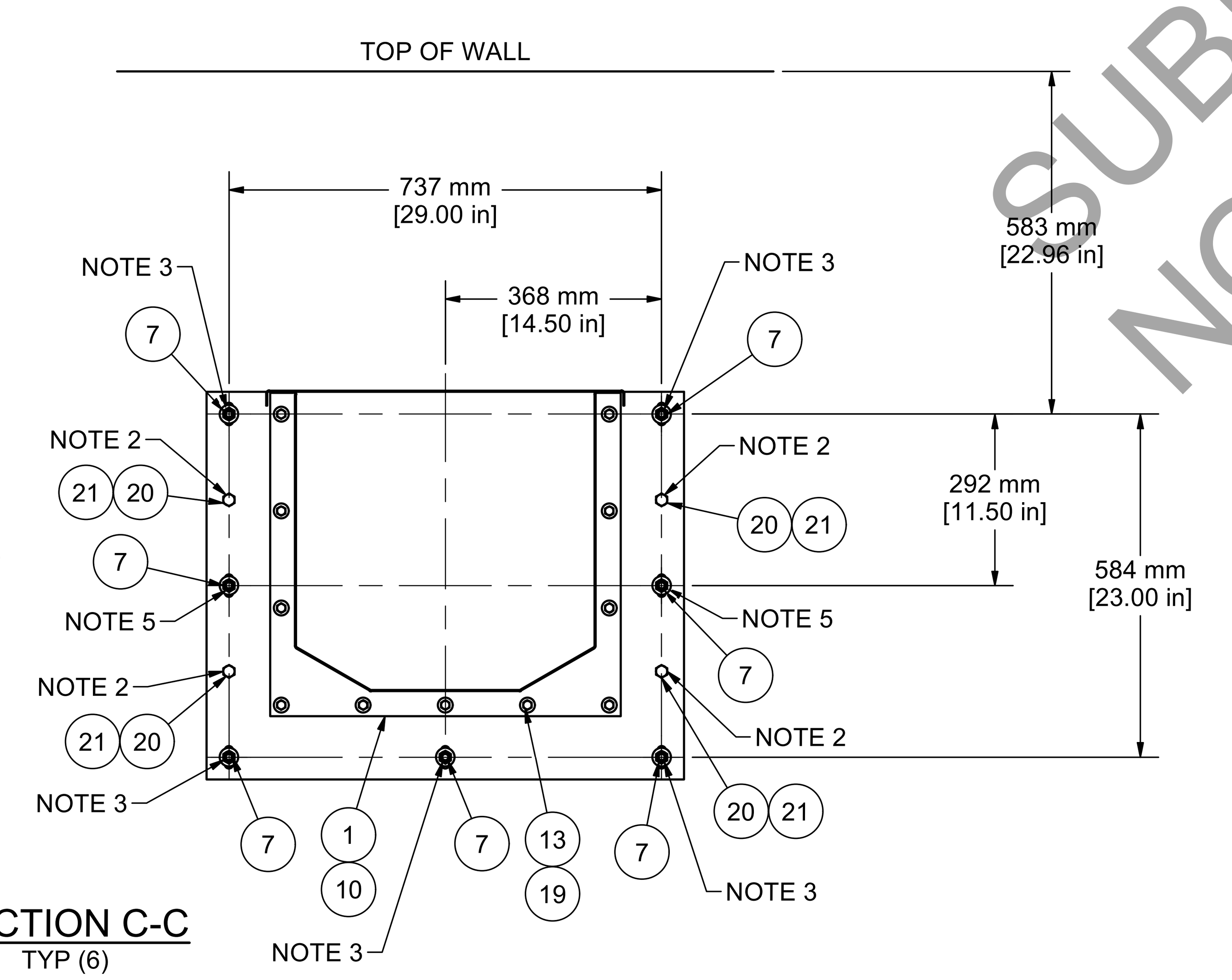
INSTALLATION NOTES:

8. VERTICAL SUPPORT BASE PLATES TO BE USED AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.
9. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR PROPER INSTALLATION.
10. FOR ALL EFFLUENT LAUNDER SLIDE BARS: SPIN FULL NUT UNTIL SLIDE BAR IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH SECOND FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

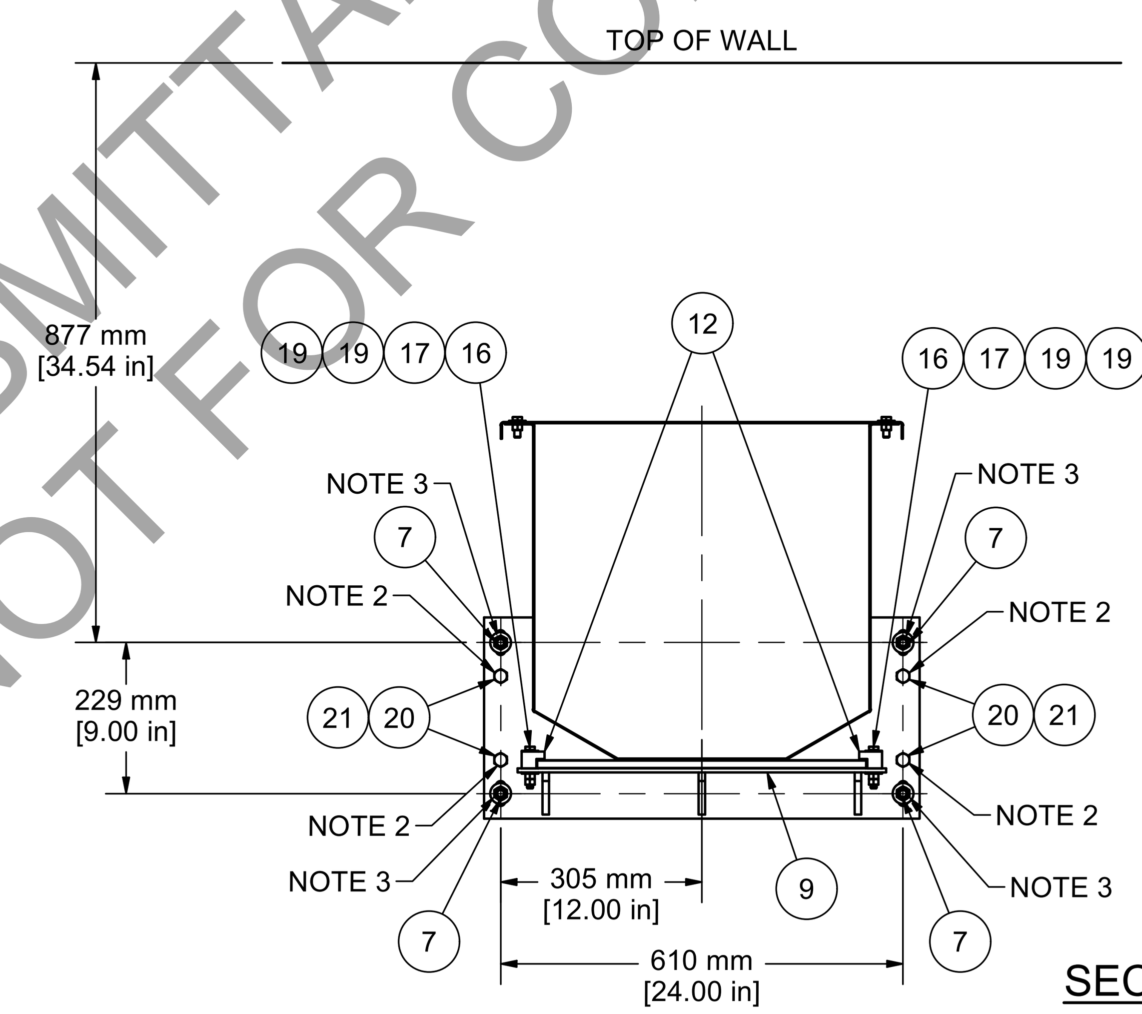


DETAIL E
TYP (6)

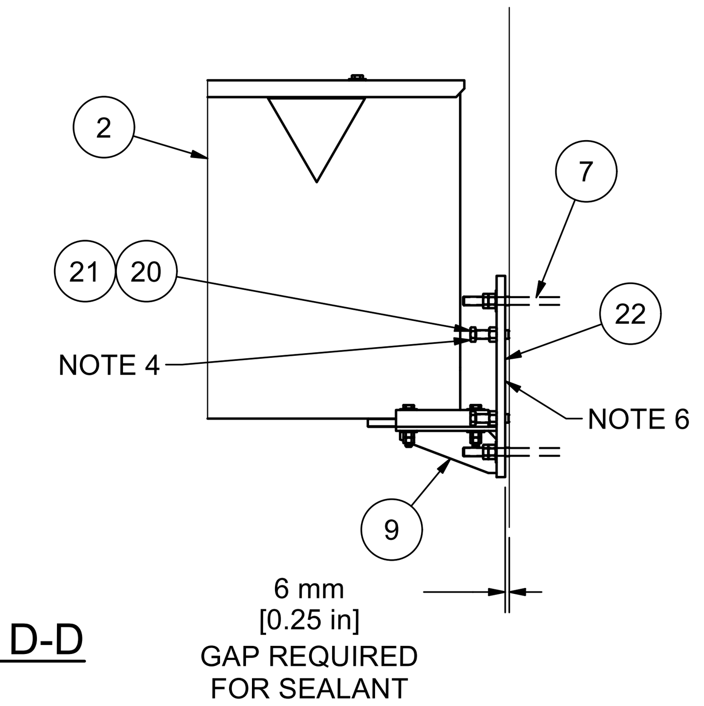




SECTION C-C
TYP (6)



SECTION D-D
TYP (6)



JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-09-16	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 3				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

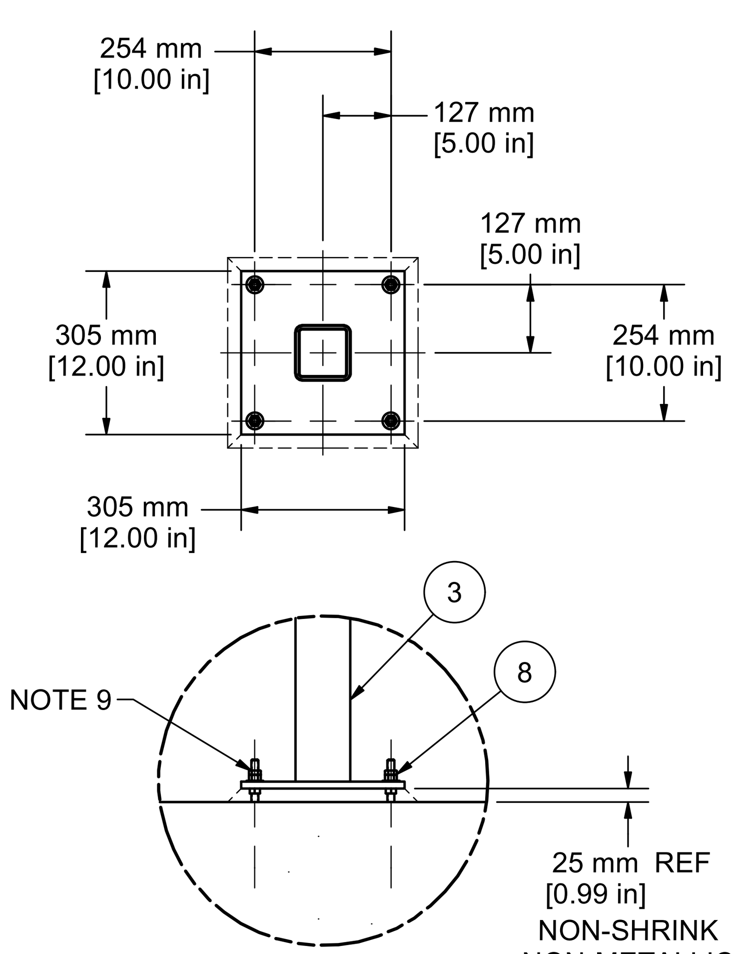
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

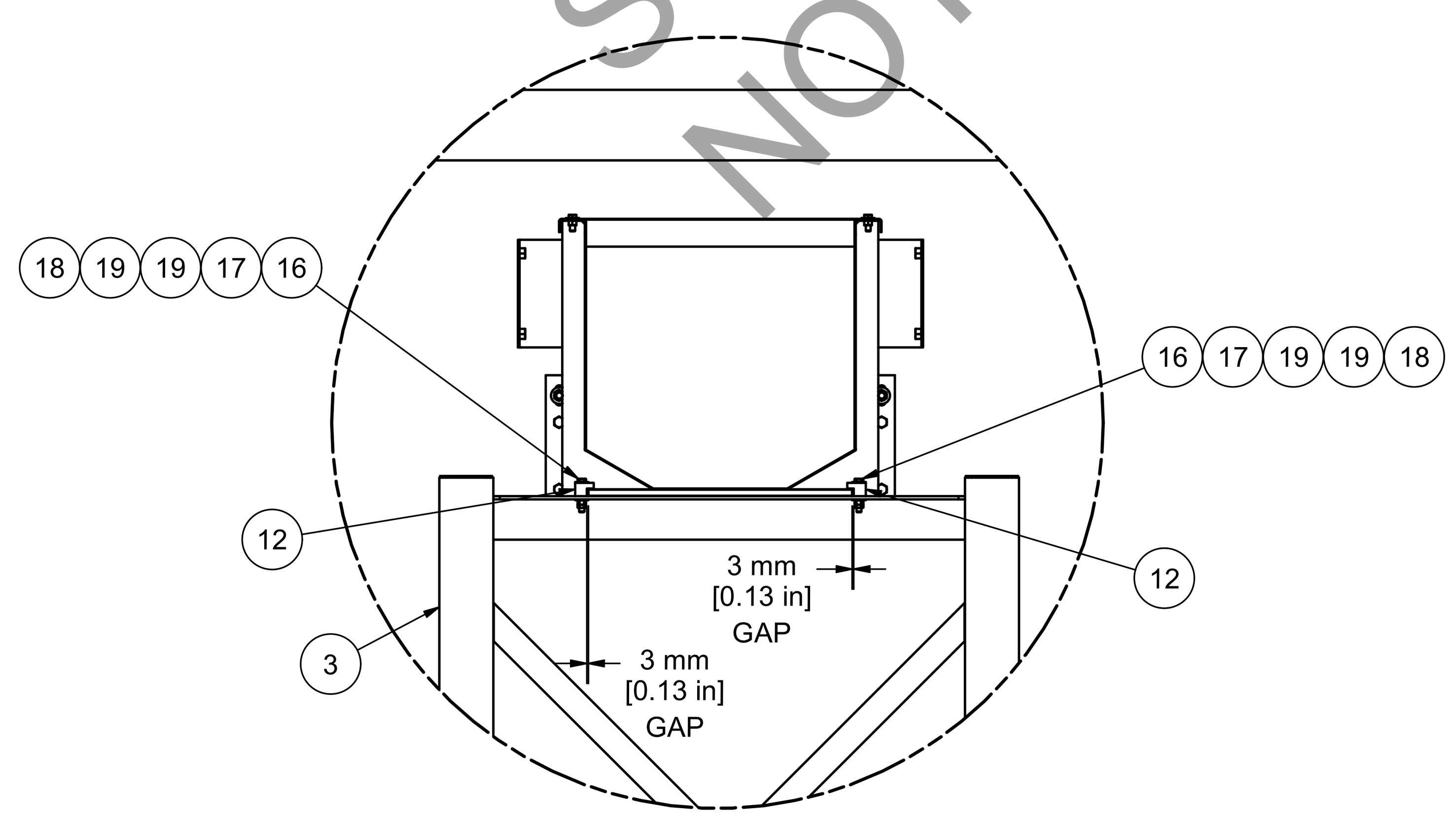
ANSI

MATERIAL:	304 SS
SIMILAR TO:	911689230004
TYPE:	AQUANEREDA
DRAWN BY:	JFM
DATE:	2024-09-11
WEIGHT:	
SHEET:	2 OF 3
DRAWING NUMBER:	9704419A30004
SCALE:	1:39
SIZE:	D

SECTION B-B



DETAIL G
TYP (48)



DETAIL F
TYP (24)

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-09-16	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: EFFLUENT LAUNDER INSTL, AGS 3				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

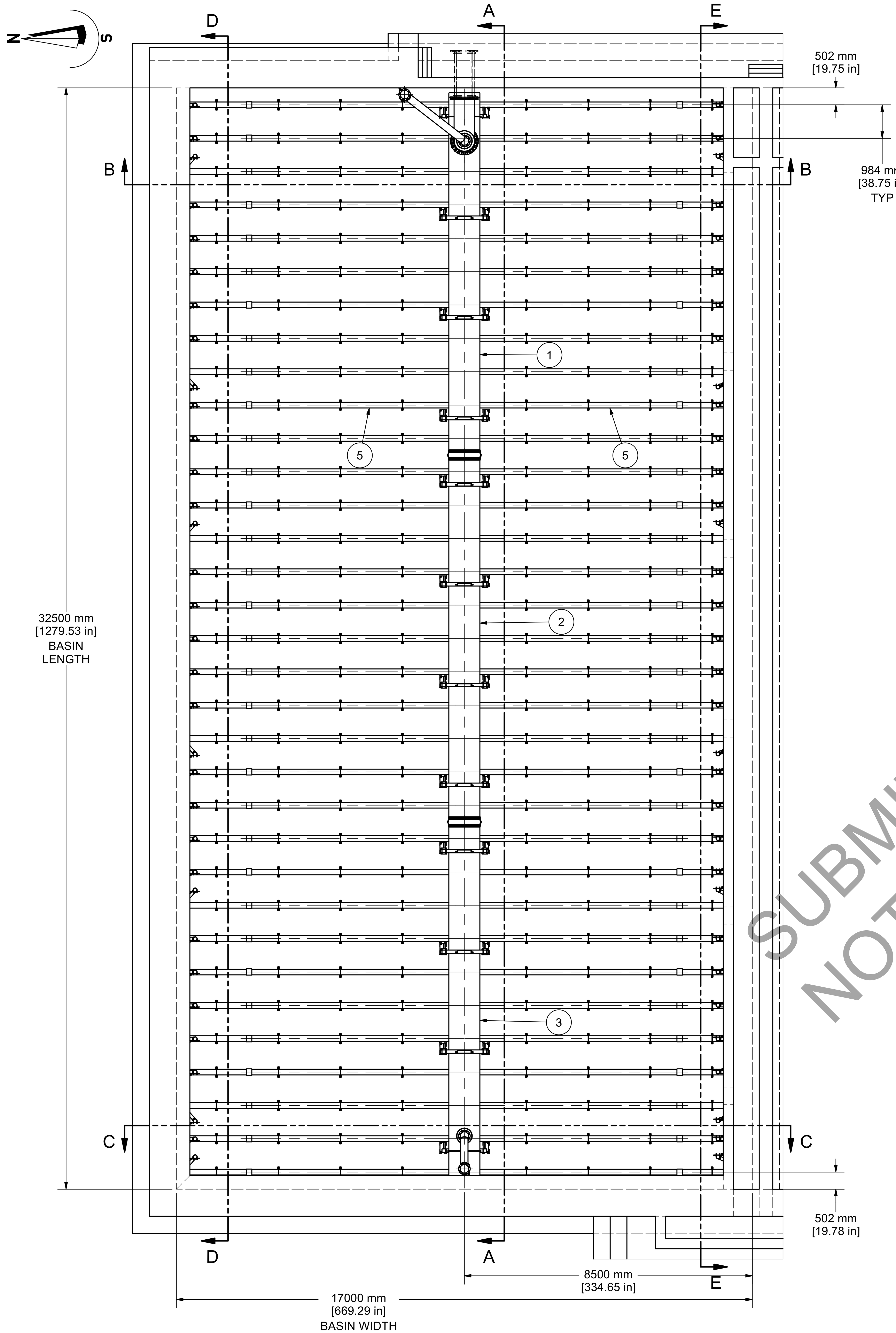
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230004
TYPE: AQUANEREDA
DRAWN BY: JFM — DATE: 2024-09-11
WEIGHT: — SHEET: 3 OF 3
DRAWING NUMBER: 9704419A30004 — SCALE: 1:48 — SIZE: D



NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. INFLUENT LATERAL PIPES MUST BE MOUNTED WITH THE ORIFICE HOLES POINTED STRAIGHT DOWN WITHIN +/- 1°. A MARK HAS BEEN MADE AT EACH END OF THE PIPE TO AID IN ALIGNMENT. THE SUPPORT BRACKETS MUST NOT COVER THE ORIFICES.

9. ALL INFLUENT LATERAL PIPES MUST BE HELD ON THE SAME CENTERLINE ELEVATION WITHIN +/- 1/4" TO MAINTAIN UNIFORM DISTRIBUTION.

10. USE VENT PIPE SUPPORT BRACKETS AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.

11. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR INSTALLATION INSTRUCTIONS.

12. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TURN THE FIRST FULL NUT AN ADDITIONAL 1/2 TURN. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

13. THE FIXED END OF THE HEADER SECTION MUST BE LOCATED RELATIVE TO THE INFLUENT WALL, NOT THE PRECEDING LATERAL ROW. PIPES WILL THEN BE INSERTED EQUALLY INTO THE COUPLING.

14. IT IS PREFERRED TO ERECT THE HEADER PIPING WHEN PIPE TEMPERATURES ARE AS CLOSE TO 70°F, AS POSSIBLE.

15. FOR SUMMER INSTALLATIONS, THE PIPES CAN BE COOLED WITH WATER, SHADE OR INSTALLED EARLY IN THE MORNING. PIPES SHOULD NOT EXCEED 122°F SURFACE TEMPERATURE DURING INSTALLATION.

16. FOR WINTER INSTALLATIONS, INSTALLATION OF THE JOINTS SHOULD TAKE PLACE AT THE WARMEST TIME OF THE DAY. WHEN THE TEMPERATURE IS LESS THAN 18°F AND IF LOW POWER HEATING BLANKETS OR DARK COLORED TARPS ARE AVAILABLE, THEY SHOULD BE USED TO WARM THE PIPES PRIOR TO CENTERING THE EXPANSION JOINT OVER THE GAP.

17. FILL HOLE 1/2 TO 2/3 FULL OF ADHESIVE COMPOUND. TWISTING SLIGHTLY, INSERT THREADED ROD TO EMBEDMENT DEPTH AS SHOWN. DO NOT DISTURB THREADED ROD UNTIL CURE TIME HAS ELAPSED. REFER TO SECTION 4 IN THE OPERATION AND MAINTENANCE MANUAL FOR ADHESIVE CURE TIME.

COMPONENT WEIGHTS:

- INFLUENT HEADER ASSY, 36" X 24", INLET END: 887 KG [1956 LB]
- INFLUENT HEADER ASSY, 36", MID: 848 KG [1870 LB]
- INFLUENT HEADER ASSY, 36", END: 883 KG [1947 LB]
- INFLUENT HEADER ASSY, INLET, 24": 87 KG [192 LB]
- INFLUENT LATERAL ASSY, 6" X 3": 48 KG [106 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 1-2: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 1-2: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 1-3: 16 KG [36 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 1-3: 17 KG [37 LB]
- INFLUENT HEADER VENT ASSY, 8", INLET END: 55 KG [121 LB]
- INFLUENT HEADER VENT ASSY, 8", WALKWAY END, AGS 1-3: 60 KG [131 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36": 63 KG [138 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER: 71 KG [156 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER: 194 KG [428 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
50	1984	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
49	136	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
48	1984	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
47	1056	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
46	1056	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
45	730	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
44	344	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
43	428	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
42	264	2613239	HHCS, 5/8-11 X 4"	316 SS	-
41	80	2600269	HHCS, 5/8-11 X 2"	316 SS	-
40	1120	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
39	560	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
38	560	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
37	32	2609801	HHCS, 3/4-10 X 4.5"	316 SS	-
36	528	2607490	HHCS, 3/4-10 X 4"	316 SS	-
35	40	2611859	WASHER, FLAT, 1 1/4" X 2 3/4" X 1/8"	316 SS	-
34	20	2611861	NUT, HEX, JAM, 1 1/4-7	316 SS	-
33	20	2611860	NUT, HEX, FULL, 1 1/4-7	316 SS	-
32	20	2611858	HHCS, 1 1/4-7 X 6"	316 SS	-
31	8	2620438-036	CLAMP, T-BOLT, LATCH STYLE, 36"	STAINLESS STEEL	-
30	2	2620429-360	EXPANSION SLEEVE, 36", GARLOCK 9394	EPDM	-
29	2	2616610-080-PX0	FLANGE, BLIND, 8", S80	PVC	-
28	12	2524048-SX0	U-BOLT, 5/8-11, 36" PIPE	304 SS	Y
27	2	2617771-008-SX0	U-BOLT, 3/8"-16UNC x 8"	304 SS	Y
26	264	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
25	264	2617771-003-SX0	U-BOLT, 3/8"-16UNC x 3"	304 SS	Y
24	528	2617042	THREADED ROD, 1/2"-13 X 17" LG	304 SS	-
23	48	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
22	532	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
21	264	2522720-SX0	VENT PIPE WALL SUPPORT, 3"-4"	304 SS	Y
20	2	2523765-SX0	VENT PIPE WALL SUPPORT, 6"-8", WALKWAY	304 SS	Y
19	264	2522719-SX0	INFLUENT LATERAL FLOOR SUPPORT PLATE, 6"	304 SS	Y
18	1	2607136	GASKET, 24", RED RUBBER, W/HOLES	SBR	-
17	4	2602740	GASKET, 8", RED RUBBER, W/HOLES	SBR	-
16	66	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
15	66	2600718	GASKET, 3", RED RUBBER, W/HOLES	SBR	-
14	10	9704419A30201	INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER	304 SS	Y
13	10	9704419A30200	INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER	304 SS	Y
12	2	9704419A30202	INFLUENT HEADER SUPPORT WELDMENT, 36"	304 SS	Y
11	1	9704419A30110	INFLUENT HEADER VENT ASSY, 8", WALKWAY END, AGS 1-3	PVC	Y
10	1	9704419A30109	INFLUENT HEADER VENT ASSY, 8", INLET END	PVC	Y
9	7	9704419A30114	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 1-3	PVC	Y
8	26	9704419A30113	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 1-3	PVC	Y
7	7	9704419A30112	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 1-2	PVC	Y
6	26	9704419A30111	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 1-2	PVC	Y
5	66	9704419A30108	INFLUENT LATERAL ASSY, 6" X 3"	PVC	Y
4	1	9704419A30103	INFLUENT HEADER ASSY, INLET, 24"	HDPE	Y
3	1	9704419A30102	INFLUENT HEADER ASSY, 36", END	HDPE	Y
2	1	9704419A30101	INFLUENT HEADER ASSY, 36", MID	HDPE	Y
1	1	9704419A30100	INFLUENT HEADER ASSY, 36" X 24", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-10-01
WEIGHT:
SHEET: 1 OF 7

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 1
DRAWING NUMBER: 9704419A30005
SCALE: 1:78
SIZE: D

SECTION A-A

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

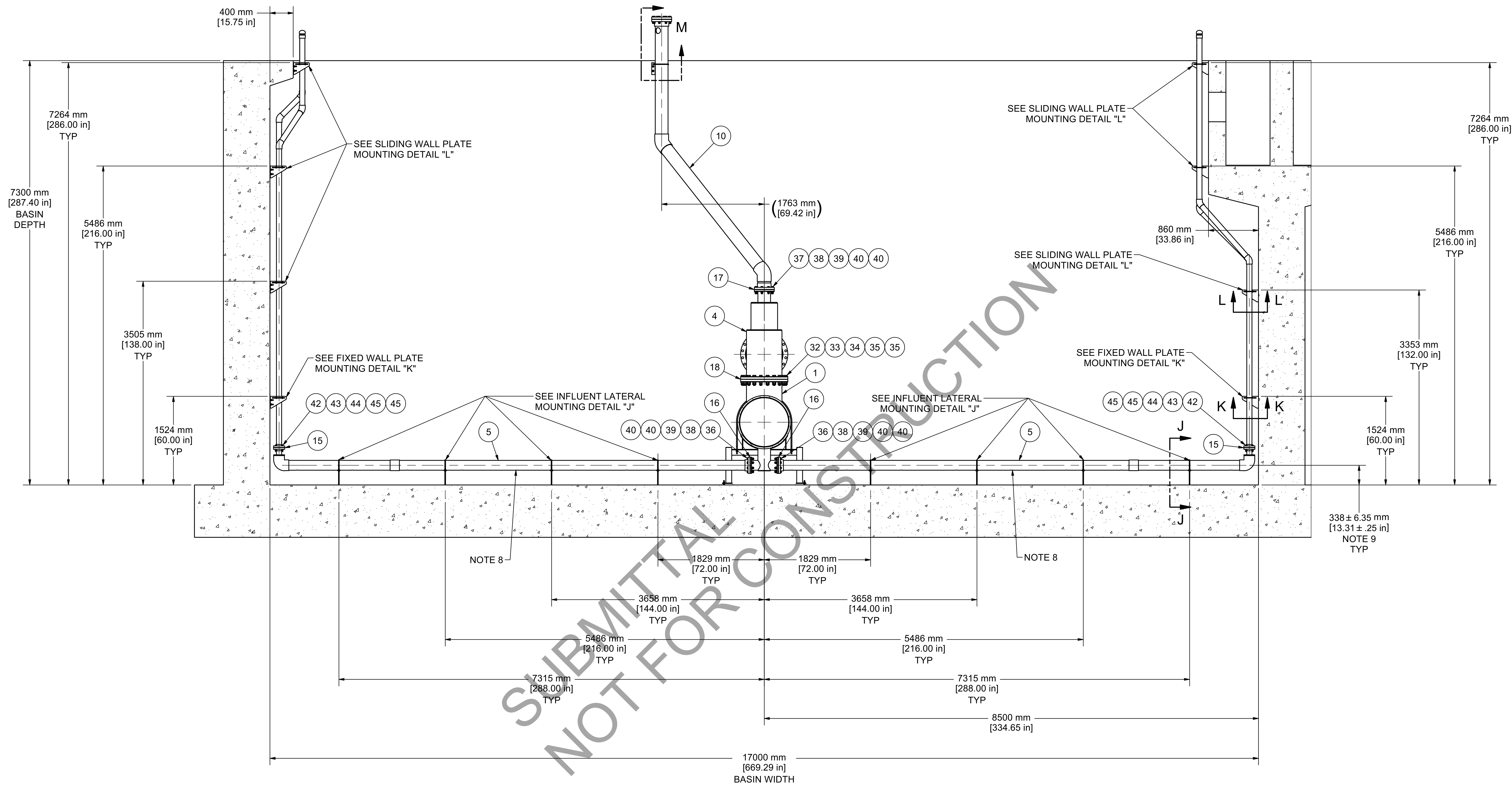
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

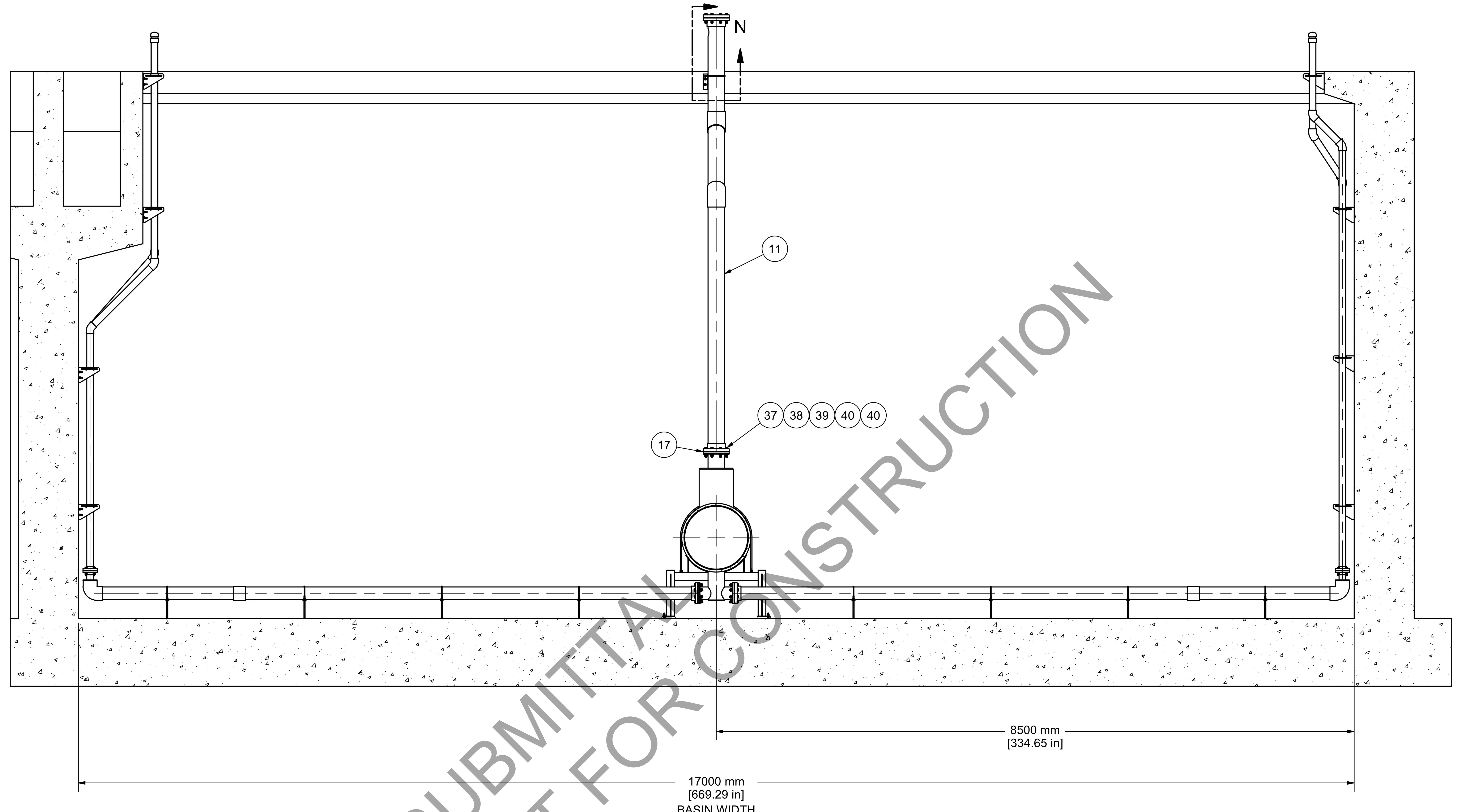
MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-01
WEIGHT: SHEET: 2 OF 7
DRAWING NAME: INFLUENT PIPING INSTL, AGS 1
DRAWING NUMBER: 9704419A30005 SCALE: 1:48 SIZE: D



SECTION B-B

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES					AQUA-AEROBIC SYSTEMS, INC. A Metawater Company
JOB LOCATION: NAPANEE, ONTARIO, CANADA					
					DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES; FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2°; ANSI
					MATERIAL:
					SIMILAR TO: 911689230005
A		2024-10-02	JFM	SUBMITTAL	TYPE: AQUANEREDA
B		2025-02-14	CJC	FULL SUBMITTAL	DRAWN BY: JFM — DATE: 2024-10-01
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: — SHEET: 3 OF 7
DRAWING NAME: INFLUENT PIPING INSTL, AGS 1					DRAWING NUMBER: 9704419A30005 — SCALE: 1:36 — SIZE: D



SECTION C-C

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-01
WEIGHT: SHEET: 4 OF 7

DRAWING NAME: INFLUENT PIPING INSTL, AGS 1
DRAWING NUMBER: 9704419A30005
SCALE: 1:36
SIZE: D

SECTION D-D

VIEW TOWARDS WALKWAY SIDE OF BASIN

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-01
WEIGHT: SHEET: 5 OF 7

DRAWING NAME:
INFLUENT PIPING INSTL, AGS 1

DRAWING NUMBER: 9704419A30005
SCALE: 1:48
SIZE: D

SECTION E-E

VIEW TOWARDS EFFLUENT CHANNEL SIDE OF BASIN

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES

JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°

ANSI

MATERIAL:

SIMILAR TO: 911689230005

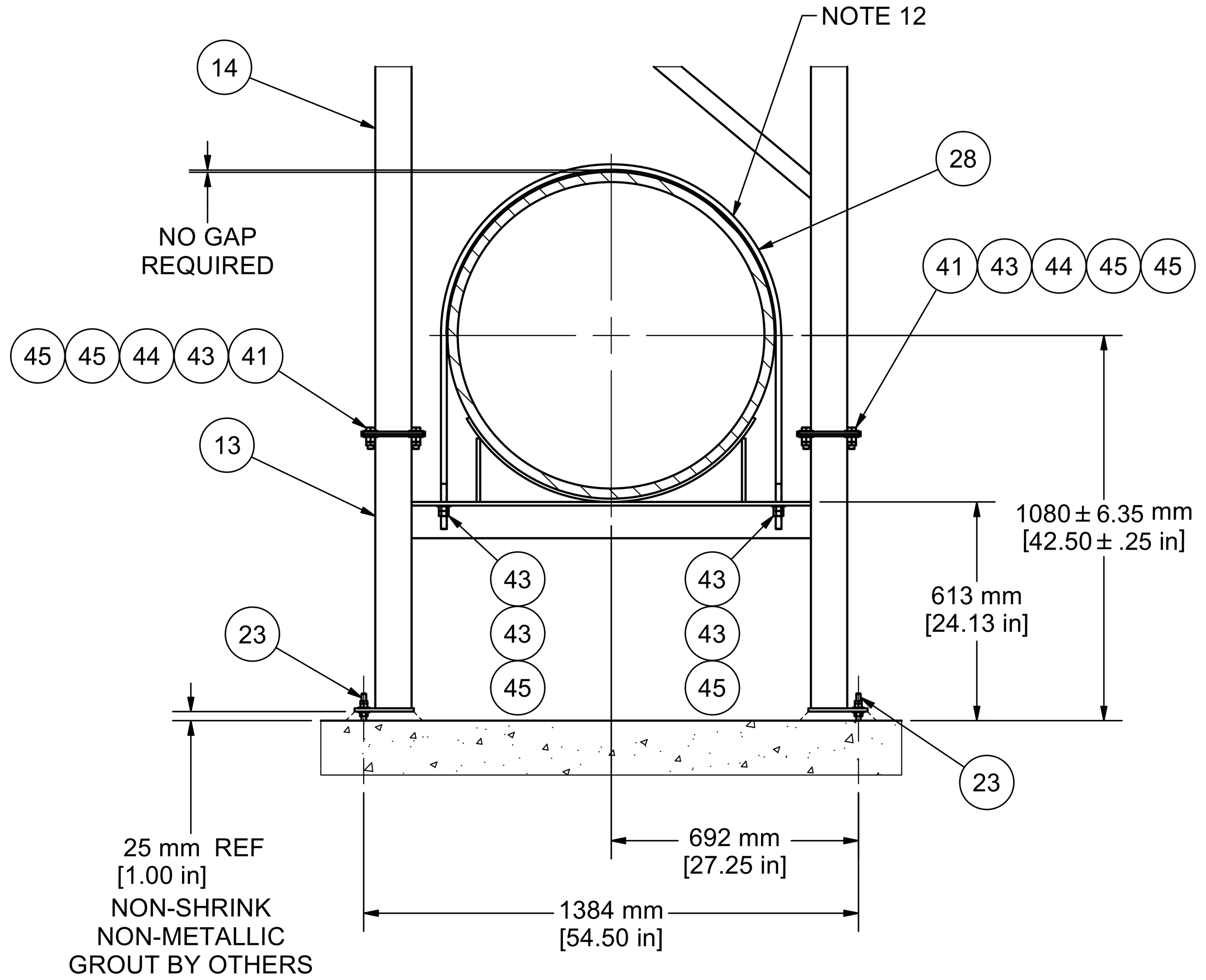
TYPE: AQUANEREDA

DRAWN BY: JFM DATE: 2024-10-01

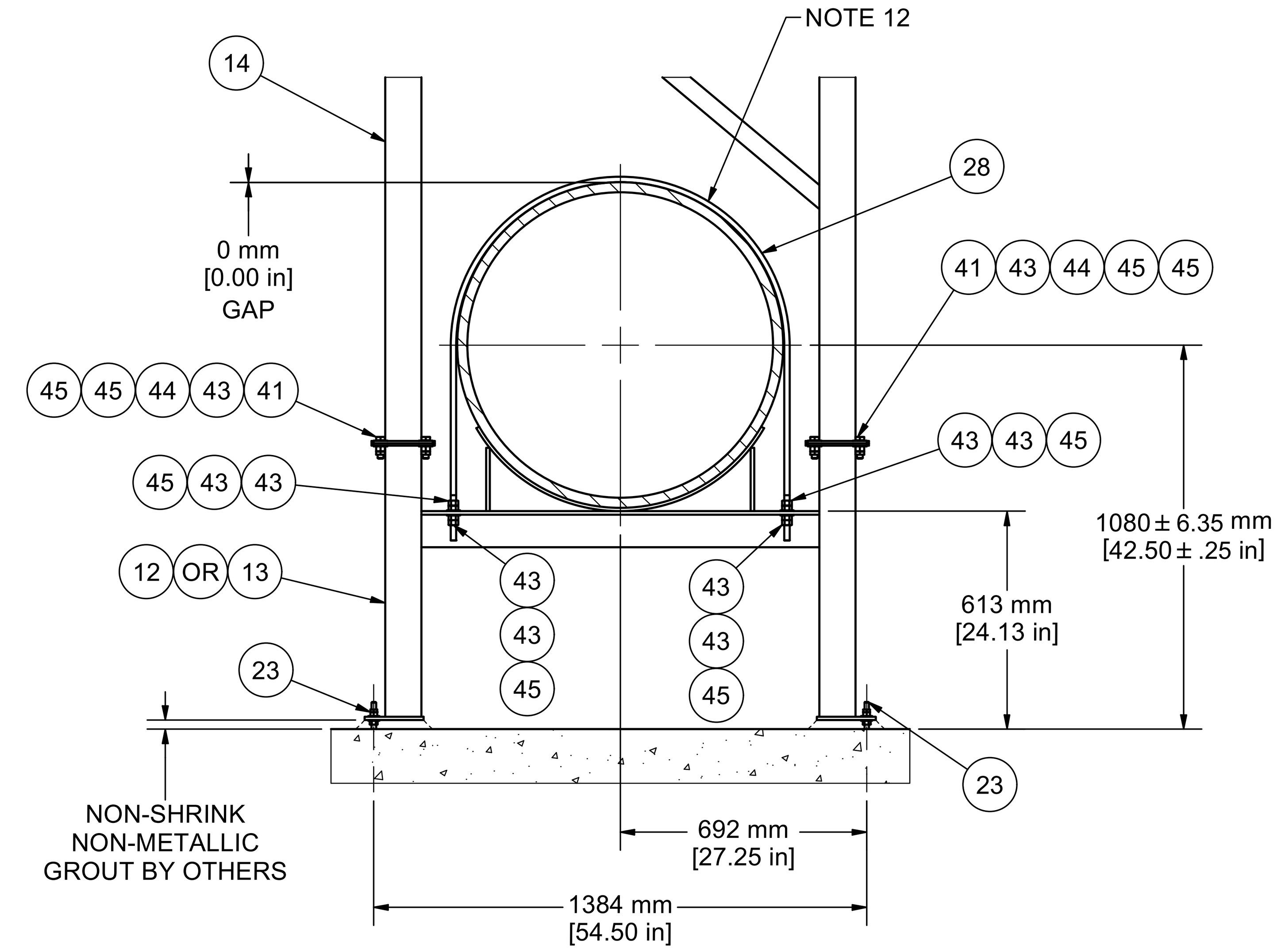
WEIGHT: SHEET: 6 OF 7

DRAWING NAME: INFLUENT PIPING INSTL, AGS 1

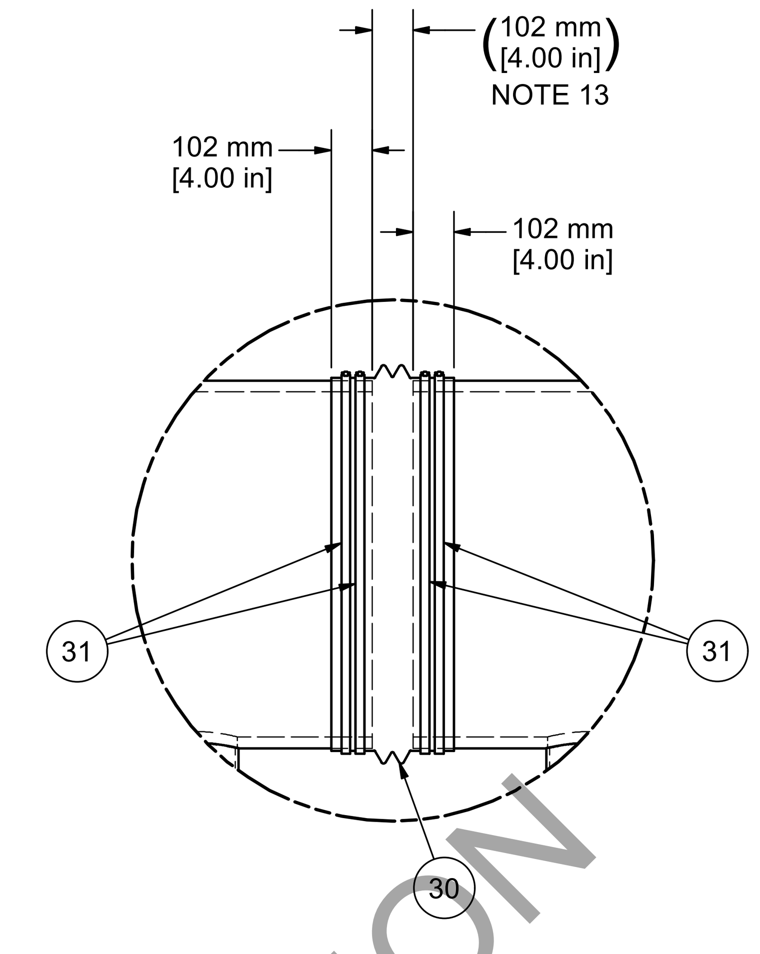
DRAWING NUMBER: 9704419A30005 SCALE: 1:48 SIZE: D



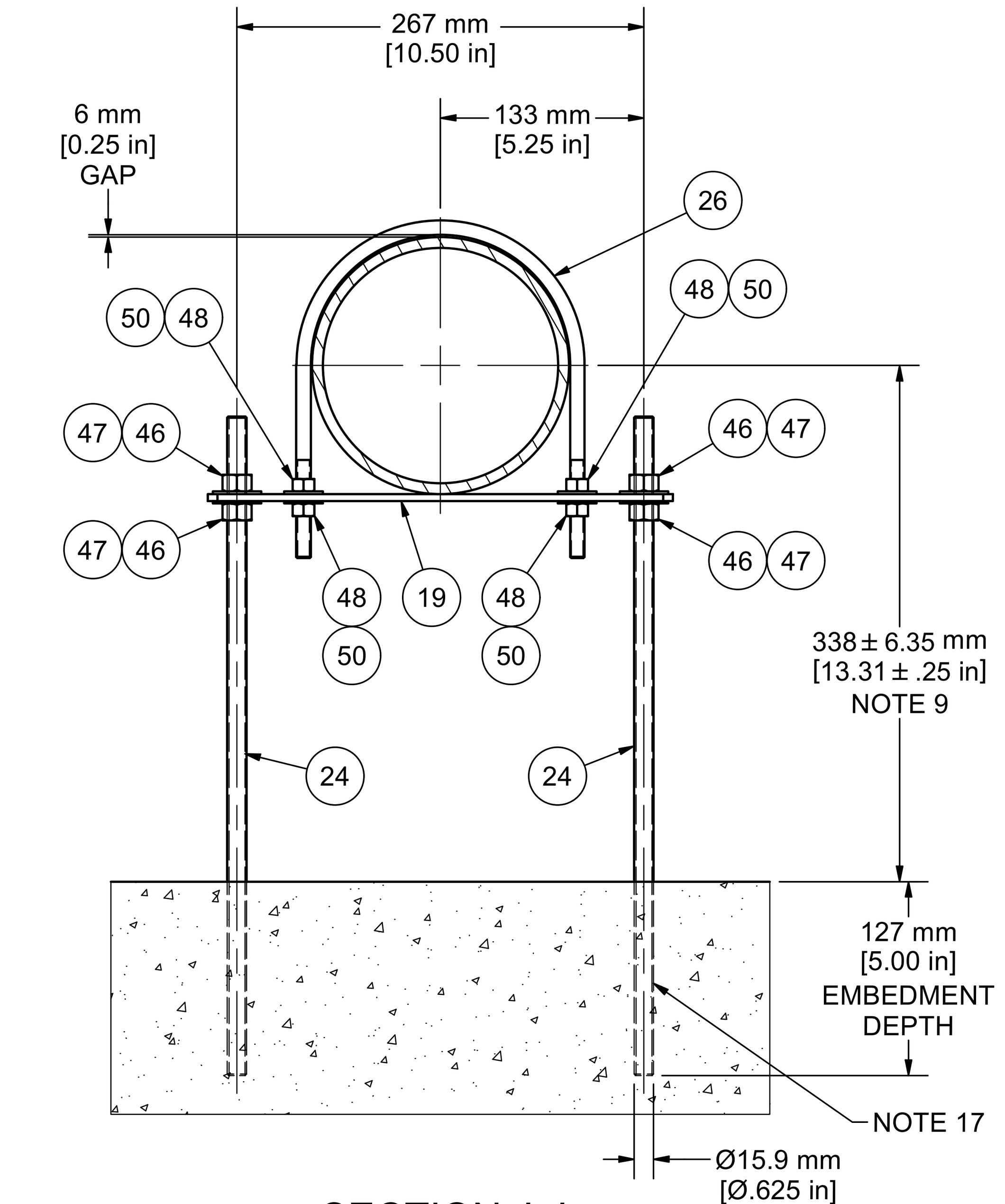
SECTION F-F
FIXED FLOOR PLATE DETAIL (B)
(3) PLACE



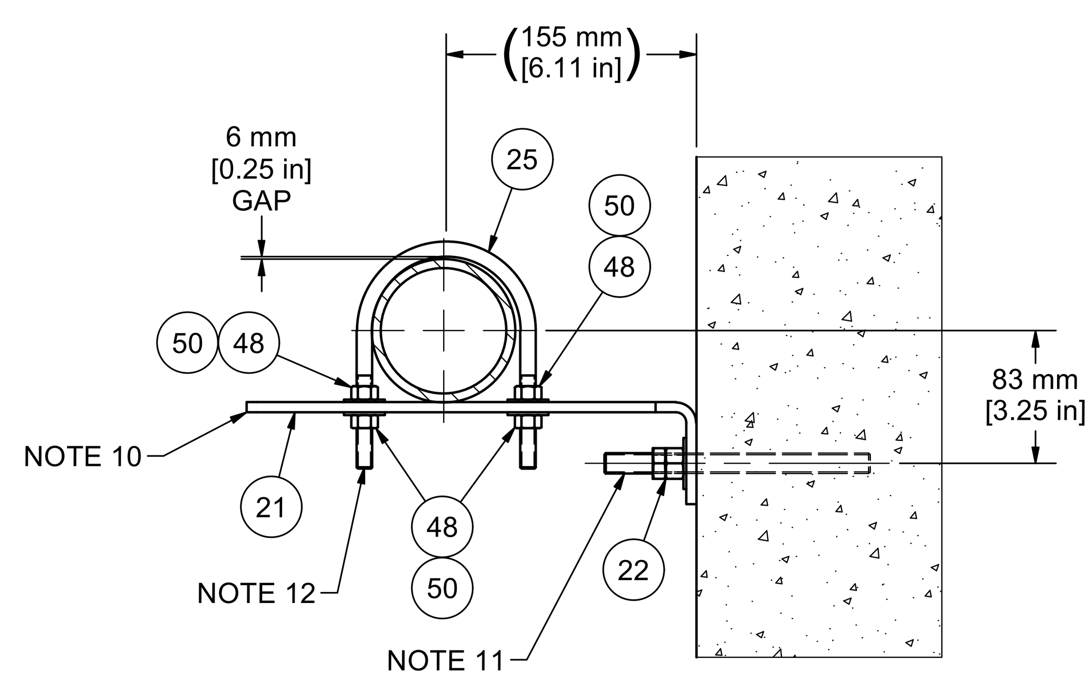
SECTION G-G
SLIDING FLOOR PLATE DETAIL (B)
TYP (9)



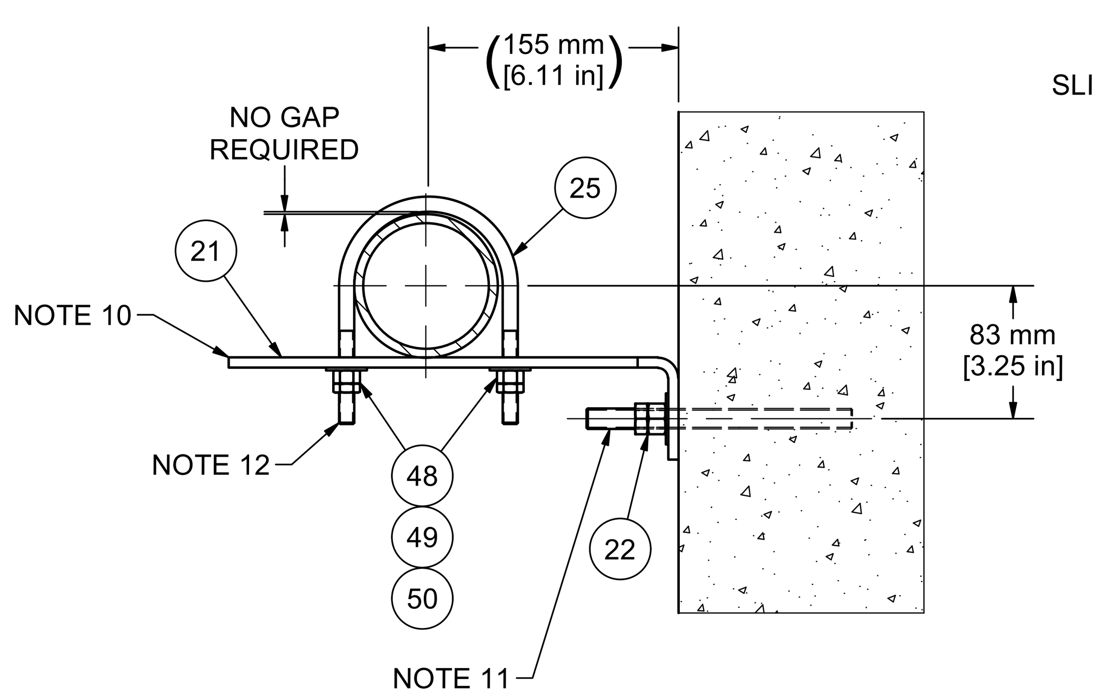
DETAIL H
EXPANSION SLEEVE MOUNTING DETAIL
TYP (2)



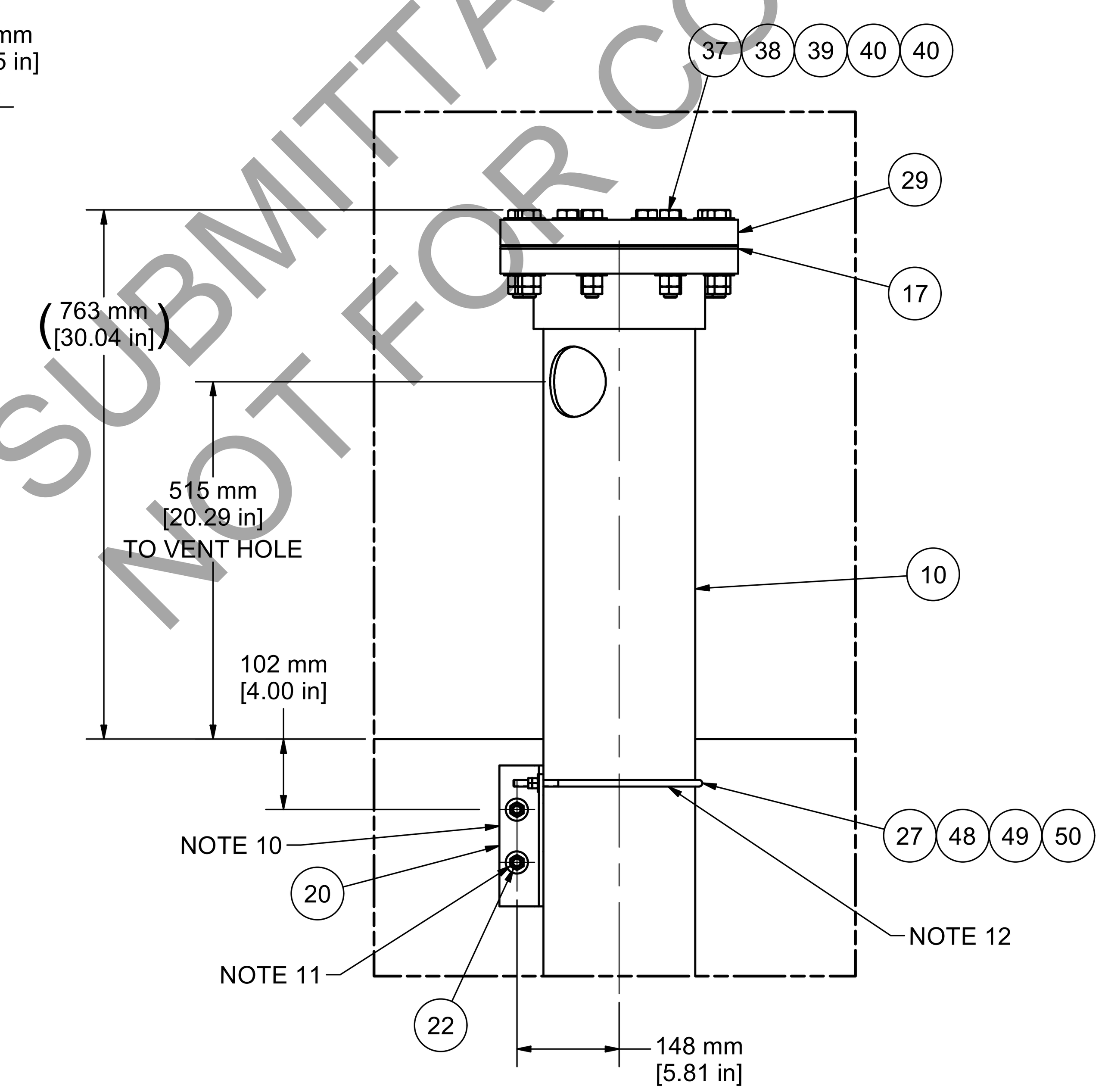
SECTION J-J
INFLUENT LATERAL MOUNTING DETAIL
TYP (264)



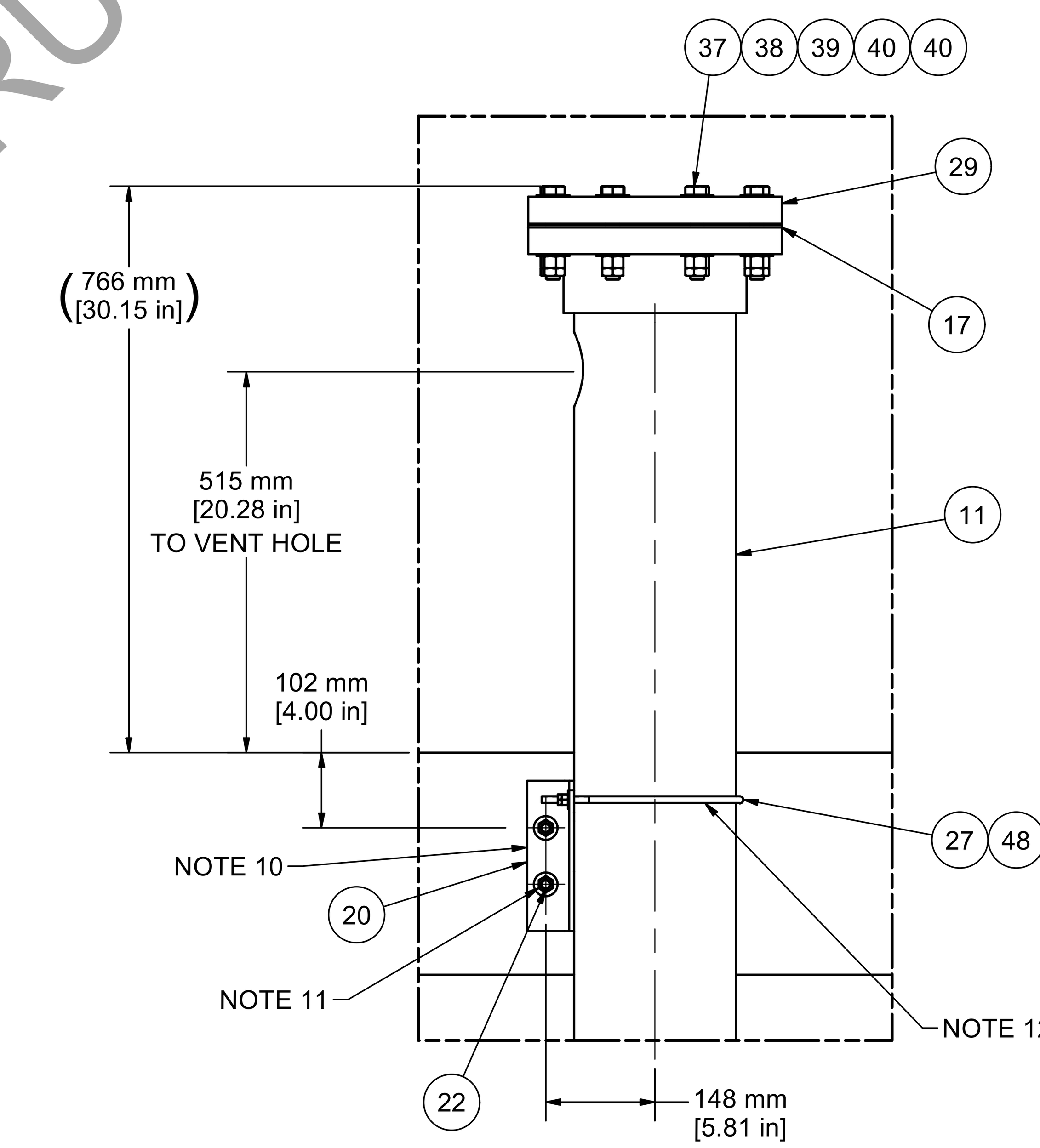
SECTION L-L
SLIDING WALL PLATE MOUNTING DETAIL
TYP (198)



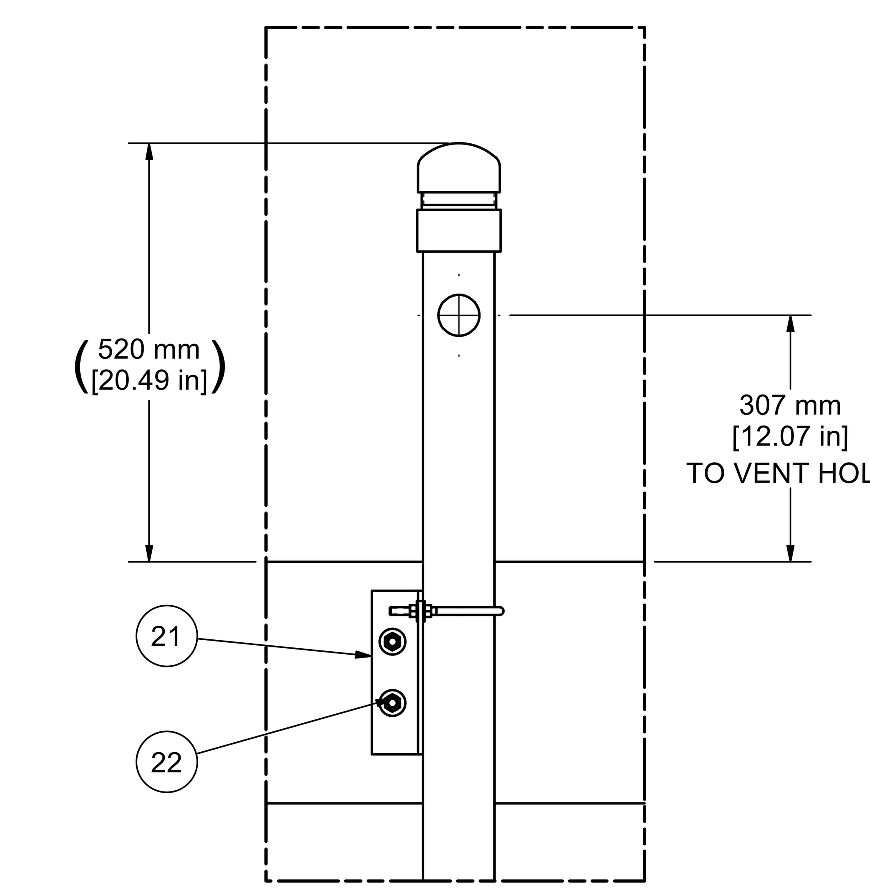
SECTION K-K
FIXED WALL PLATE MOUNTING DETAIL
TYP (66)



DETAIL M
INFLUENT HEADER VENT ASSEMBLY
MOUNTING DETAIL
(INFLUENT INLET END)



DETAIL N
INFLUENT HEADER VENT ASSEMBLY
MOUNTING DETAIL
(OPPOSITE OF INFLUENT INLET END)



DETAIL P
INFLUENT LATERAL VENT ASSEMBLY DETAIL
TYP (66)

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-02	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION

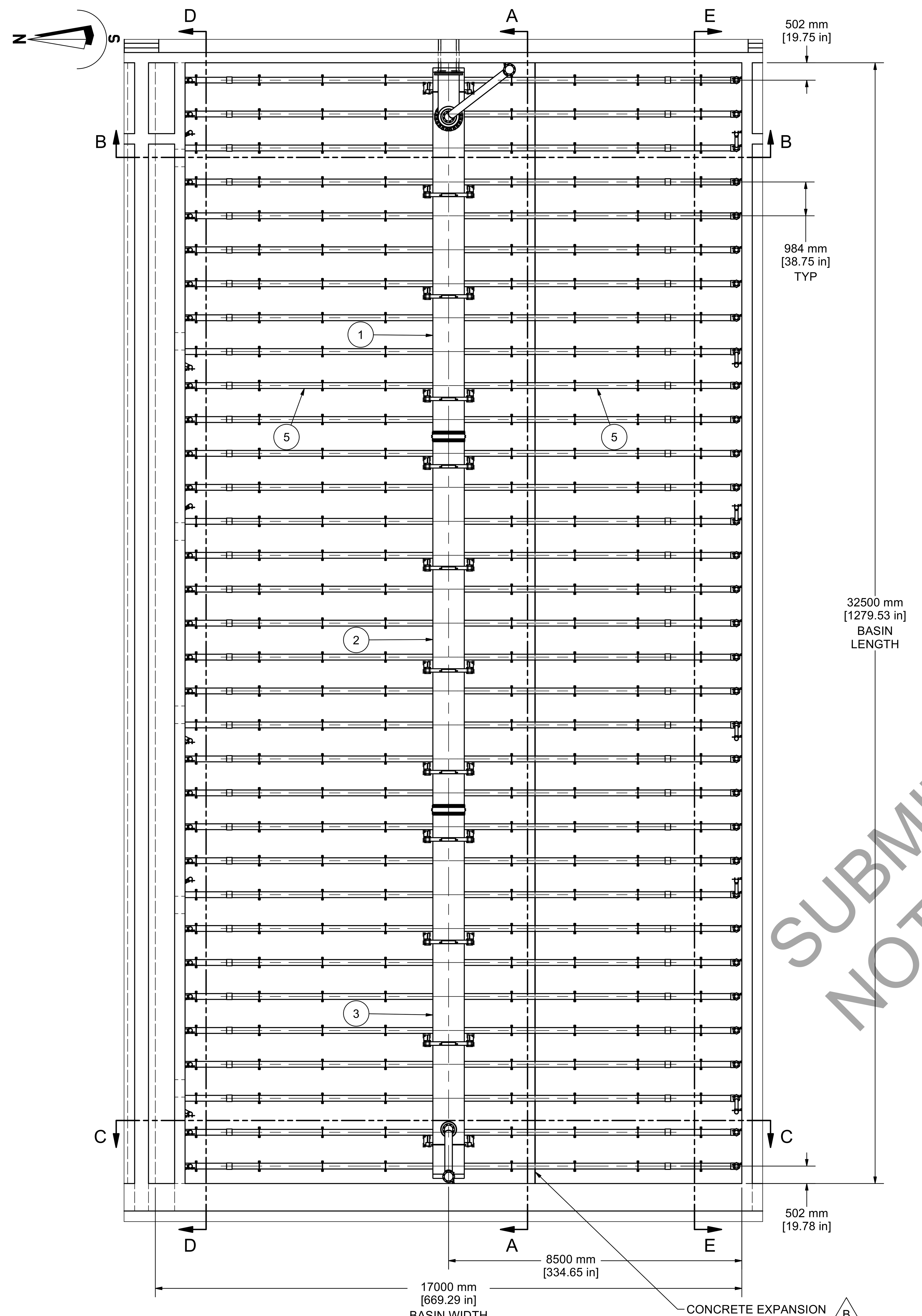
DRAWING NAME: INFLUENT PIPING INSTL, AGS 1

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-01
WEIGHT: | SHEET: 7 OF 7
DRAWING NUMBER: 9704419A30005 | SCALE: 1:16 | SIZE: D



NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. INFLUENT LATERAL PIPES MUST BE MOUNTED WITH THE ORIFICE HOLES POINTED STRAIGHT DOWN WITHIN +/- 1°. A MARK HAS BEEN MADE AT EACH END OF THE PIPE TO AID IN ALIGNMENT. THE SUPPORT BRACKETS MUST NOT COVER THE ORIFICES.

9. ALL INFLUENT LATERAL PIPES MUST BE HELD ON THE SAME CENTERLINE ELEVATION WITHIN +/- 1/4" TO MAINTAIN UNIFORM DISTRIBUTION.

10. USE VENT PIPE SUPPORT BRACKETS AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.

11. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR INSTALLATION INSTRUCTIONS.

12. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TURN THE FIRST FULL NUT AN ADDITIONAL 1/2 TURN. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

13. THE FIXED END OF THE HEADER SECTION MUST BE LOCATED RELATIVE TO THE INFLUENT WALL, NOT THE PRECEDING LATERAL ROW. PIPES WILL THEN BE INSERTED EQUALLY INTO THE COUPLING.

14. IT IS PREFERRED TO ERECT THE HEADER PIPING WHEN PIPE TEMPERATURES ARE AS CLOSE TO 70°F, AS POSSIBLE.

15. FOR SUMMER INSTALLATIONS, THE PIPES CAN BE COOLED WITH WATER, SHADE OR INSTALLED EARLY IN THE MORNING. PIPES SHOULD NOT EXCEED 122°F SURFACE TEMPERATURE DURING INSTALLATION.

16. FOR WINTER INSTALLATIONS, INSTALLATION OF THE JOINTS SHOULD TAKE PLACE AT THE WARMEST TIME OF THE DAY. WHEN THE TEMPERATURE IS LESS THAN 18°F AND IF LOW POWER HEATING BLANKETS OR DARK COLORED TARPS ARE AVAILABLE, THEY SHOULD BE USED TO WARM THE PIPES PRIOR TO CENTERING THE EXPANSION JOINT OVER THE GAP.

17. FILL HOLE 1/2 TO 2/3 FULL OF ADHESIVE COMPOUND. TWISTING SLIGHTLY, INSERT THREADED ROD TO EMBEDMENT DEPTH AS SHOWN. DO NOT DISTURB THREADED ROD UNTIL CURE TIME HAS ELAPSED. REFER TO SECTION 4 IN THE OPERATION AND MAINTENANCE MANUAL FOR ADHESIVE CURE TIME.

COMPONENT WEIGHTS:

- INFLUENT HEADER ASSY, 36" X 24", INLET END: 887 KG [1956 LB]
- INFLUENT HEADER ASSY, 36", MID: 848 KG [1870 LB]
- INFLUENT HEADER ASSY, 36", END: 883 KG [1947 LB]
- INFLUENT HEADER ASSY, INLET, 24": 87 KG [192 LB]
- INFLUENT LATERAL ASSY, 6" X 3": 48 KG [106 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 1-2: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 1-2: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 2: 16 KG [36 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 2: 17 KG [37 LB]
- INFLUENT HEADER VENT ASSY, 8", INLET END: 55 KG [121 LB]
- INFLUENT HEADER VENT ASSY, 8", END, AGS 2: 60 KG [131 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36": 63 KG [138 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER: 71 KG [156 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER: 194 KG [428 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
50	1984	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
49	136	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
48	1984	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
47	1056	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
46	1056	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
45	730	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
44	344	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
43	428	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
42	264	2613239	HHCS, 5/8-11 X 4"	316 SS	-
41	80	2600269	HHCS, 5/8-11 X 2"	316 SS	-
40	1120	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
39	560	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
38	560	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
37	32	2609801	HHCS, 3/4-10 X 4.5"	316 SS	-
36	528	2607490	HHCS, 3/4-10 X 4"	316 SS	-
35	40	2611859	WASHER, FLAT, 1 1/4" X 2 3/4" X 1/8"	316 SS	-
34	20	2611861	NUT, HEX, JAM, 1 1/4-7	316 SS	-
33	20	2611860	NUT, HEX, FULL, 1 1/4-7	316 SS	-
32	20	2611858	HHCS, 1 1/4-7 X 6"	316 SS	-
31	8	2620438-036	CLAMP, T-BOLT, LATCH STYLE, 36"	STAINLESS STEEL	-
30	2	2620429-360	EXPANSION SLEEVE, 36", GARLOCK 9394	EPDM	-
29	2	2616610-080-PX0	FLANGE, BLIND, 8", S80	PVC	-
28	12	2524048-SX0	U-BOLT, 5/8-11, 36" PIPE	304 SS	Y
27	2	2617771-008-SX0	U-BOLT, 3/8"-16UNC x 8"	304 SS	Y
26	264	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
25	264	2617771-003-SX0	U-BOLT, 3/8"-16UNC x 3"	304 SS	Y
24	528	2617042	THREADED ROD, 1/2"-13 X 17" LG	304 SS	-
23	48	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
22	532	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
21	264	2522720-SX0	VENT PIPE WALL SUPPORT, 3"-4"	304 SS	Y
20	2	2523765-SX0	VENT PIPE WALL SUPPORT, 6"-8", WALKWAY	304 SS	Y
19	264	2522719-SX0	INFLUENT LATERAL FLOOR SUPPORT PLATE, 6"	304 SS	Y
18	1	2607136	GASKET, 24", RED RUBBER, W/HOLES	SBR	-
17	4	2602740	GASKET, 8", RED RUBBER, W/HOLES	SBR	-
16	66	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
15	66	2600718	GASKET, 3", RED RUBBER, W/HOLES	SBR	-
14	10	9704419A30201	INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER	304 SS	Y
13	10	9704419A30200	INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER	304 SS	Y
12	2	9704419A30202	INFLUENT HEADER SUPPORT WELDMENT, 36"	304 SS	Y
11	1	9704419A30119	INFLUENT HEADER VENT ASSY, 8", END, AGS 2	PVC	Y
10	1	9704419A30109	INFLUENT HEADER VENT ASSY, 8", INLET END	PVC	Y
9	6	9704419A30116	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 2	PVC	Y
8	27	9704419A30115	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 2	PVC	Y
7	6	9704419A30112	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 1-2	PVC	Y
6	27	9704419A30111	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 1-2	PVC	Y
5	66	9704419A30108	INFLUENT LATERAL ASSY, 6" X 3"	PVC	Y
4	1	9704419A30103	INFLUENT HEADER ASSY, INLET, 24"	HDPE	Y
3	1	9704419A30102	INFLUENT HEADER ASSY, 36", END	HDPE	Y
2	1	9704419A30101	INFLUENT HEADER ASSY, 36", MID	HDPE	Y
1	1	9704419A30100	INFLUENT HEADER ASSY, 36" X 24", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-02
WEIGHT: SHEET: 1 OF 7

DRAWING NAME: INFLUENT PIPING INSTL, AGS 2
DRAWING NUMBER: 9704419A30006 SCALE: 1:78 SIZE: D

CONFIDENTIAL

SECTION A-A

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION

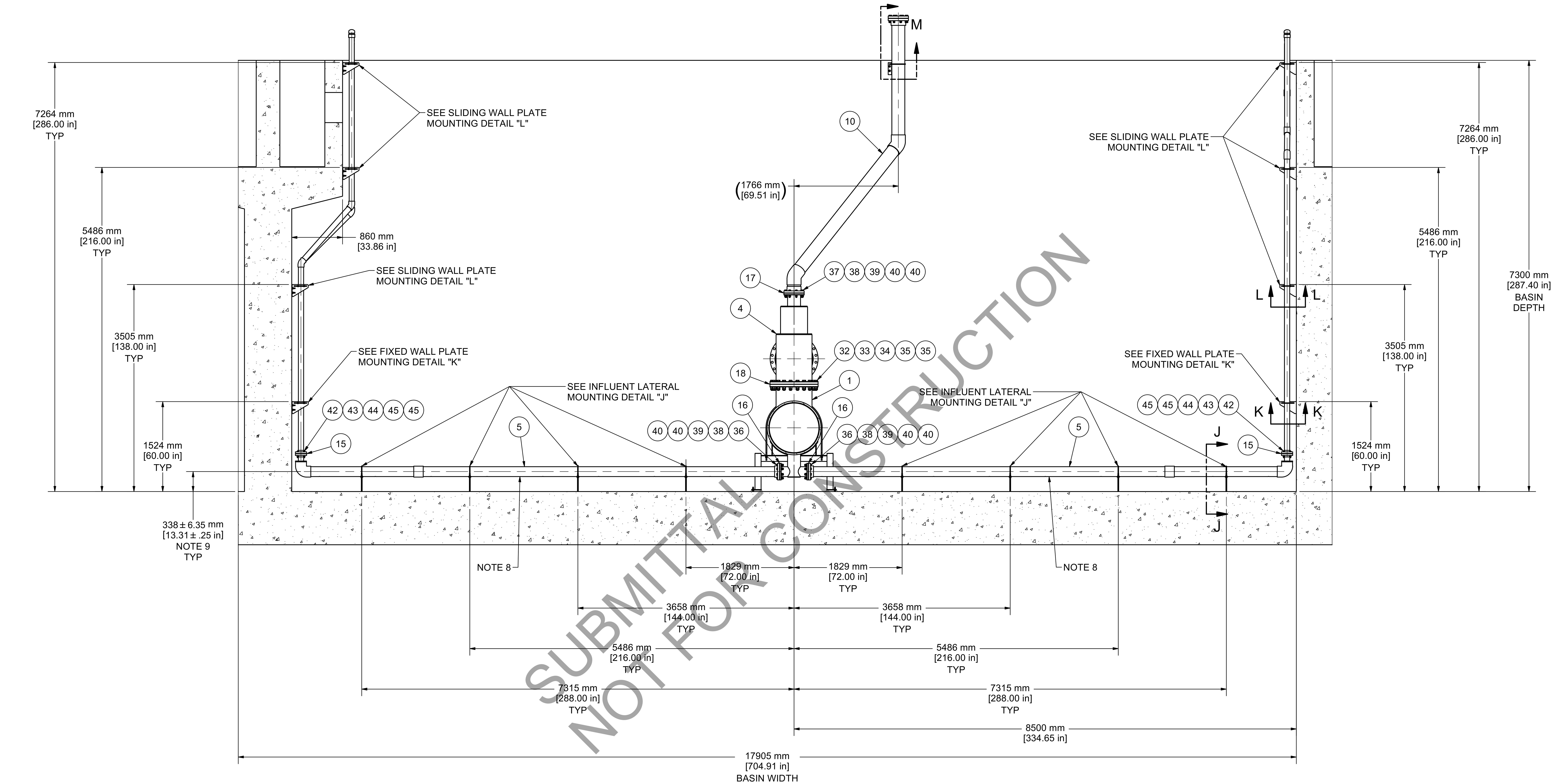
DRAWING NAME: INFLUENT PIPING INSTL, AGS 2

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-02
WEIGHT: SHEET: 2 OF 7
DRAWING NUMBER: 9704419A30006 SCALE: 1:48 SIZE: D



SECTION B-B

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

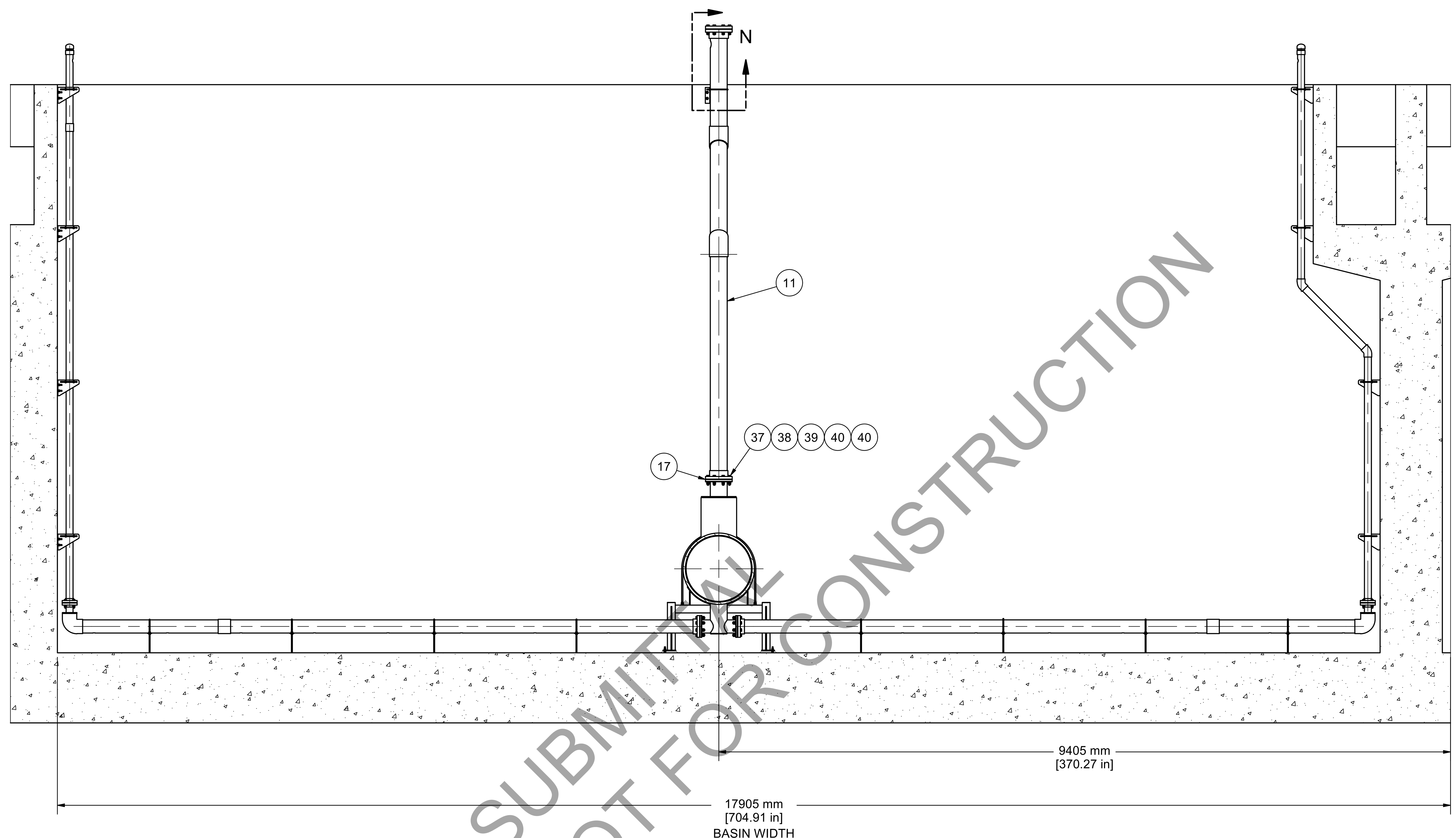
DRAWING NAME: INFLUENT PIPING INSTL, AGS 2

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-02
WEIGHT: SHEET: 3 OF 7
DRAWING NUMBER: 9704419A30006 SCALE: 1:36 SIZE: D



SECTION C-C

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: INFLUENT PIPING INSTL, AGS 2				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:			
SIMILAR TO: 911689230005			
TYPE: AQUANEREDA			
DRAWN BY: JFM	DATE: 2024-10-02		
WEIGHT:	SHEET: 4 OF 7		
DRAWING NUMBER: 9704419A30006		SCALE: 1:36	SIZE: D

SECTION D-D
VIEW TOWARDS EFFLUENT CHANNEL SIDE OF BASIN

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 2

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-02
WEIGHT: SHEET: 5 OF 7
DRAWING NUMBER: 9704419A30006 SCALE: 1:48 SIZE: D

SECTION E-E
VIEW TOWARDS STRAIGHT WALL SIDE OF BASIN

SUBMITTAL
NOT FOR CONSTRUCTION

CONFIDENTIAL

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-10-02
WEIGHT:
SHEET: 6 OF 7
DRAWING NAME: INFLUENT PIPING INSTL, AGS 2
DRAWING NUMBER: 9704419A30006
SCALE: 1:48
SIZE: D

SECTION K-K
FIXED WALL PLATE MOUNTING DETAIL
TYP (66)

DETAIL M
INFLUENT HEADER VENT ASSEMBLY
MOUNTING DETAIL
(INFLUENT INLET END)

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-03	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: INFLUENT PIPING INSTL, AGS 2				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

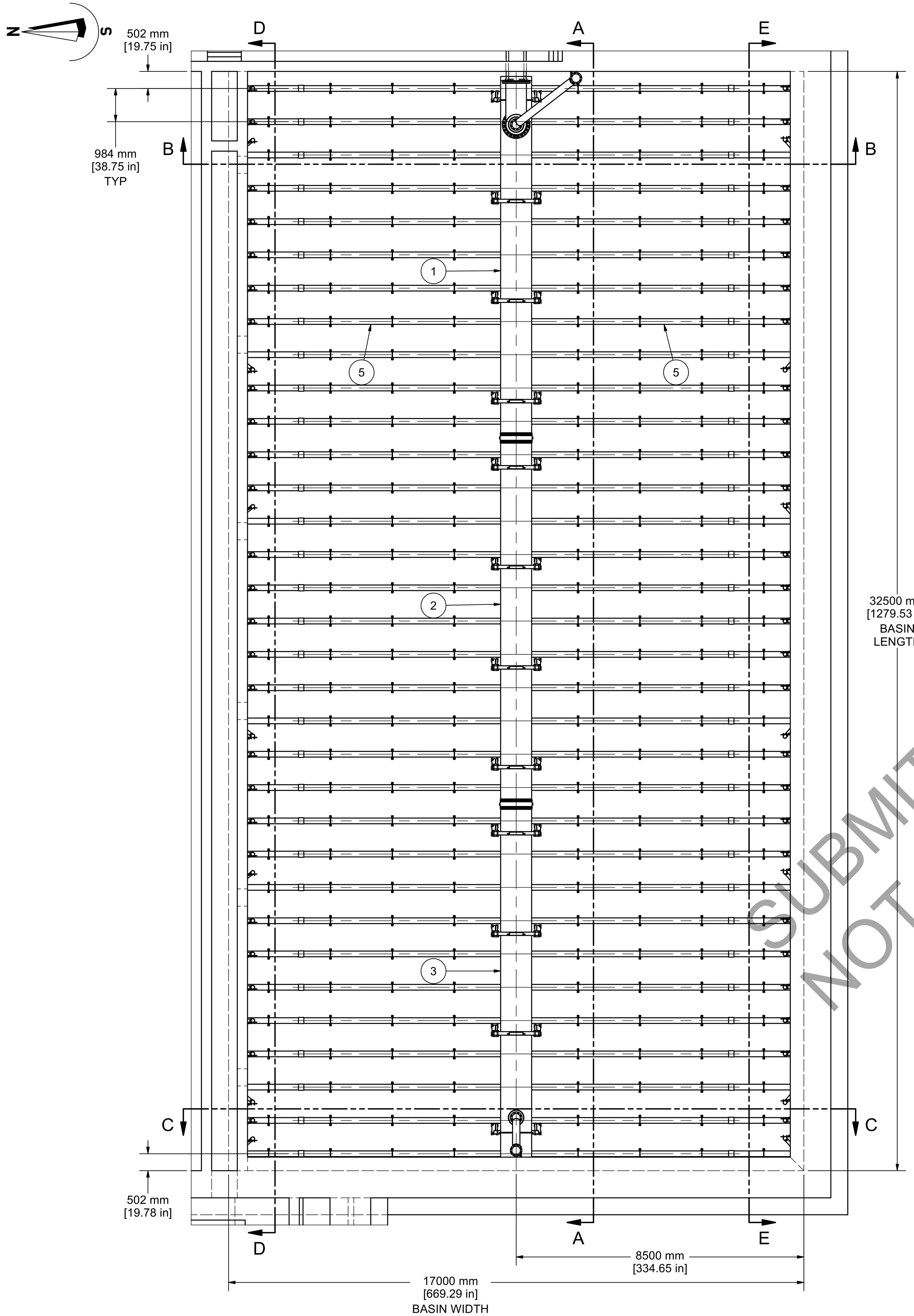
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-02
WEIGHT: SHEET: 7 OF 7
DRAWING NUMBER: 9704419A30006 SCALE: 1:16 SIZE: D



NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. INFLUENT LATERAL PIPES MUST BE MOUNTED WITH THE ORIFICE HOLES POINTED STRAIGHT DOWN WITHIN +/- 1°. A MARK HAS BEEN MADE AT EACH END OF THE PIPE TO AID IN ALIGNMENT. THE SUPPORT BRACKETS MUST NOT COVER THE ORIFICES.

9. ALL INFLUENT LATERAL PIPES MUST BE HELD ON THE SAME CENTERLINE ELEVATION WITHIN +/- 1/4" TO MAINTAIN UNIFORM DISTRIBUTION.

10. USE VENT PIPE SUPPORT BRACKETS AS A TEMPLATE TO MARK AND DRILL FOR ADHESIVE ANCHORS.

11. REFER TO ADHESIVE ANCHOR DRAWING AND O&M MANUAL FOR INSTALLATION INSTRUCTIONS.

12. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TURN THE FIRST FULL NUT AN ADDITIONAL 1/2 TURN. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

13. THE FIXED END OF THE HEADER SECTION MUST BE LOCATED RELATIVE TO THE INFLUENT WALL, NOT THE PRECEDING LATERAL ROW. PIPES WILL THEN BE INSERTED EQUALLY INTO THE COUPLING.

14. IT IS PREFERRED TO ERECT THE HEADER PIPING WHEN PIPE TEMPERATURES ARE AS CLOSE TO 70°F, AS POSSIBLE.

15. FOR SUMMER INSTALLATIONS, THE PIPES CAN BE COOLED WITH WATER, SHADE OR INSTALLED EARLY IN THE MORNING. PIPES SHOULD NOT EXCEED 122°F SURFACE TEMPERATURE DURING INSTALLATION.

16. FOR WINTER INSTALLATIONS, INSTALLATION OF THE JOINTS SHOULD TAKE PLACE AT THE WARMEST TIME OF THE DAY. WHEN THE TEMPERATURE IS LESS THAN 18°F AND IF LOW POWER HEATING BLANKETS OR DARK COLORED TARPS ARE AVAILABLE, THEY SHOULD BE USED TO WARM THE PIPES PRIOR TO CENTERING THE EXPANSION JOINT OVER THE GAP.

17. FILL HOLE 1/2 TO 2/3 FULL OF ADHESIVE COMPOUND. TWISTING SLIGHTLY, INSERT THREADED ROD TO EMBEDMENT DEPTH AS SHOWN. DO NOT DISTURB THREADED ROD UNTIL CURE TIME HAS ELAPSED. REFER TO SECTION 4 IN THE OPERATION AND MAINTENANCE MANUAL FOR ADHESIVE CURE TIME.

COMPONENT WEIGHTS:

- INFLUENT HEADER ASSY, 36" X 24", INLET END: 887 KG [1956 LB]
- INFLUENT HEADER ASSY, 36", MID: 848 KG [1870 LB]
- INFLUENT HEADER ASSY, 36", END: 883 KG [1947 LB]
- INFLUENT HEADER ASSY, INLET, 24": 87 KG [192 LB]
- INFLUENT LATERAL ASSY, 6" X 3": 48 KG [106 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 3: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 3: 17 KG [37 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 1-3: 16 KG [36 LB]
- INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 1-3: 17 KG [37 LB]
- INFLUENT HEADER VENT ASSY, 8", INLET END: 55 KG [121 LB]
- INFLUENT HEADER VENT ASSY, 8", END, AGS 1-3: 60 KG [131 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36": 63 KG [138 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER: 71 KG [156 LB]
- INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER: 194 KG [428 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
50	1984	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
49	136	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
48	1984	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
47	1056	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
46	1056	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
45	730	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
44	344	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
43	428	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
42	264	2613239	HHCS, 5/8-11 X 4"	316 SS	-
41	80	2600269	HHCS, 5/8-11 X 2"	316 SS	-
40	1120	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
39	560	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
38	560	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
37	32	2609801	HHCS, 3/4-10 X 4.5"	316 SS	-
36	528	2607490	HHCS, 3/4-10 X 4"	316 SS	-
35	40	2611859	WASHER, FLAT, 1 1/4" X 2 3/4" X 1/8"	316 SS	-
34	20	2611861	NUT, HEX, JAM, 1 1/4-7	316 SS	-
33	20	2611860	NUT, HEX, FULL, 1 1/4-7	316 SS	-
32	20	2611858	HHCS, 1 1/4-7 X 6"	316 SS	-
31	8	2620438-036	CLAMP, T-BOLT, LATCH STYLE, 36"	STAINLESS STEEL	-
30	2	2620429-360	EXPANSION SLEEVE, 36", GARLOCK 9394	EPDM	-
29	2	2616610-080-PX0	FLANGE, BLIND, 8", S80	PVC	-
28	12	2524048-SX0	U-BOLT, 5/8-11, 36" PIPE	304 SS	Y
27	2	2617771-008-SX0	U-BOLT, 3/8"-16UNC x 8"	304 SS	Y
26	264	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
25	264	2617771-003-SX0	U-BOLT, 3/8"-16UNC x 3"	304 SS	Y
24	528	2617042	THREADED ROD, 1/2"-13 X 17" LG	304 SS	-
23	48	2965006-1	KIT, ADHESIVE ANCHOR, 1/2", 8" LG	304 SS	Y
22	532	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
21	264	2522720-SX0	VENT PIPE WALL SUPPORT, 3"-4"	304 SS	Y
20	2	2523765-SX0	VENT PIPE WALL SUPPORT, 6"-8", WALKWAY	304 SS	Y
19	264	2522719-SX0	INFLUENT LATERAL FLOOR SUPPORT PLATE, 6"	304 SS	Y
18	1	2607136	GASKET, 24", RED RUBBER, W/HOLES	SBR	-
17	4	2602740	GASKET, 8", RED RUBBER, W/HOLES	SBR	-
16	66	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
15	66	2600718	GASKET, 3", RED RUBBER, W/HOLES	SBR	-
14	10	9704419A30201	INFLUENT HEADER SUPPORT WELDMENT, 36", 18" UPPER	304 SS	Y
13	10	9704419A30200	INFLUENT HEADER SUPPORT WELDMENT, 36", LOWER	304 SS	Y
12	2	9704419A30202	INFLUENT HEADER SUPPORT WELDMENT, 36"	304 SS	Y
11	1	9704419A30110	INFLUENT HEADER VENT ASSY, 8", WALKWAY END, AGS 1-3	PVC	Y
10	1	9704419A30109	INFLUENT HEADER VENT ASSY, 8", INLET END	PVC	Y
9	7	9704419A30114	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 2, AGS 1-3	PVC	Y
8	26	9704419A30113	INFLUENT LATERAL VENT ASSY, WALKWAY SIDE, 1, AGS 1-3	PVC	Y
7	7	9704419A30118	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 2, AGS 3	PVC	Y
6	26	9704419A30117	INFLUENT LATERAL VENT ASSY, CHANNEL SIDE, 1, AGS 3	PVC	Y
5	66	9704419A30108	INFLUENT LATERAL ASSY, 6" X 3"	PVC	Y
4	1	9704419A30103	INFLUENT HEADER ASSY, INLET, 24"	HDPE	Y
3	1	9704419A30102	INFLUENT HEADER ASSY, 36", END	HDPE	Y
2	1	9704419A30101	INFLUENT HEADER ASSY, 36", MID	HDPE	Y
1	1	9704419A30100	INFLUENT HEADER ASSY, 36" X 24", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-03
WEIGHT: SHEET: 1 OF 7

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 3
DRAWING NUMBER: 9704419A30007
SCALE: 1:78
SIZE: D

CONFIDENTIAL

SECTION A-A

CONFIDENTIAL

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

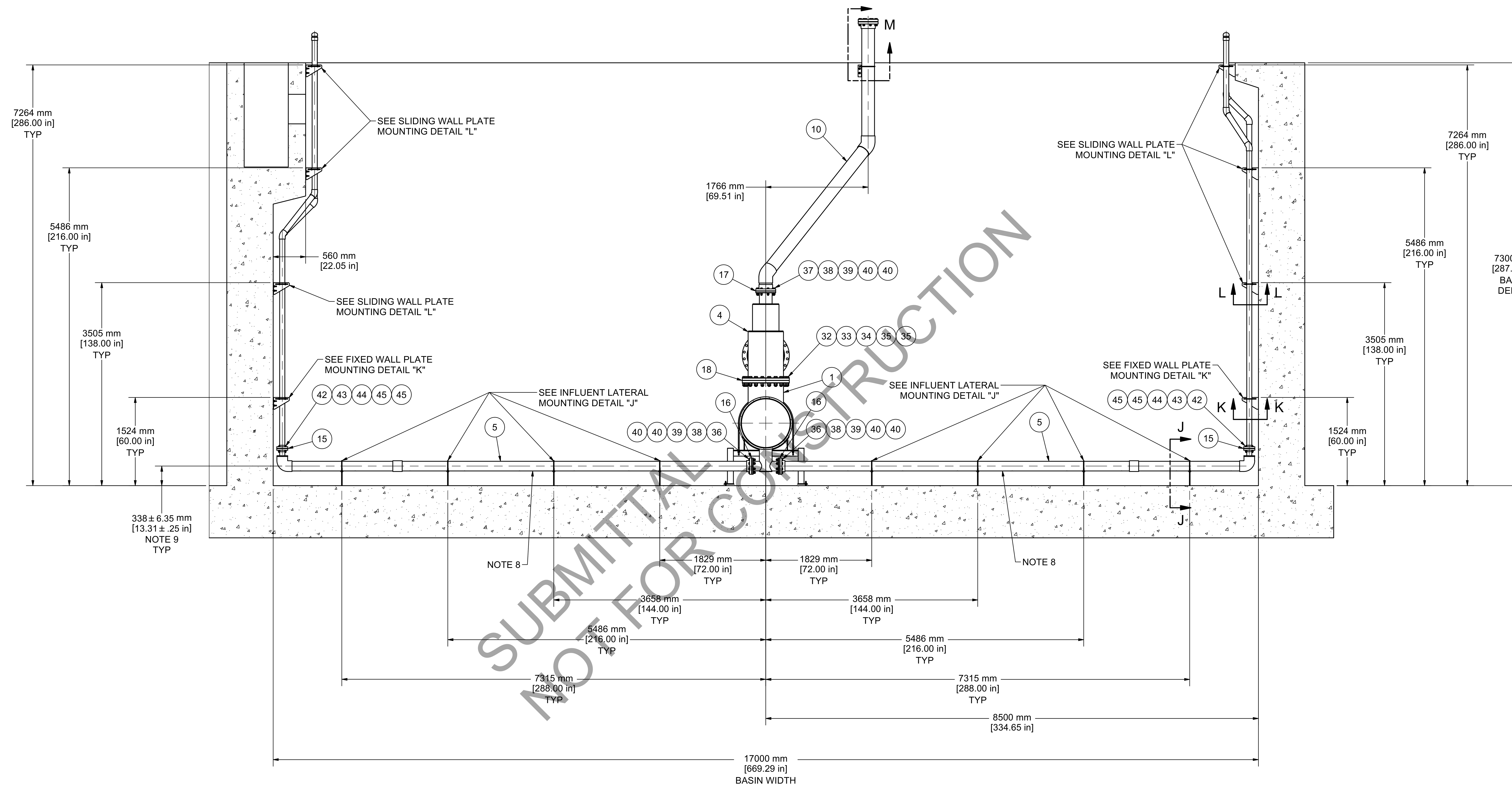
JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM — DATE: 2024-10-03
WEIGHT: — SHEET: 2 OF 7
DRAWING NAME: INFLUENT PIPING INSTL, AGS 3
DRAWING NUMBER: 9704419A30007 — SCALE: 1:48 — SIZE: D



SECTION B-B

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: INFLUENT PIPING INSTL, AGS 3				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

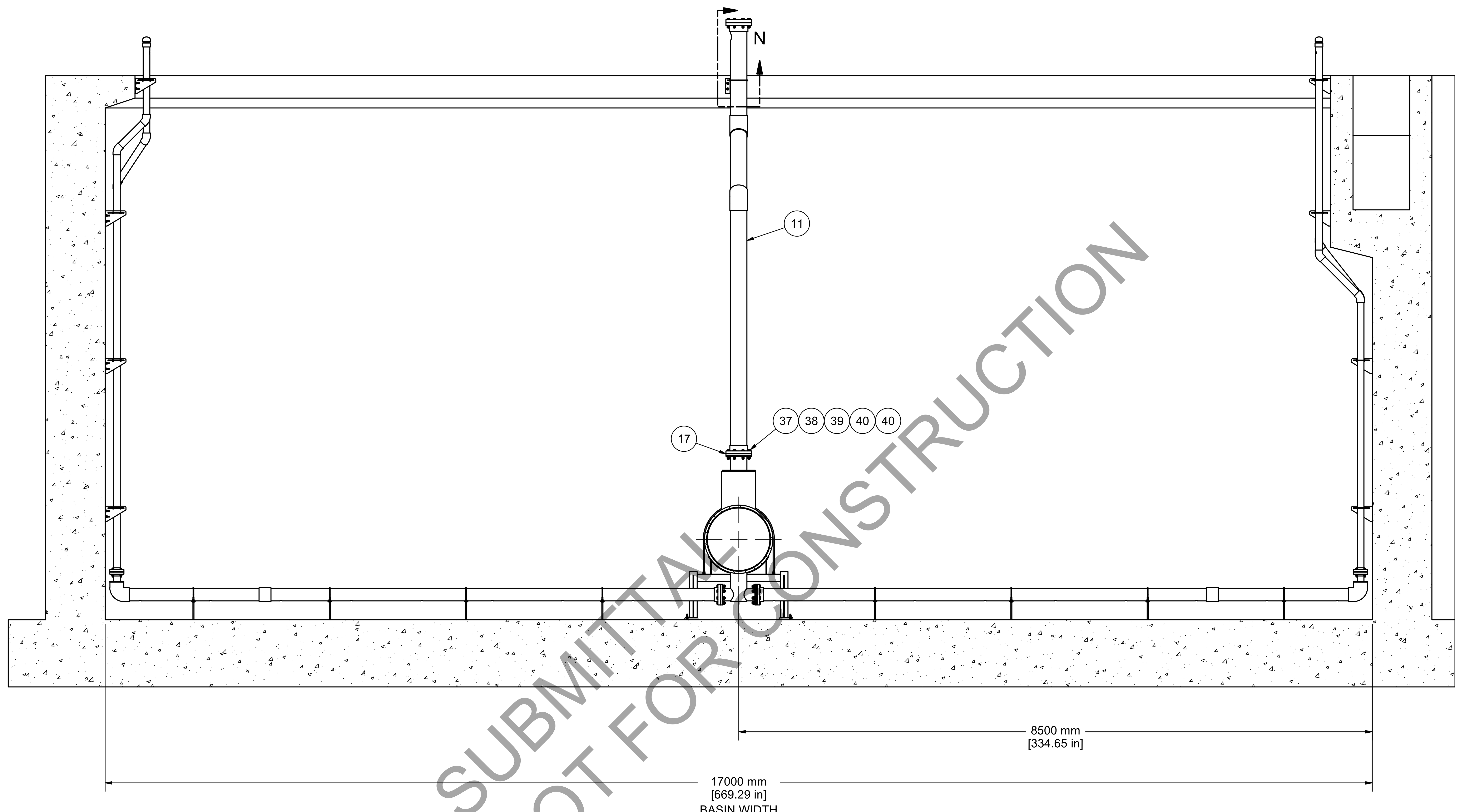
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-03
WEIGHT: SHEET: 3 OF 7
DRAWING NUMBER: 9704419A30007 SCALE: 1:36 SIZE: D



SECTION C-C

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 3

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-03
WEIGHT: SHEET: 4 OF 7
DRAWING NUMBER: 9704419A30007 SCALE: 1:36 SIZE: D

SECTION D-D
VIEW TOWARDS EFFLUENT CHANNEL SIDE OF BASIN

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 3

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-03
WEIGHT: | SHEET: 5 OF 7
DRAWING NUMBER: 9704419A30007 | SCALE: 1:48 | SIZE: D

SECTION E-E

VIEW TOWARDS WALKWAY SIDE OF BASIN

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-04	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: INFLUENT PIPING INSTL, AGS 3

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

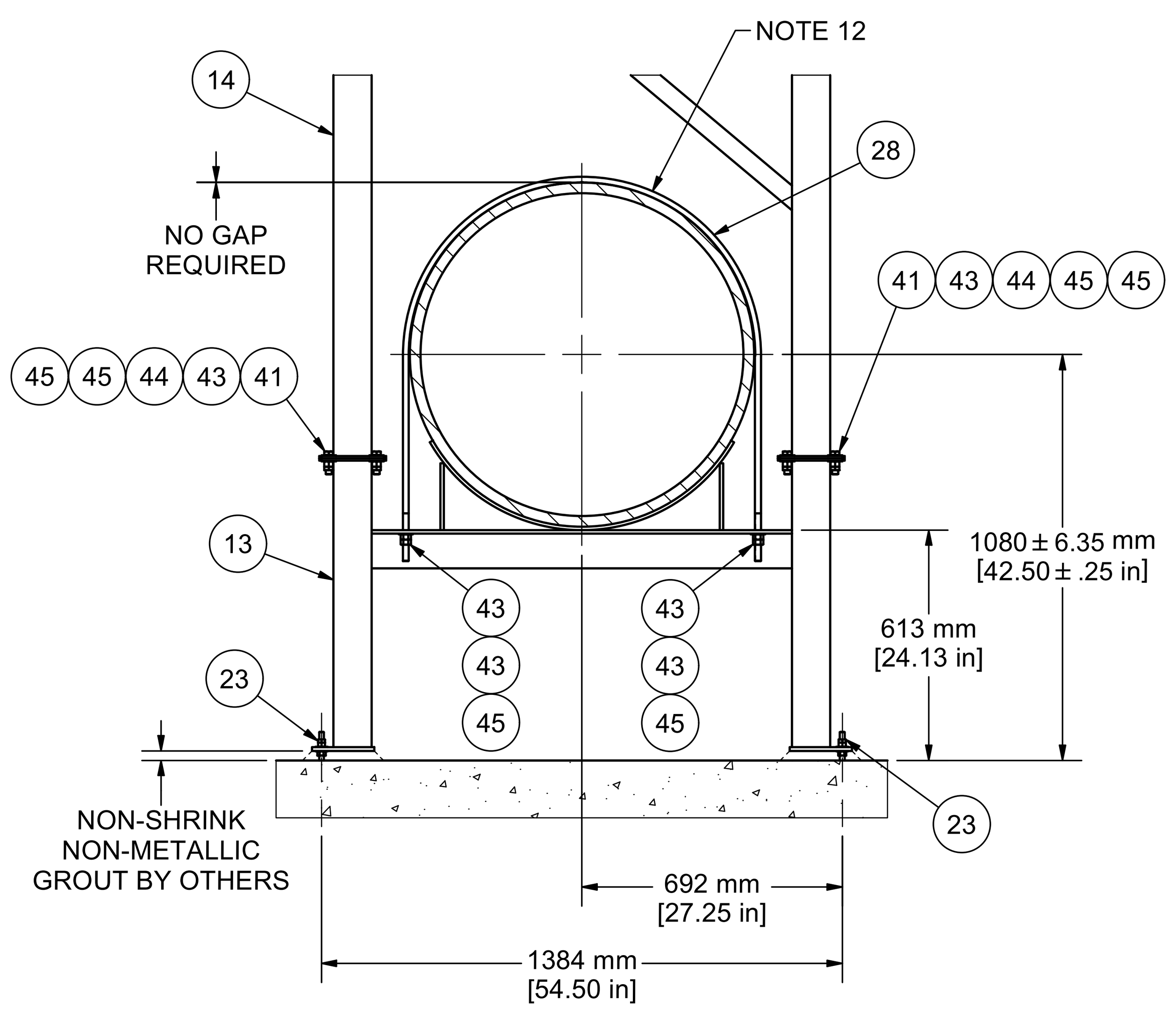
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

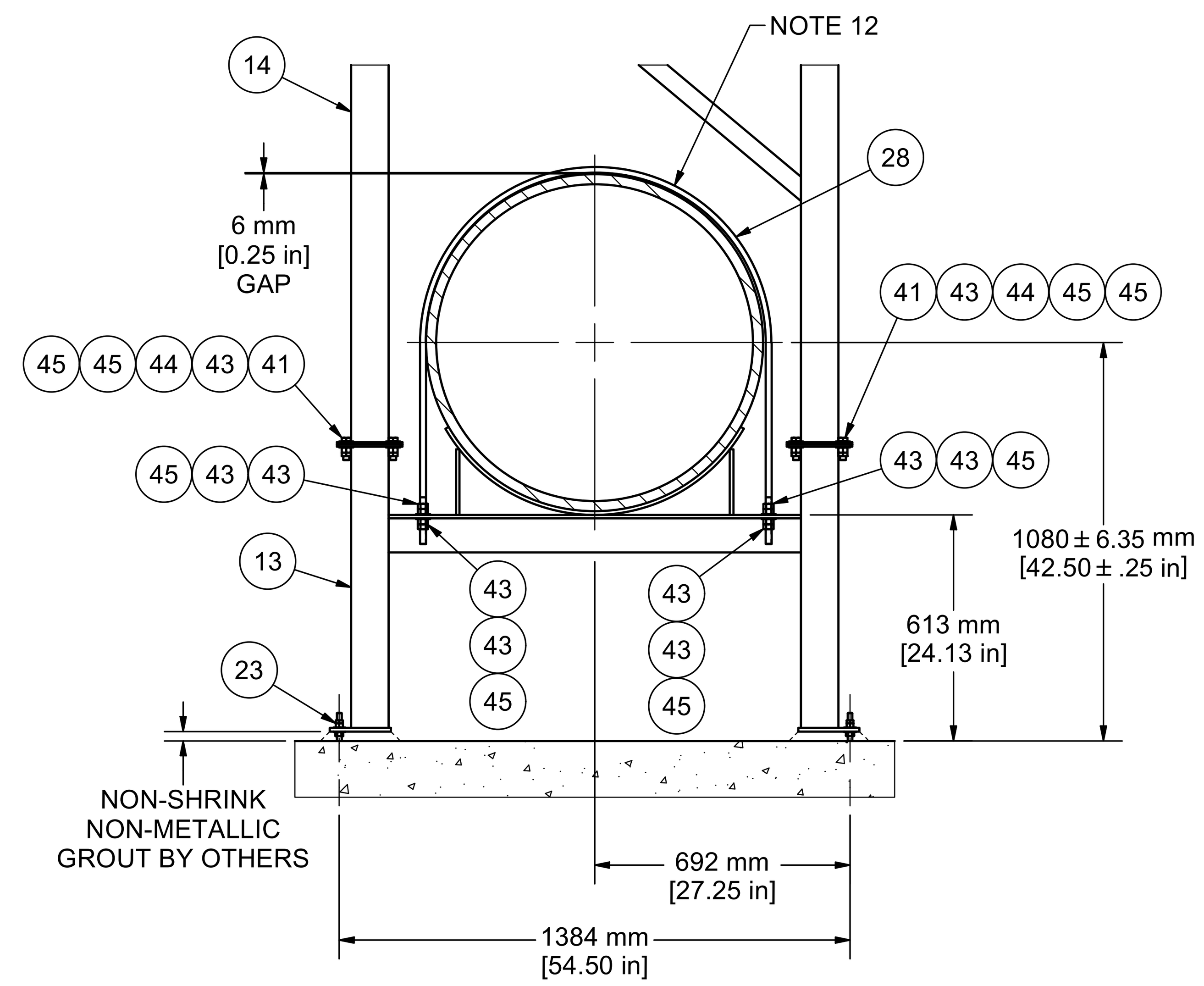
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

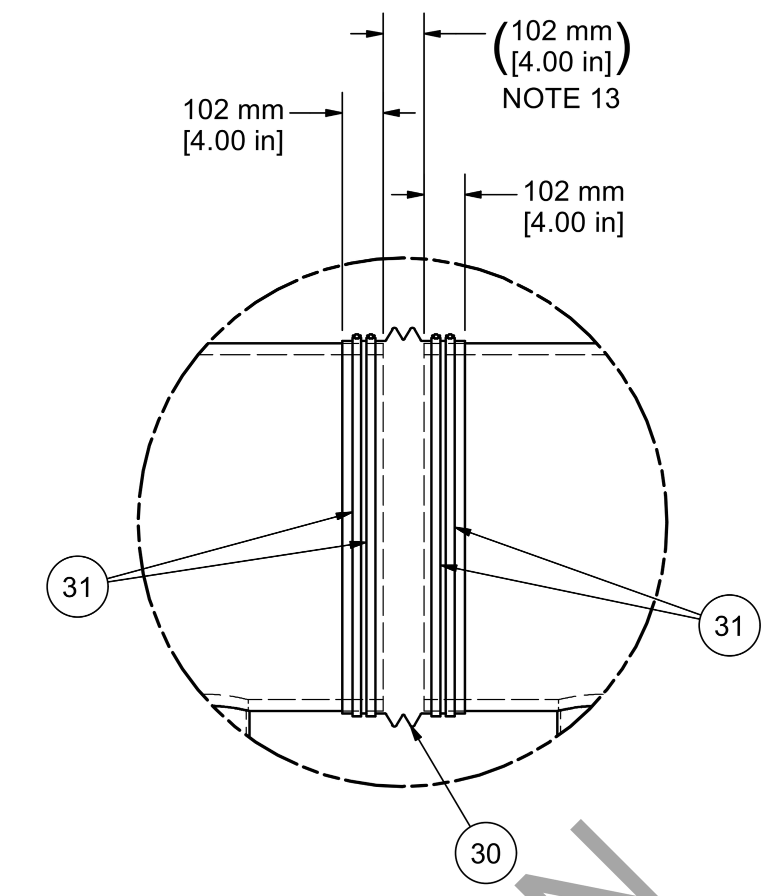
MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-03
WEIGHT: | SHEET: 6 OF 7
DRAWING NUMBER: 9704419A30007 | SCALE: 1:48 | SIZE: D



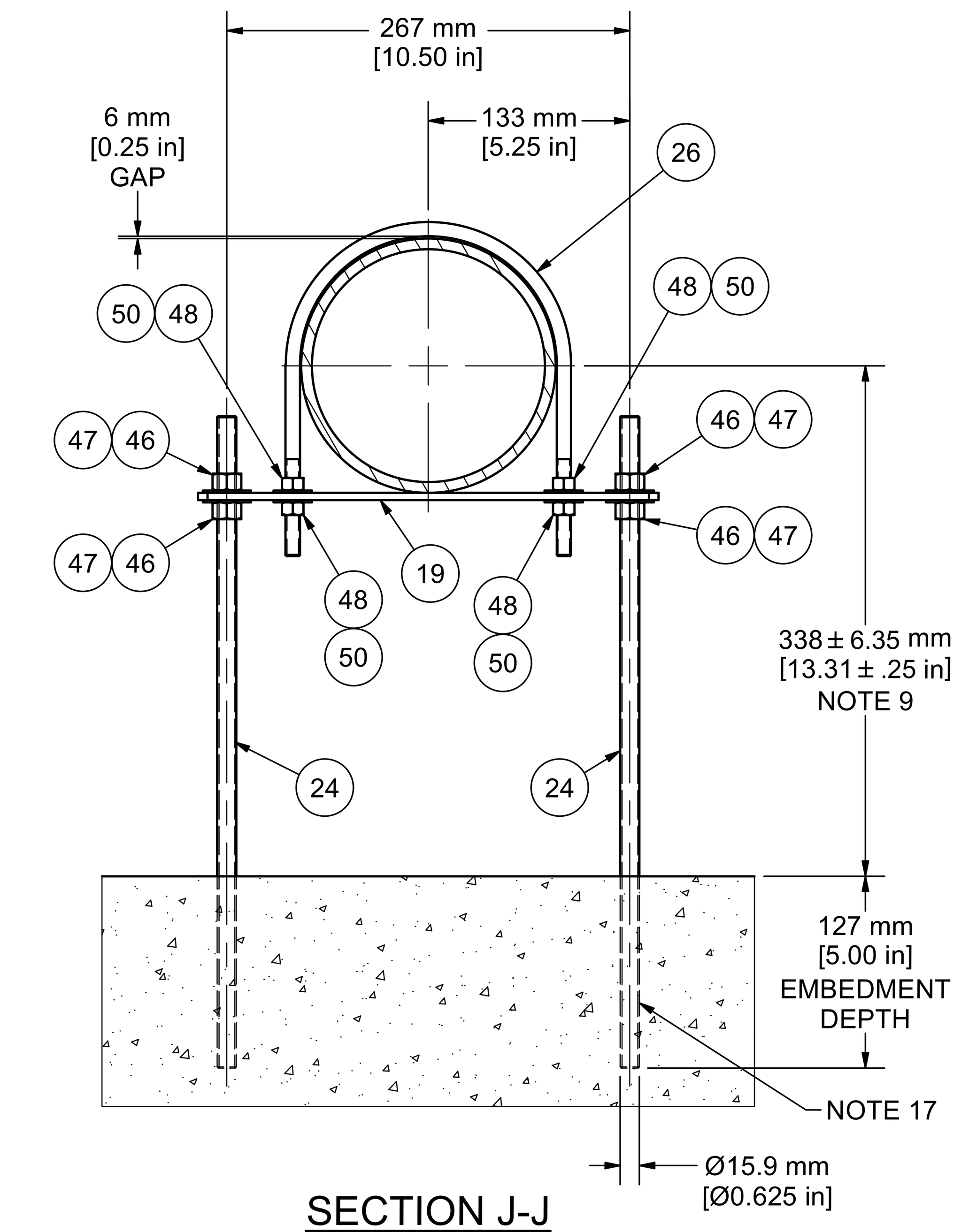
SECTION F-F
FIXED FLOOR PLATE DETAIL (B)
(3) PLACE



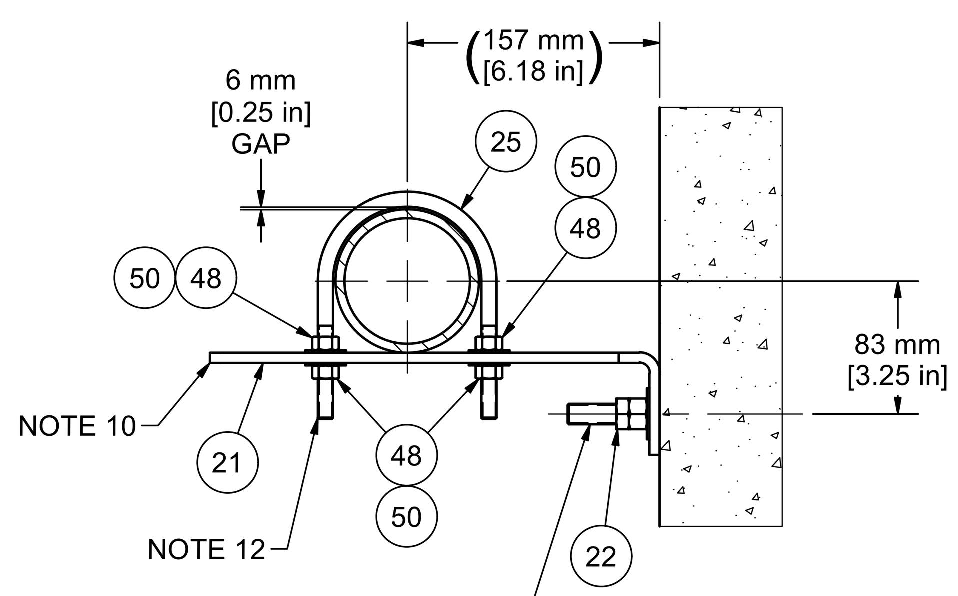
SECTION G-G
SLIDING FLOOR PLATE DETAIL (B)
TYP (9)



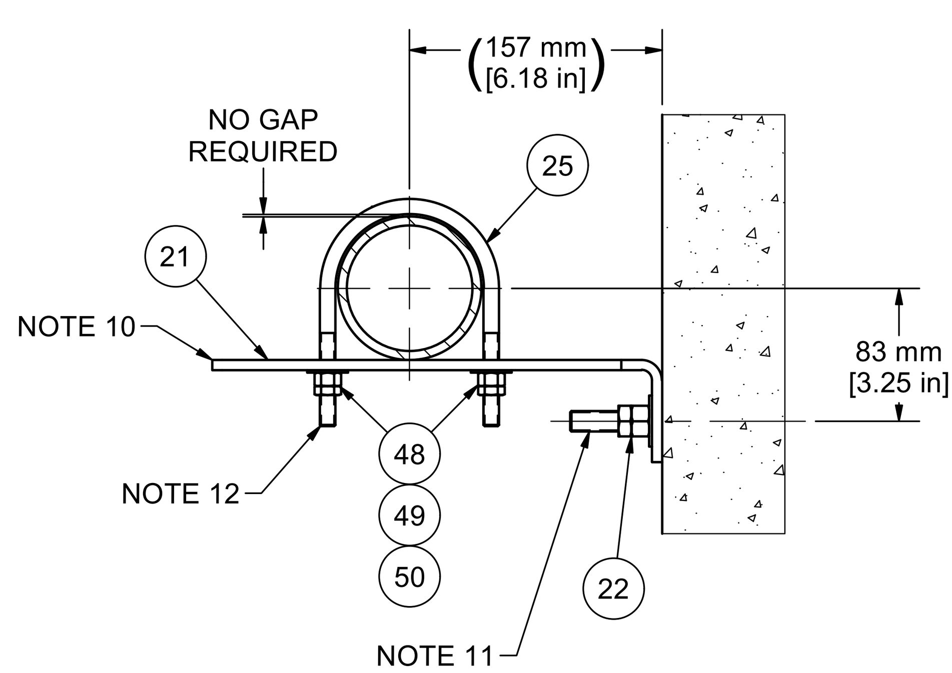
DETAIL H
EXPANSION SLEEVE MOUNTING DETAIL
TYP (2)



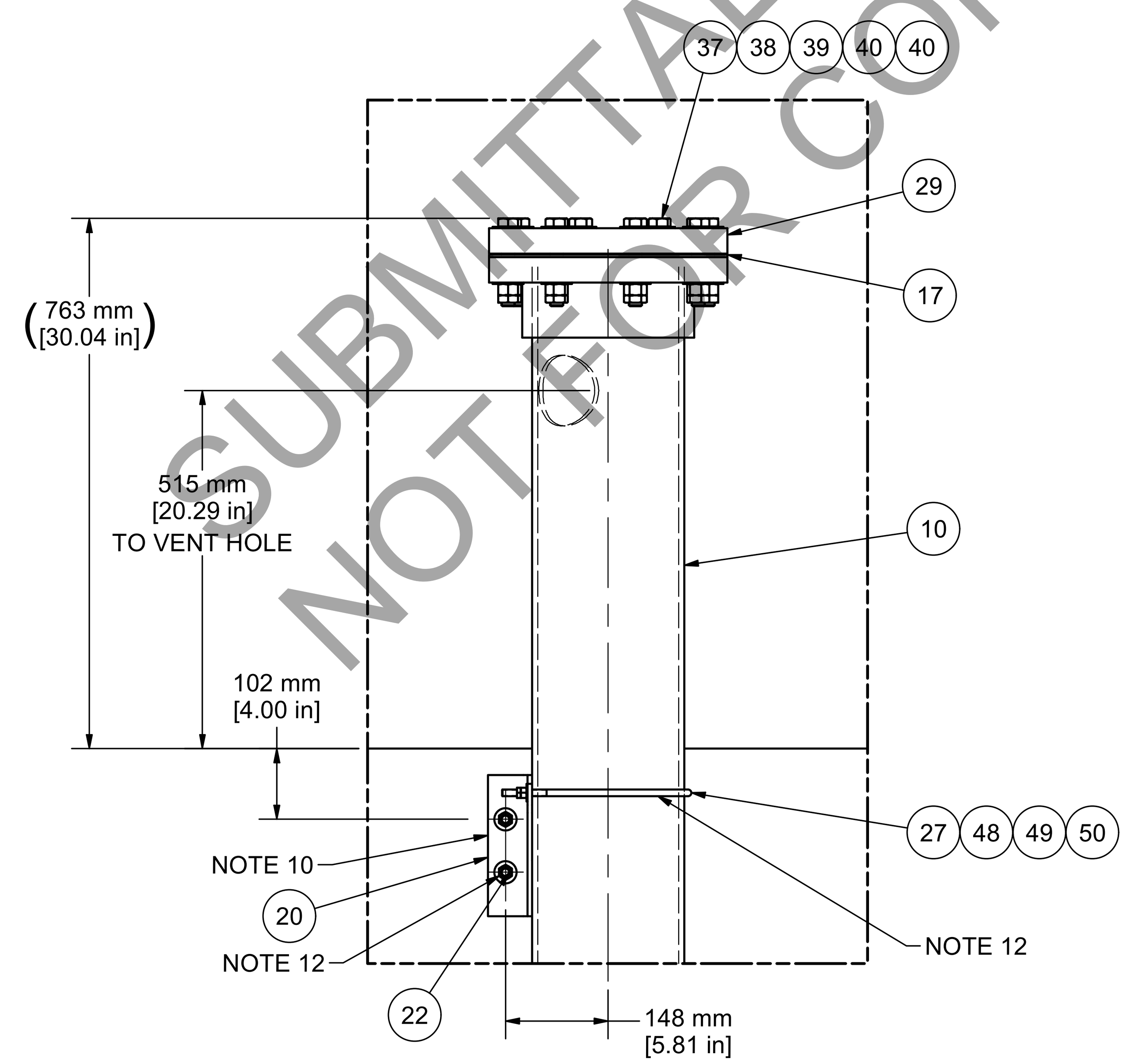
SECTION J-J
INFLUENT LATERAL MOUNTING DETAIL
TYP (264)



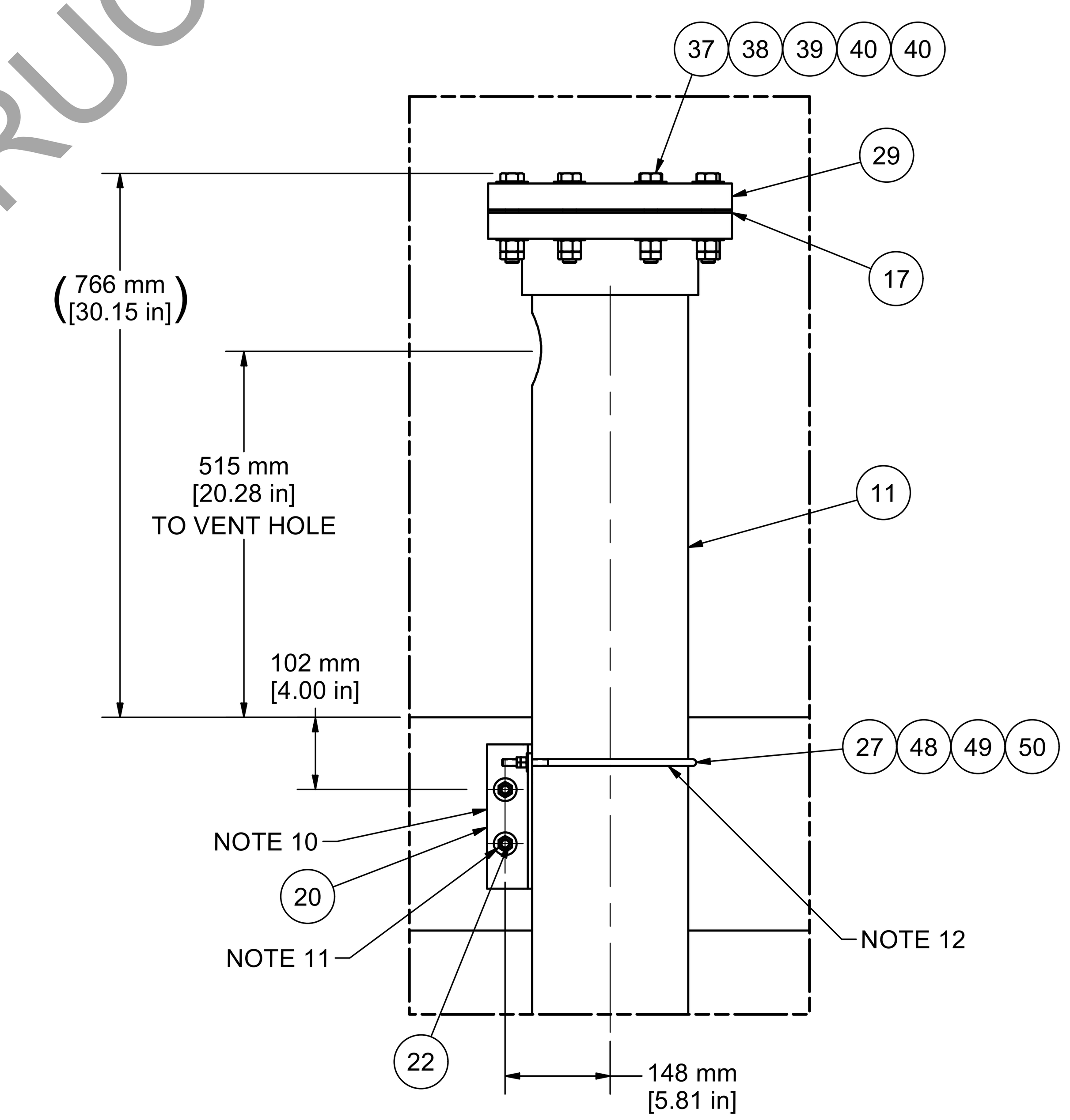
SECTION L-L
SLIDING WALL PLATE MOUNTING DETAIL
TYP (198)



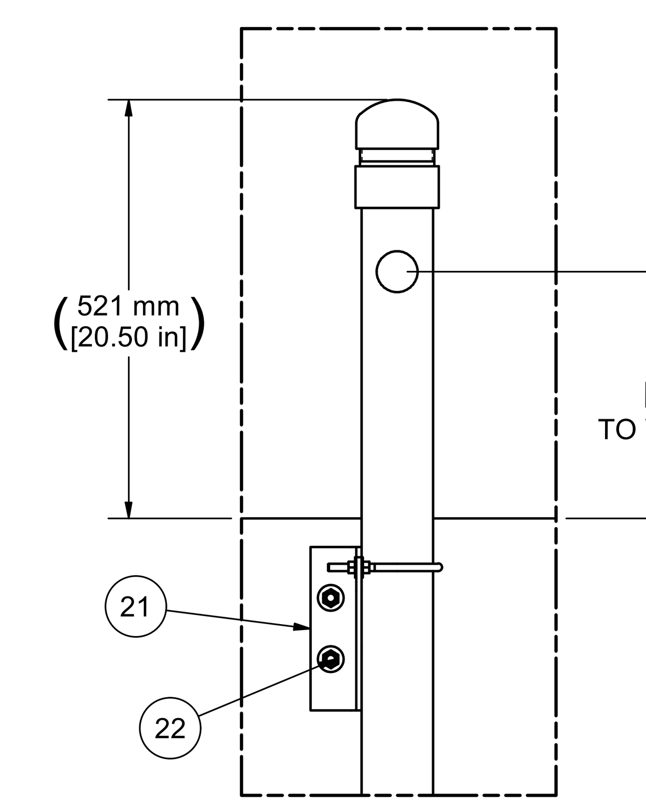
SECTION K-K
FIXED WALL PLATE MOUNTING DETAIL
TYP (66)



DETAIL M
INFLUENT HEADER VENT ASSEMBLY
MOUNTING DETAIL
(INFLUENT INLET END)



DETAIL N
INFLUENT HEADER VENT ASSEMBLY
MOUNTING DETAIL
(OPPOSITE OF INFLUENT INLET END)



DETAIL P
INFLUENT LATERAL VENT ASSEMBLY
TYP (66)

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES			
JOB LOCATION: NAPANEE, ONTARIO, CANADA			
A	2024-10-04	JFM	SUBMITTAL
B	2025-02-14	CJC	FULL SUBMITTAL
REV / ERN/ECO	DATE	BY	REVISION DESCRIPTION

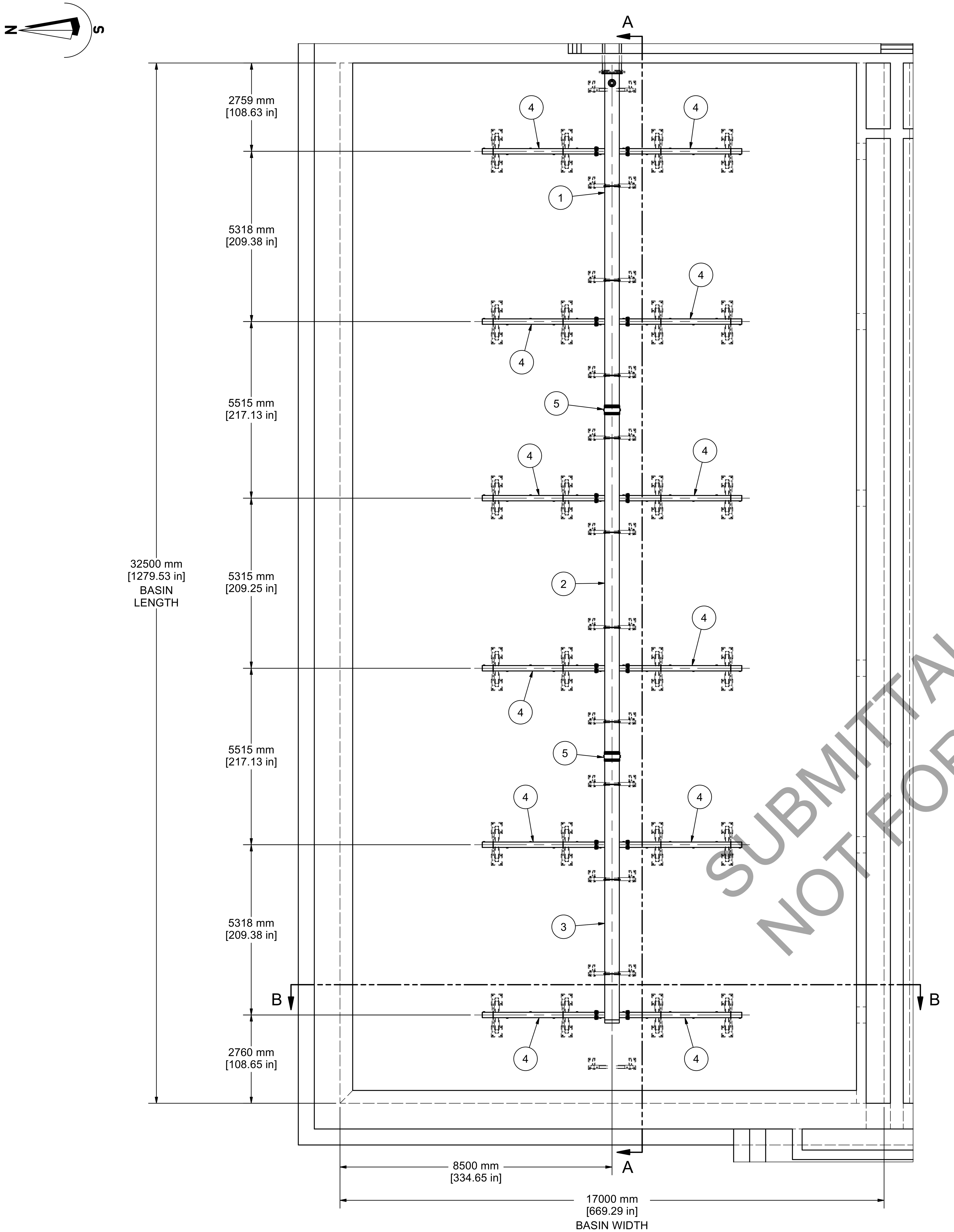
DRAWING NAME: INFLUENT PIPING INSTL, AGS 3

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230005
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-03
WEIGHT: | SHEET: 7 OF 7
DRAWING NUMBER: 9704419A30007 | SCALE: 1:16 | SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE, AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. SLUDGE LAUNDERS ARE NOT DESIGNED AS A WALKWAY, NOR DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AASI.

9. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

10. COMPONENT WEIGHTS
- SLUDGE HEADER ASSEMBLY, 18", INLET END: 171 KG [376 LB]
- SLUDGE HEADER ASSEMBLY, 18", MID: 208 KG [459 LB]
- SLUDGE HEADER ASSEMBLY, 18", END: 169 KG [370 LB]
- SLUDGE DECANTER ASSEMBLY, 6": 11 KG [25 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
19	96	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
18	96	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
17	96	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
16	24	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
15	34	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
14	34	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
13	34	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
12	10	2523759-SX0	U-BOLT, 5/8-11, 18" PIPE	304 SS	Y
11	192	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
10	96	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
9	96	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
8	96	2607145	HHCS, 3/4-10 X 3.5"	316 SS	-
7	12	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
6	8	2620438-018	CLAMP, T-BOLT, LATCH STYLE, 18"	STAINLESS STEEL	-
5	2	2620429-180	EXPANSION SLEEVE, 18", GARLOCK 9394	EPDM	-
4	12	9704419A30107	SLUDGE DECANTER ASSY, 6"	HDPE	Y
3	1	9704419A30106	SLUDGE HEADER ASSY, 18", END	HDPE	Y
2	1	9704419A30105	SLUDGE HEADER ASSY, 18", MID	HDPE	Y
1	1	9704419A30104	SLUDGE HEADER ASSY, 18", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

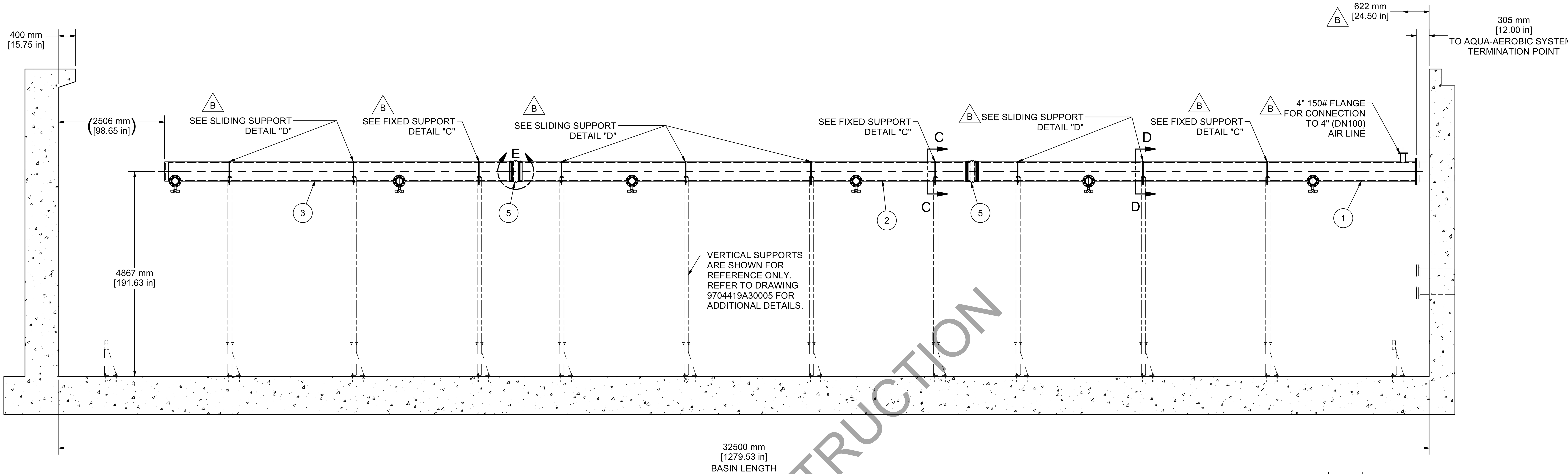
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

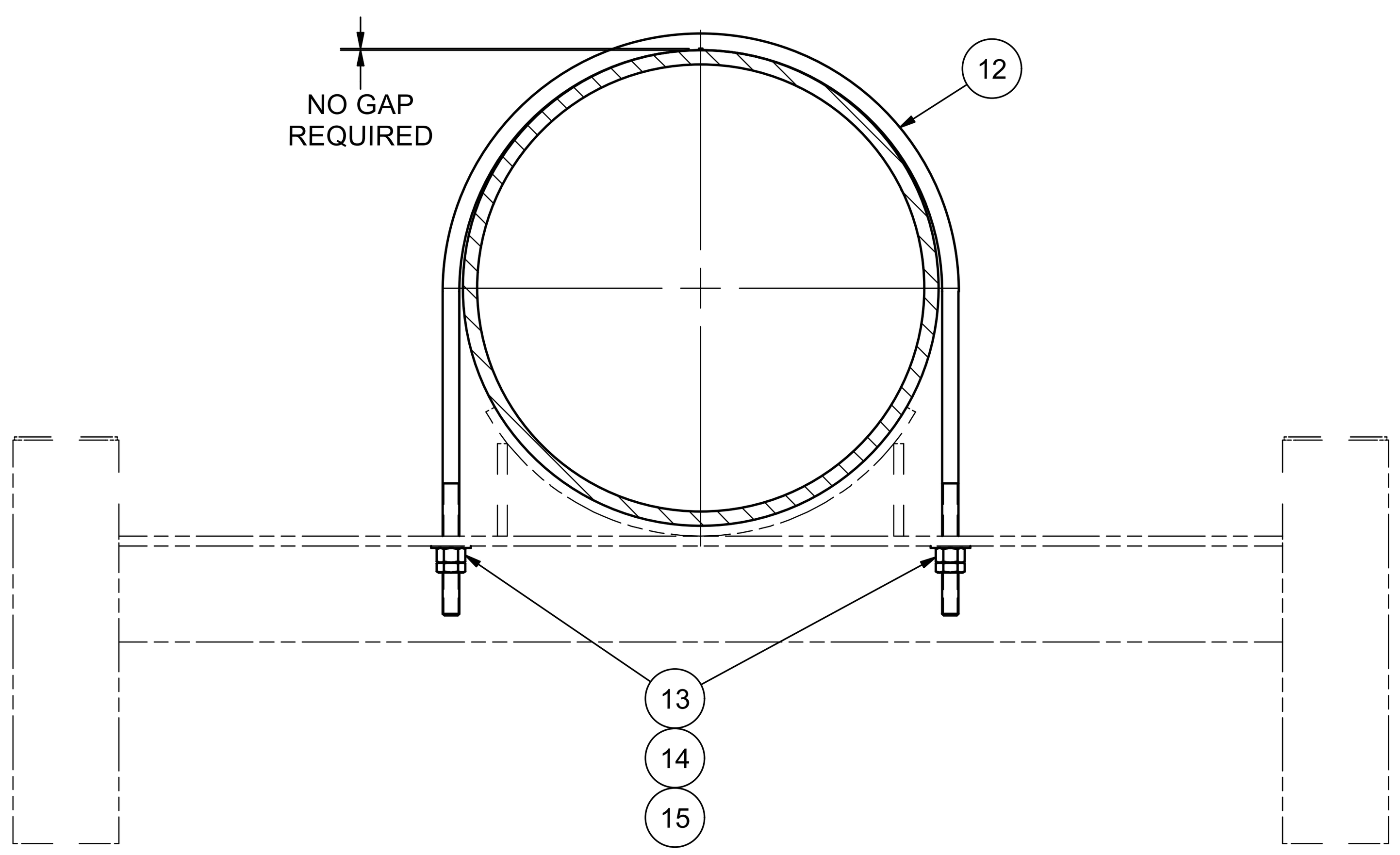
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-05
WEIGHT: SHEET: 1 OF 3
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 1
DRAWING NUMBER: 9704419A30008 SCALE: 1:78 SIZE: D

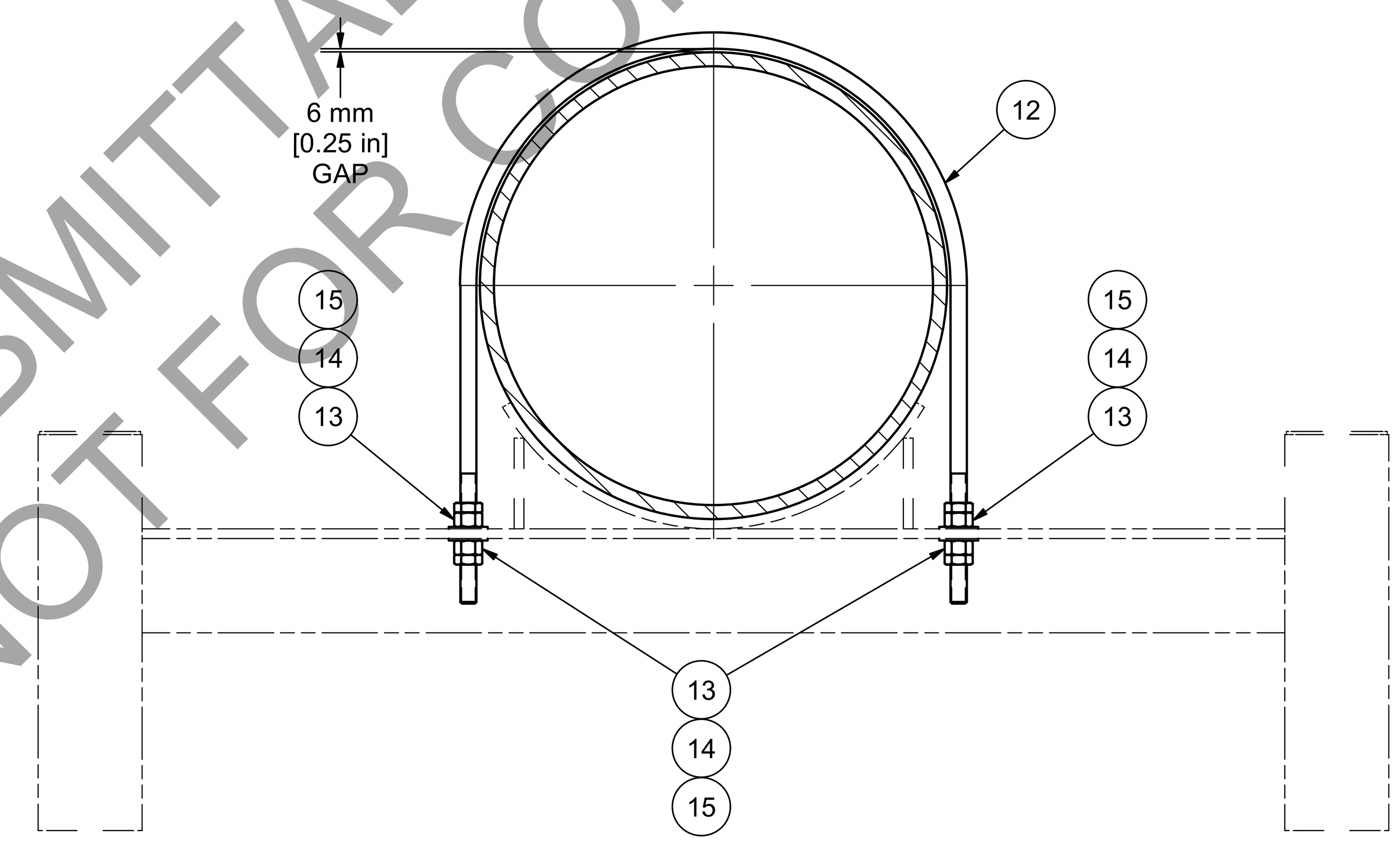
CONFIDENTIAL



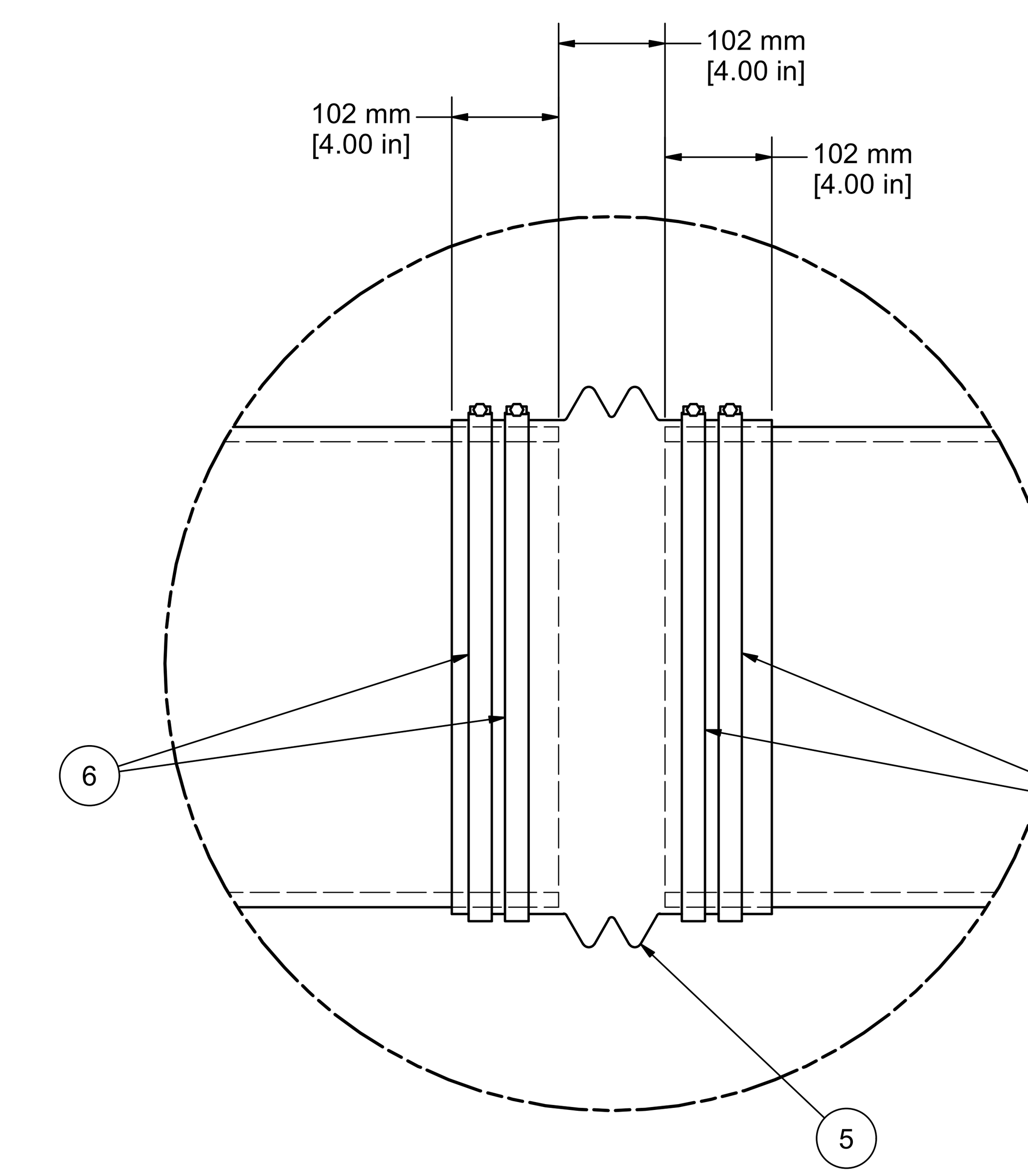
SECTION A-A



SECTION C-C
FIXED SUPPORT DETAIL
(3) PLACEs



SECTION D-D
SLIDING SUPPORT DETAIL
TYP (7)



DETAIL E
EXPANSION SLEEVE DETAIL
TYP (2)

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

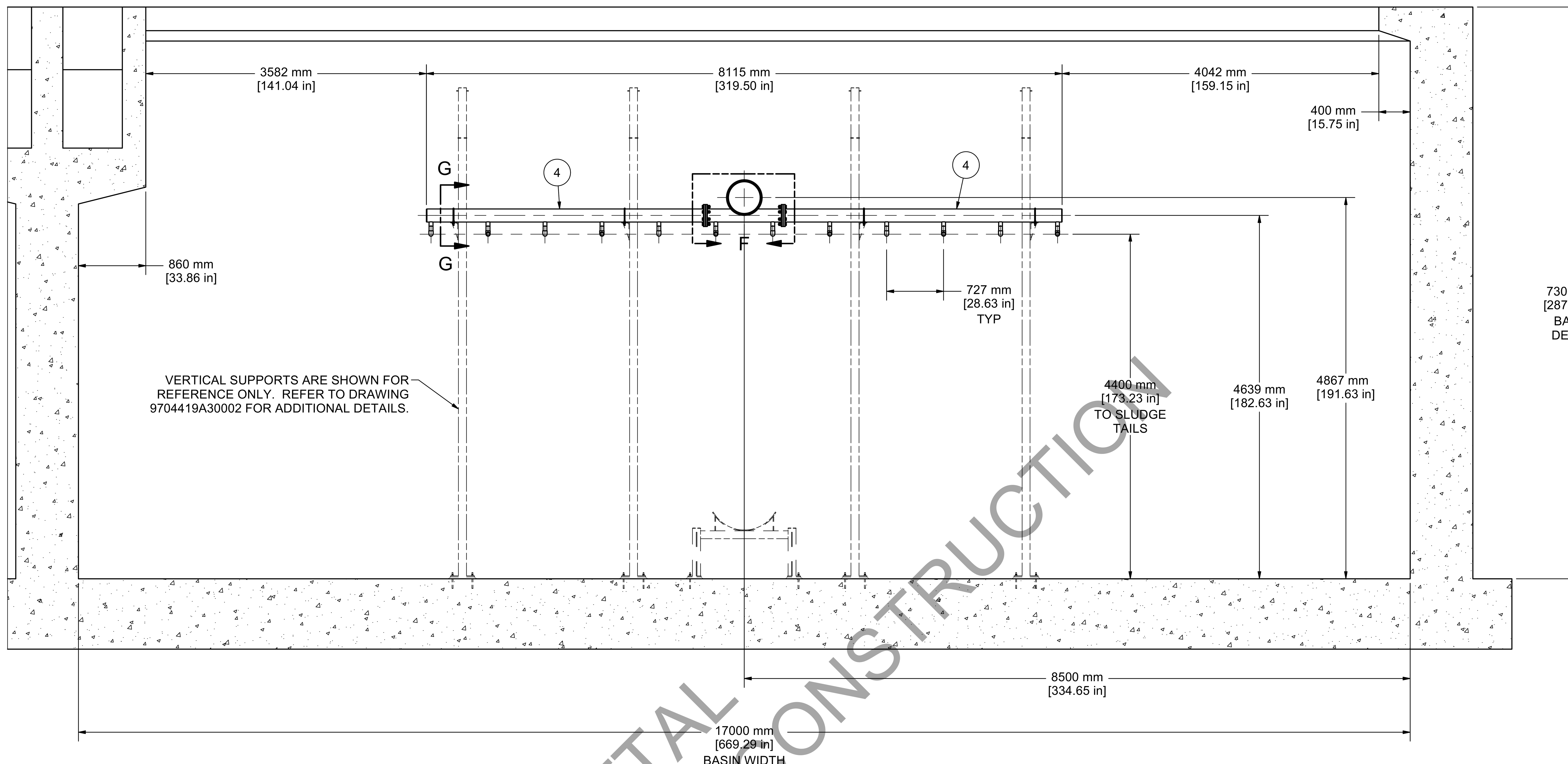
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

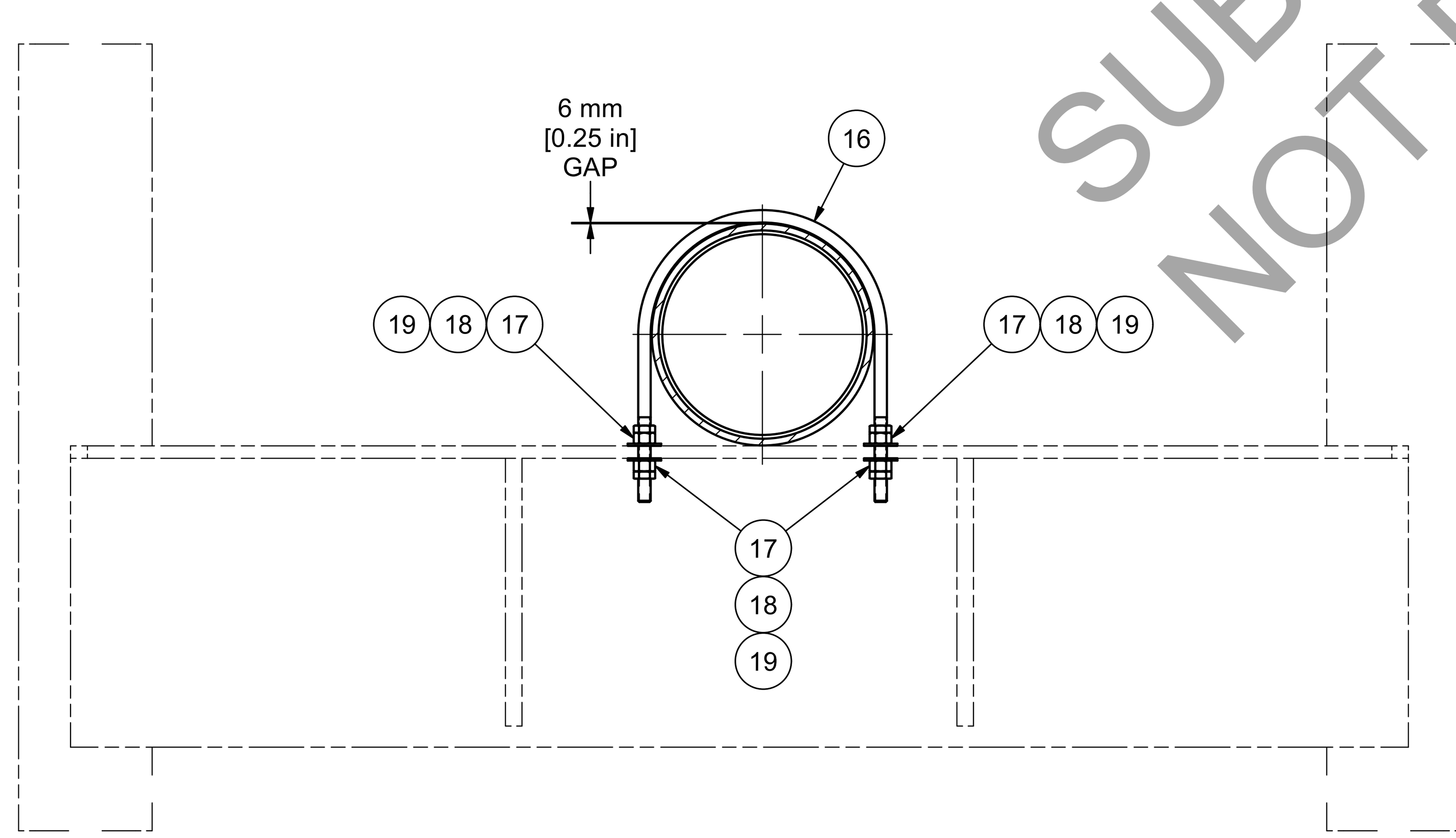
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM
DATE: 2024-10-05
WEIGHT:
SHEET: 2 OF 3
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 1
DRAWING NUMBER: 9704419A30008
SCALE: 1:48
SIZE: D

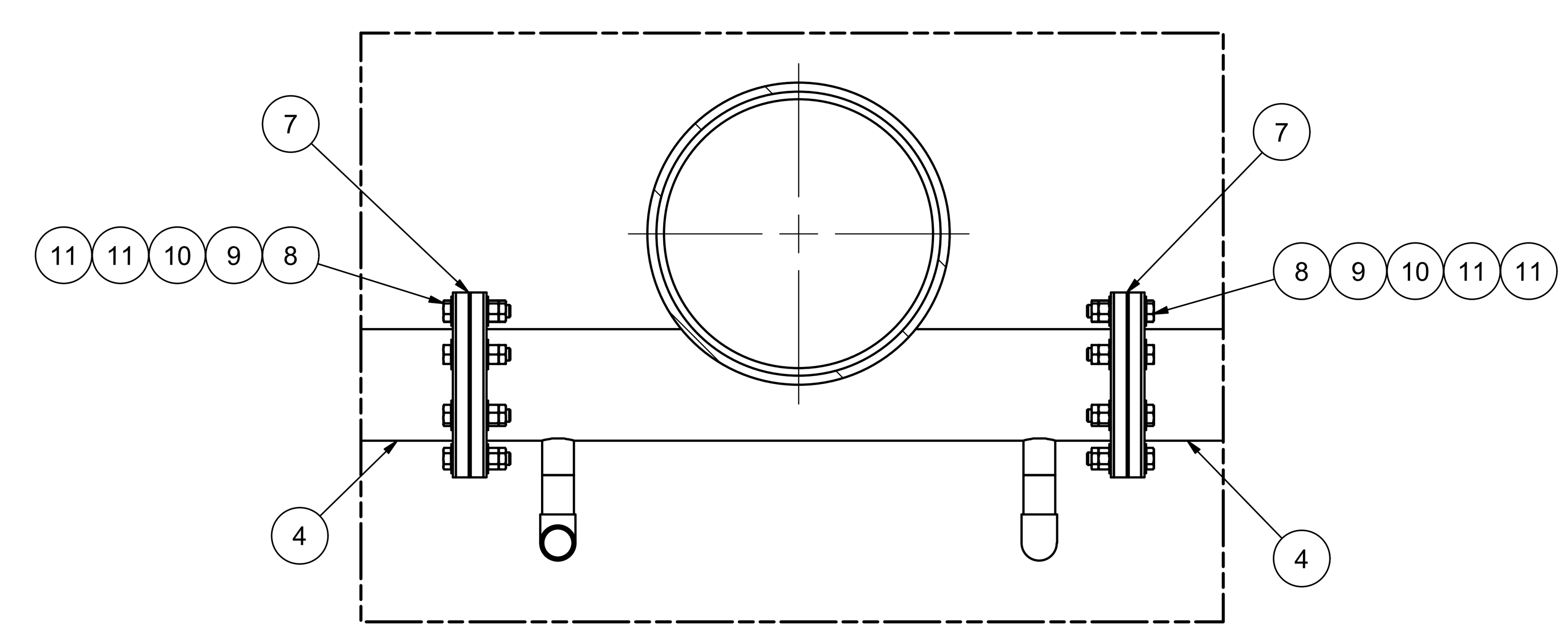


SECTION B-B



SECTION G-G

TYP (24)



DETAIL F

TYP (6)

SUBMITTAL
NOT FOR CONSTRUCTION

CONFIDENTIAL

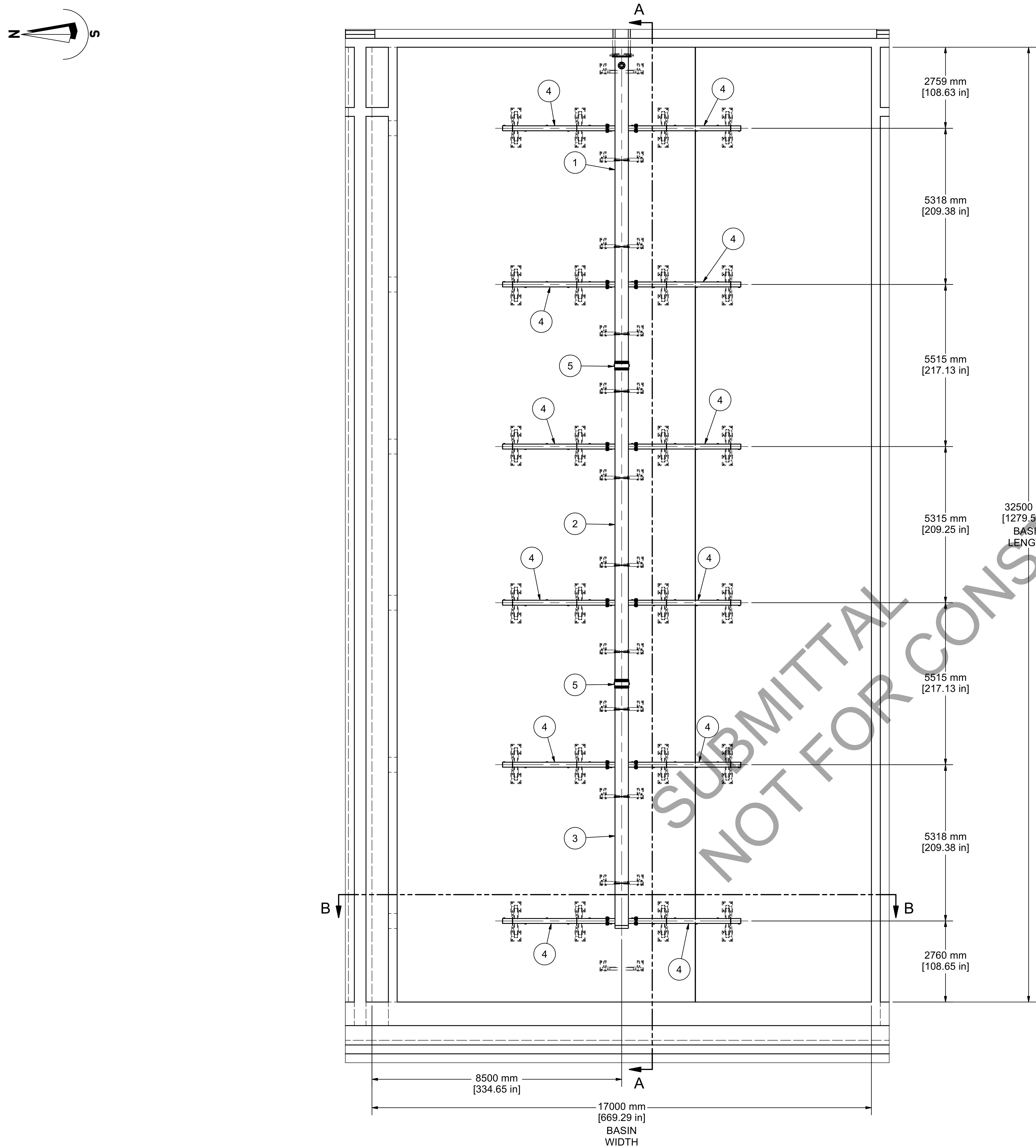
JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 1				

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-05
WEIGHT: SHEET: 3 OF 3
DRAWING NUMBER: 9704419A30008 SCALE: 1:36 SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE, AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. SLUDGE LAUNDERS ARE NOT DESIGNED AS A WALKWAY, NOR DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AASI.

9. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

10. COMPONENT WEIGHTS
- SLUDGE HEADER ASSEMBLY, 18", INLET END: 171 KG [376 LB]
- SLUDGE HEADER ASSEMBLY, 18", MID: 208 KG [459 LB]
- SLUDGE HEADER ASSEMBLY, 18", END: 169 KG [370 LB]
- SLUDGE DECANTER ASSEMBLY, 6": 11 KG [25 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
19	96	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
18	96	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
17	96	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
16	24	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
15	34	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
14	34	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
13	34	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
12	10	2523759-SX0	U-BOLT, 5/8-11, 18" PIPE	304 SS	Y
11	192	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
10	96	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
9	96	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
8	96	2607145	HHCS, 3/4-10 X 3.5"	316 SS	-
7	12	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
6	8	2620438-018	CLAMP, T-BOLT, LATCH STYLE, 18"	STAINLESS STEEL	-
5	2	2620429-180	EXPANSION SLEEVE, 18", GARLOCK 9394	EPDM	-
4	12	9704419A30107	SLUDGE DECANTER ASSY, 6"	HDPE	Y
3	1	9704419A30106	SLUDGE HEADER ASSY, 18", END	HDPE	Y
2	1	9704419A30105	SLUDGE HEADER ASSY, 18", MID	HDPE	Y
1	1	9704419A30104	SLUDGE HEADER ASSY, 18", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

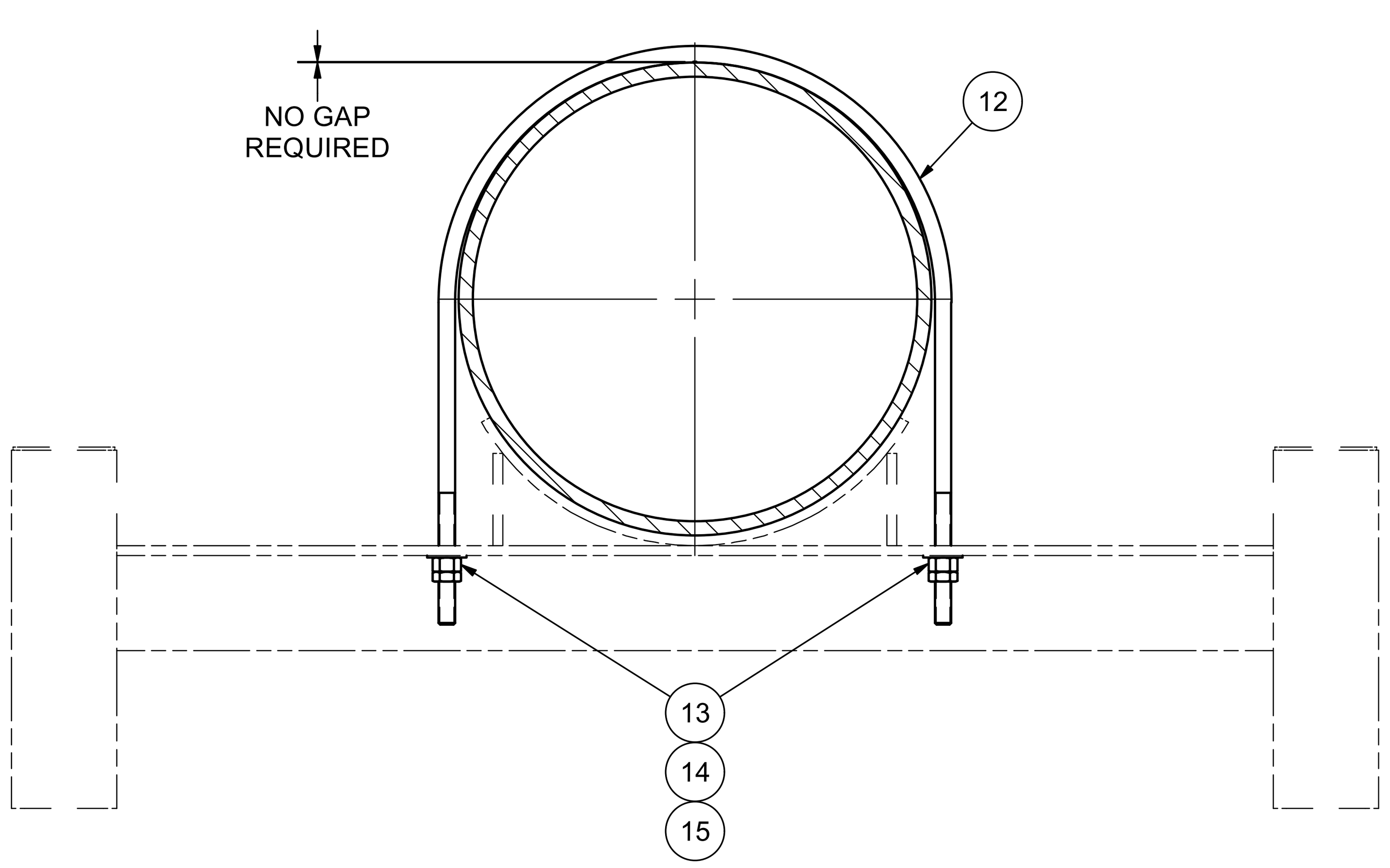
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-07
WEIGHT: SHEET: 1 OF 3

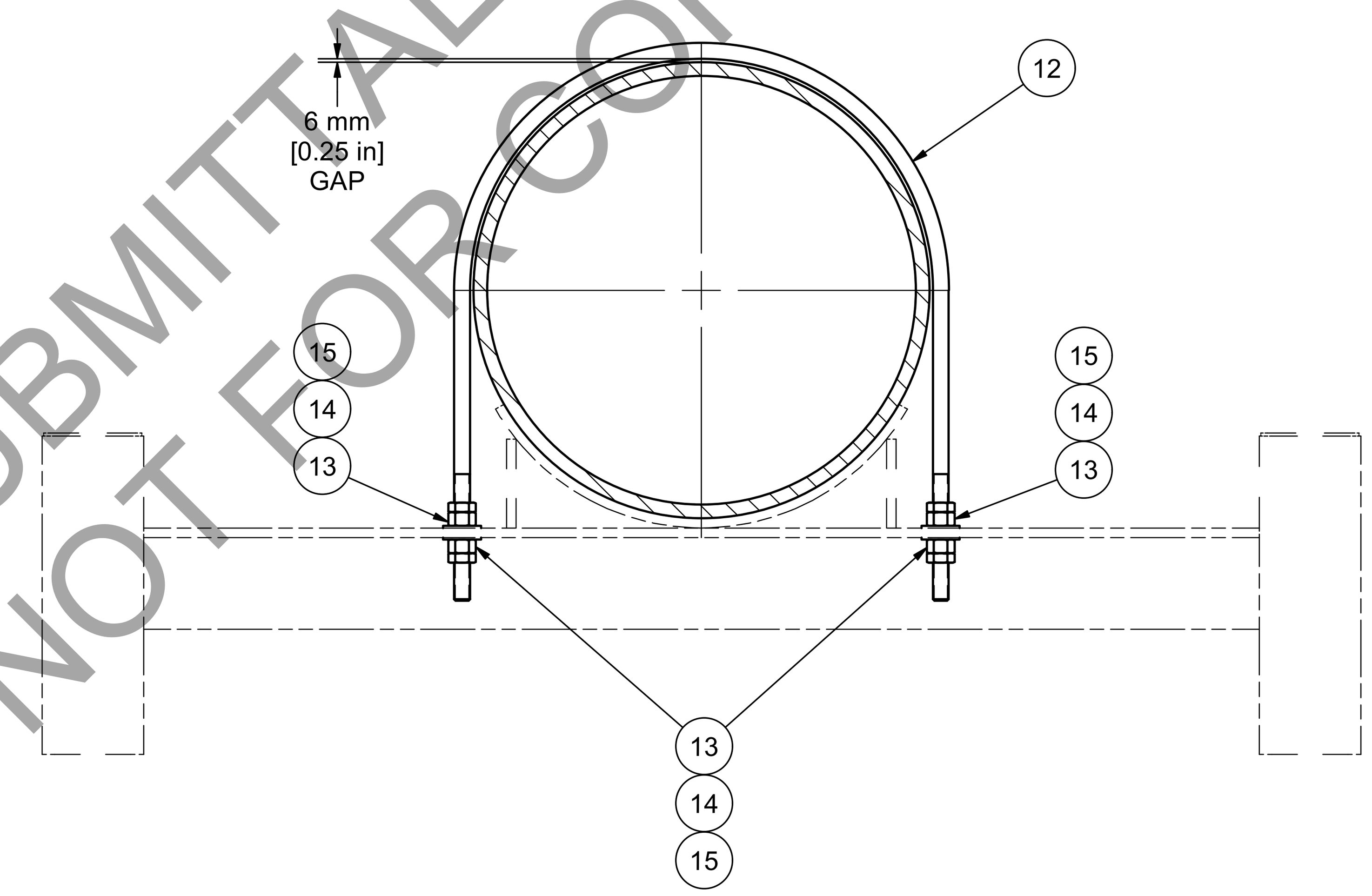
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 2
DRAWING NUMBER: 9704419A30009 SCALE: 1:78 SIZE: D

CONFIDENTIAL

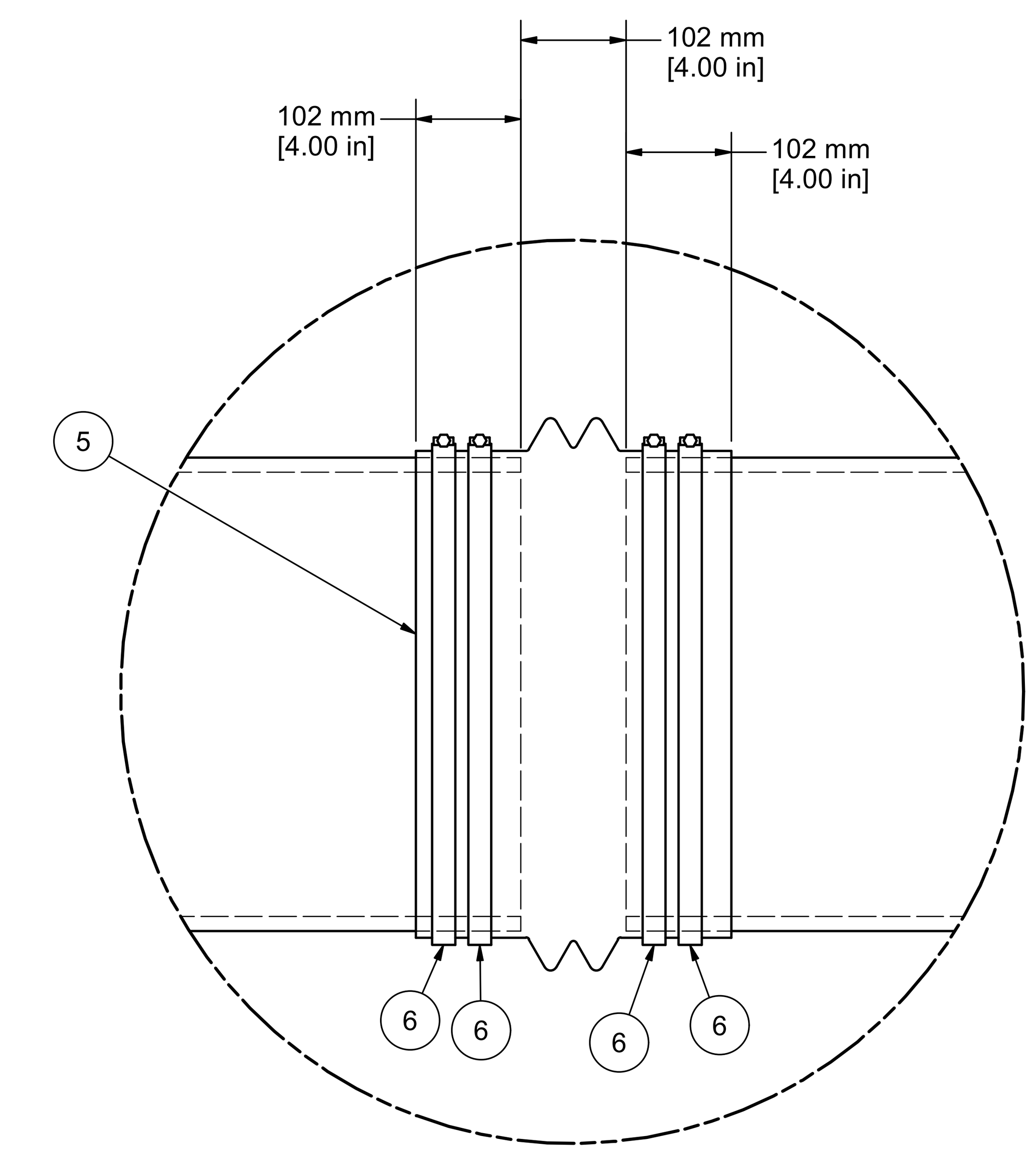
SECTION A-A



SECTION C-C
FIXED SUPPORT DETAIL
(3) PLACE

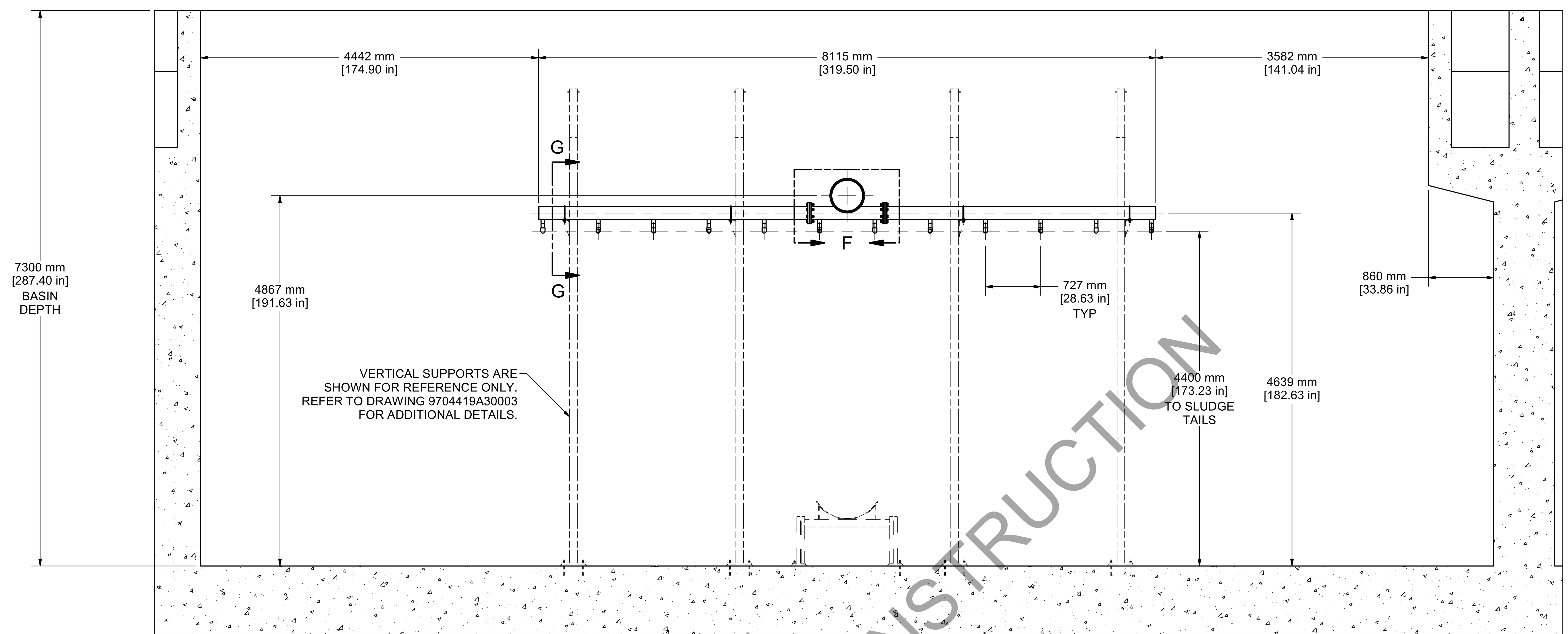


SECTION D-D
SLIDING SUPPORT DETAIL
TYP (7)

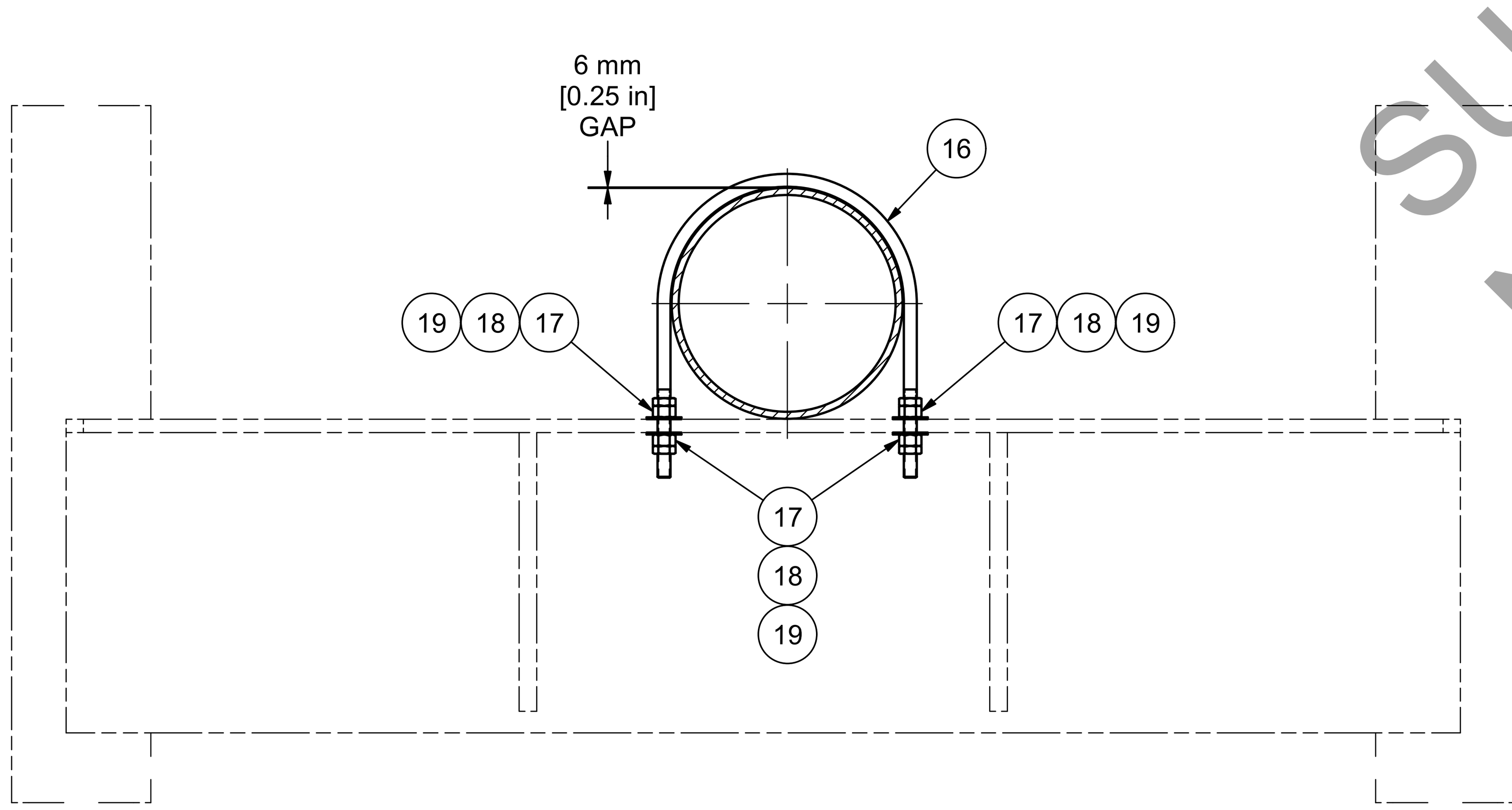


DETAIL E
EXPANSION SLEEVE DETAIL
TYP (2)

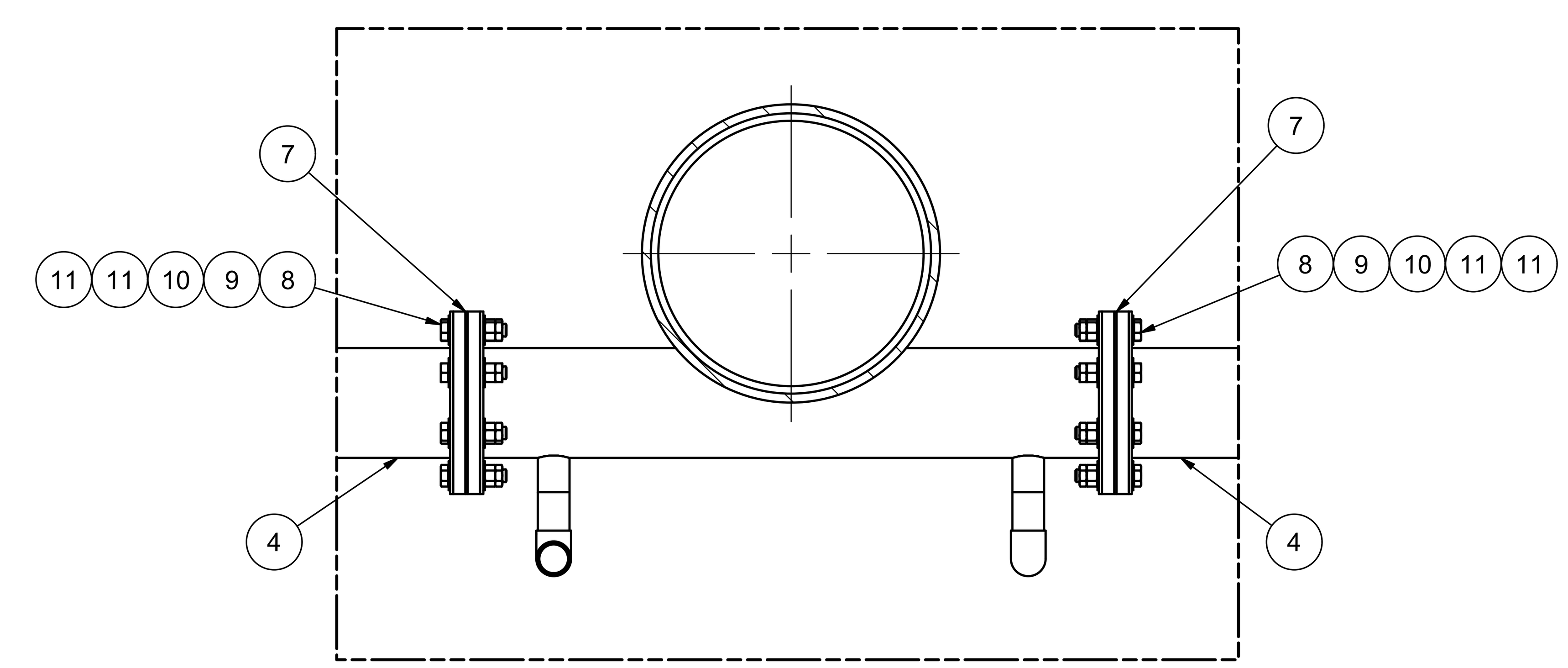
JOB NAME: NAPANEE WPCP UPGRADES					AQUA-AEROBIC SYSTEMS, INC. A Metawater Company
JOB LOCATION: NAPANEE, ONTARIO, CANADA					
					DO NOT SCALE DRAWING
					UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES; FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2°; ANSI
					MATERIAL:
					SIMILAR TO: 911689230008
A		2024-10-07	JFM	SUBMITTAL	TYPE: AQUANEREDA
B		2025-02-14	CJC	FULL SUBMITTAL	DRAWN BY: JFM — DATE: 2024-10-07
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: — SHEET: 2 OF 3
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 2					DRAWING NUMBER: 9704419A30009 — SCALE: 1:48 — SIZE: D



SECTION B-B



SECTION G-G
TYP (24)



DETAIL F
TYP (6)

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 2				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

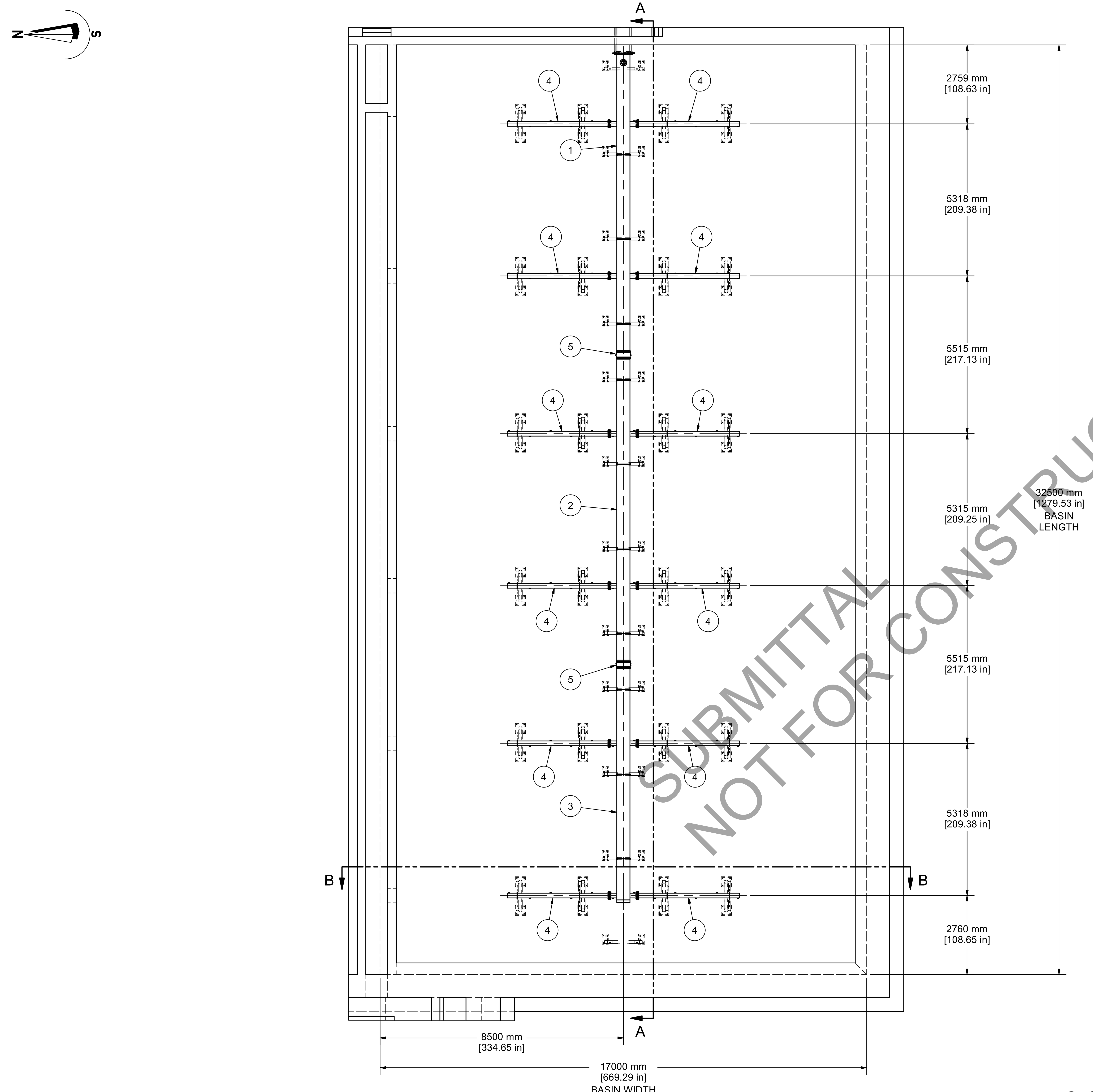
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:		
SIMILAR TO: 911689230008		
TYPE: AQUANEREDA		
DRAWN BY: JFM	DATE: 2024-10-07	
WEIGHT:	SHEET: 3 OF 3	
DRAWING NUMBER: 9704419A30009	SCALE: 1:36	SIZE: D



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND JAM NUT OR TWO FULL NUTS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. ALL PIPING, GASKETS, HARDWARE, AND PIPE SUPPORTS BEYOND AQUA-AEROBIC SYSTEMS TERMINATION FLANGE HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

5. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.

7. TORQUE ALL FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

8. SLUDGE LAUNDERS ARE NOT DESIGNED AS A WALKWAY, NOR DESIGNED TO SUPPORT ANY EQUIPMENT NOT SUPPLIED BY AASI.

9. FOR ALL U-BOLT CLAMPS: SPIN FULL NUT UNTIL CLAMP IS SNUG AND THEN TORQUE TO 41 ft-lb. LOCK WITH JAM OR FULL NUT AGAINST FIRST FULL NUT PER TORQUE SPECIFIED IN ES-1057.

10. COMPONENT WEIGHTS
   - SLUDGE HEADER ASSEMBLY, 18", INLET END: 171 KG [376 LB]
   - SLUDGE HEADER ASSEMBLY, 18", MID: 208 KG [459 LB]
   - SLUDGE HEADER ASSEMBLY, 18", END: 169 KG [370 LB]
   - SLUDGE DECANTER ASSEMBLY, 6": 11 KG [25 LB]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
19	96	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
18	96	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
17	96	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
16	24	2617771-006-SX0	U-BOLT, 3/8"-16UNC x 6"	304 SS	Y
15	34	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
14	34	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
13	34	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
12	10	2523759-SX0	U-BOLT, 5/8-11, 18" PIPE	304 SS	Y
11	192	2602580	WASHER, FLAT, 3/4" X 1 7/8"	316 SS	-
10	96	2602579	NUT, HEX, JAM, 3/4-10	316 SS	-
9	96	2600496	NUT, HEX, FULL, 3/4-10	316 SS	-
8	96	2607145	HHCS, 3/4-10 X 3.5"	316 SS	-
7	12	2600738	GASKET, 6", RED RUBBER, W/HOLES	SBR	-
6	8	2620438-018	CLAMP, T-BOLT, LATCH STYLE, 18"	STAINLESS STEEL	-
5	2	2620429-180	EXPANSION SLEEVE, 18", GARLOCK 9394	EPDM	-
4	12	9704419A30107	SLUDGE DECANTER ASSY, 6"	HDPE	Y
3	1	9704419A30106	SLUDGE HEADER ASSY, 18", END	HDPE	Y
2	1	9704419A30105	SLUDGE HEADER ASSY, 18", MID	HDPE	Y
1	1	9704419A30104	SLUDGE HEADER ASSY, 18", INLET END	HDPE	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

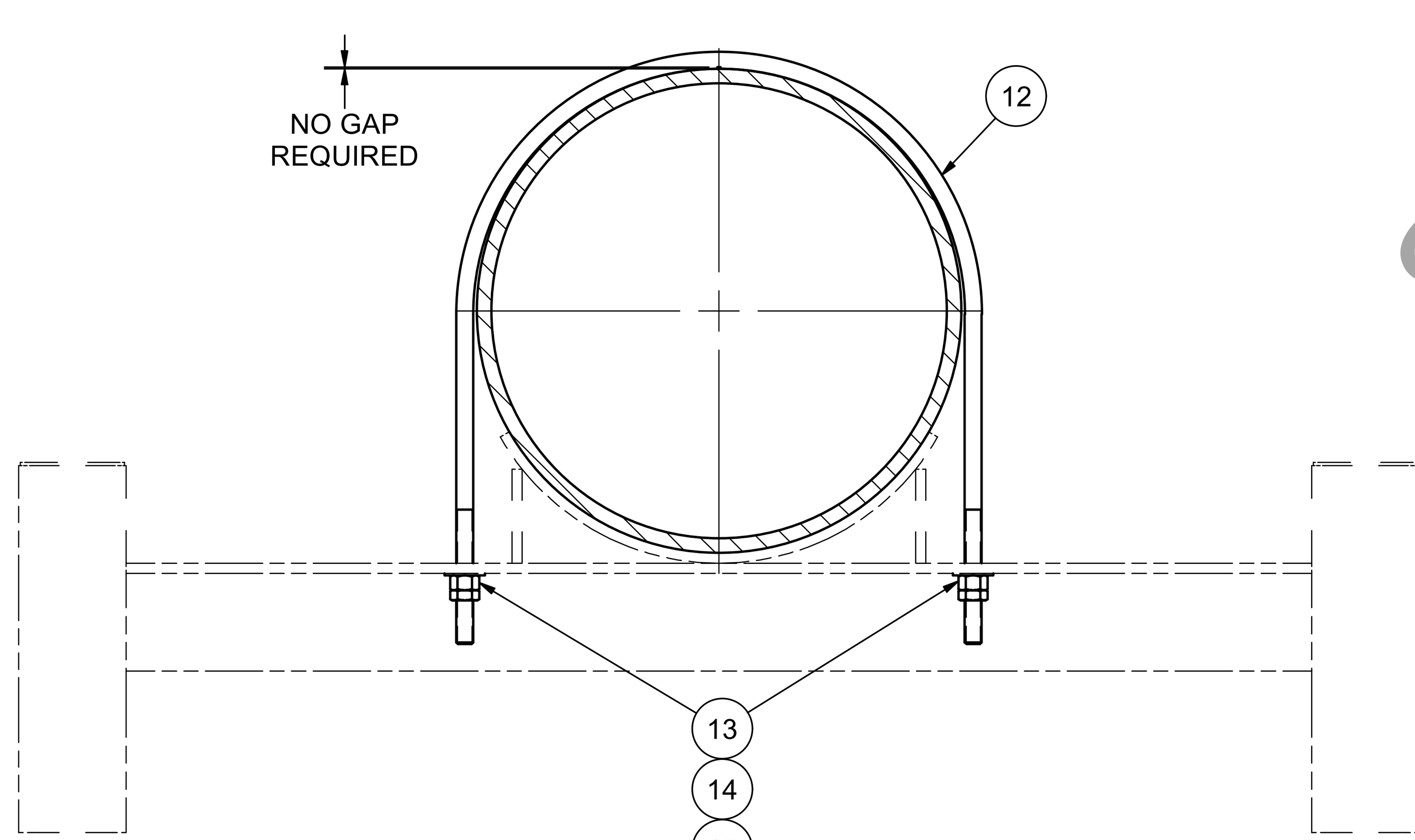
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-07
WEIGHT: SHEET: 1 OF 3

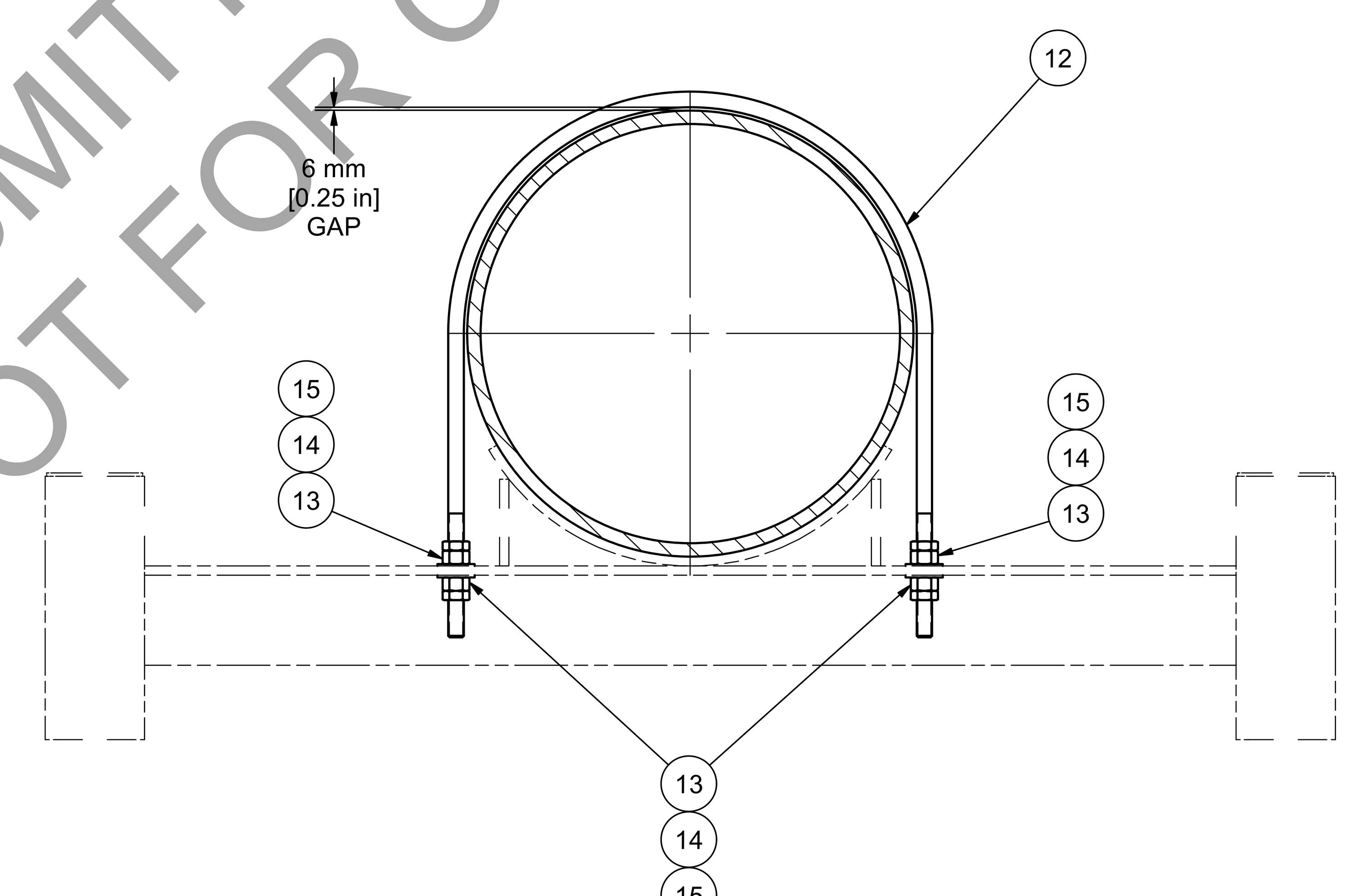
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 3
DRAWING NUMBER: 9704419A30010 SCALE: 1:78 SIZE: D

CONFIDENTIAL

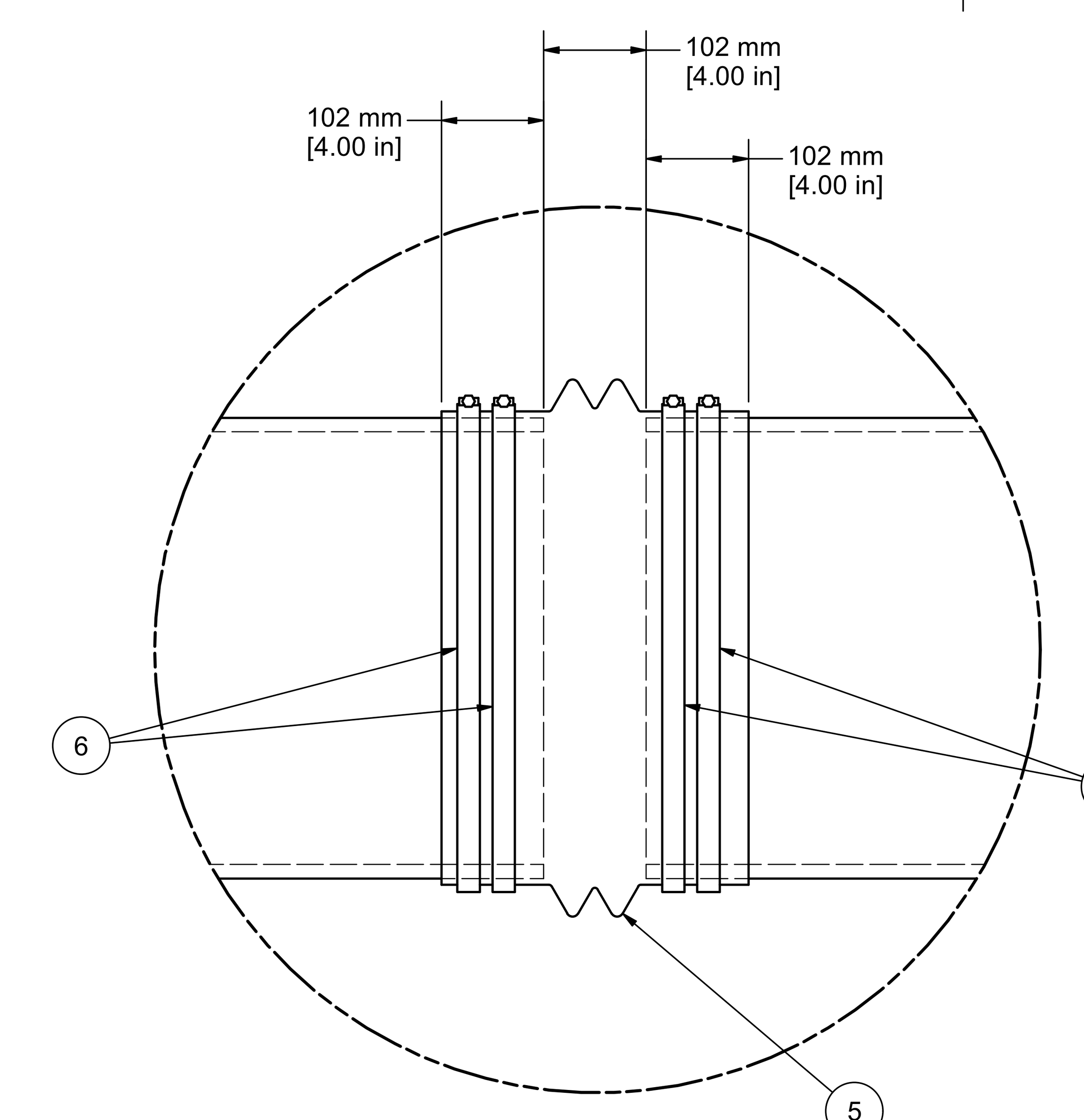
SECTION A-A



SECTION C-C
FIXED SUPPORT DETAIL
TYP (3)



SECTION D-D
SLIDING SUPPORT DETAIL
TYP (7)



DETAIL E
EXPANSION SLEEVE DETAIL
TYP (2)

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 3				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

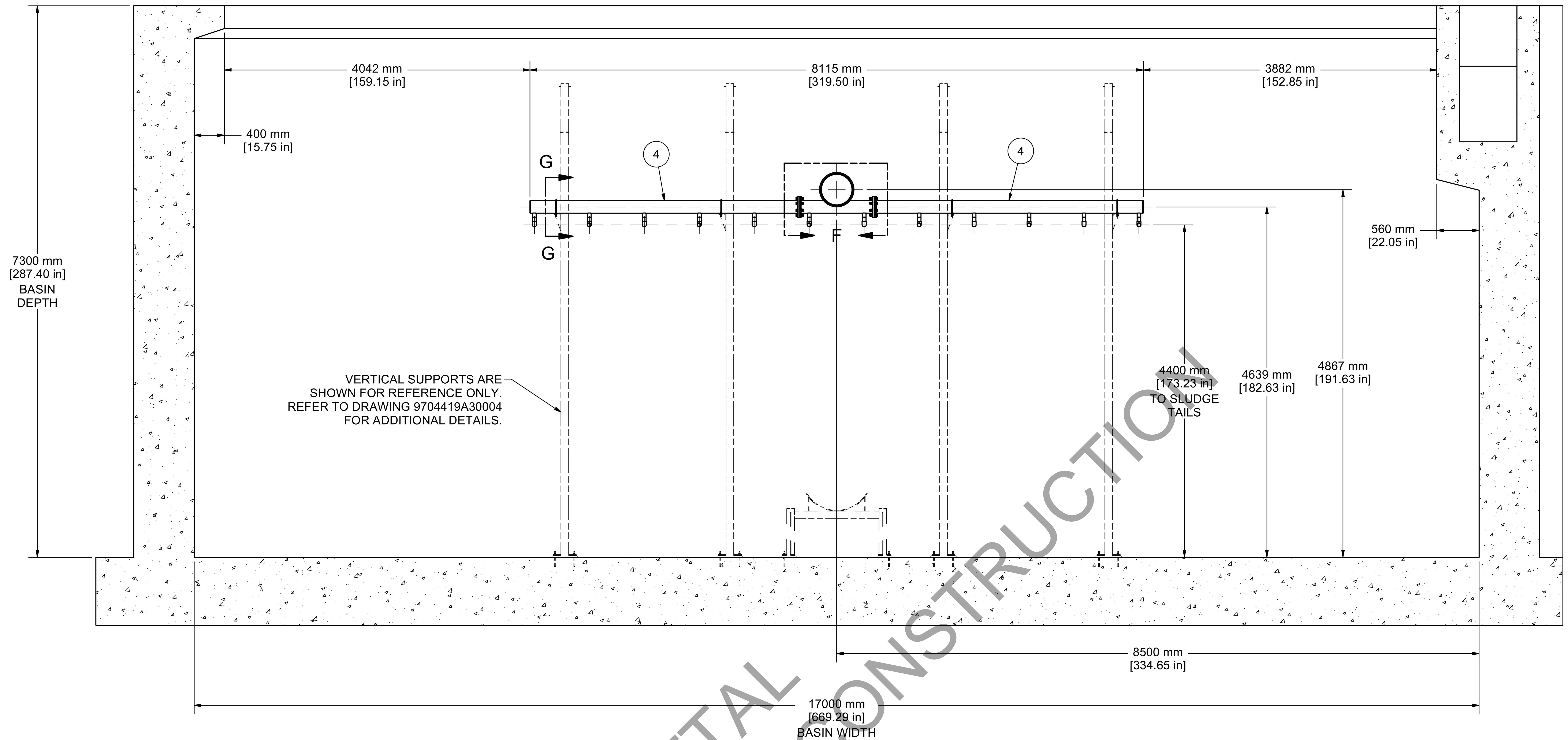
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

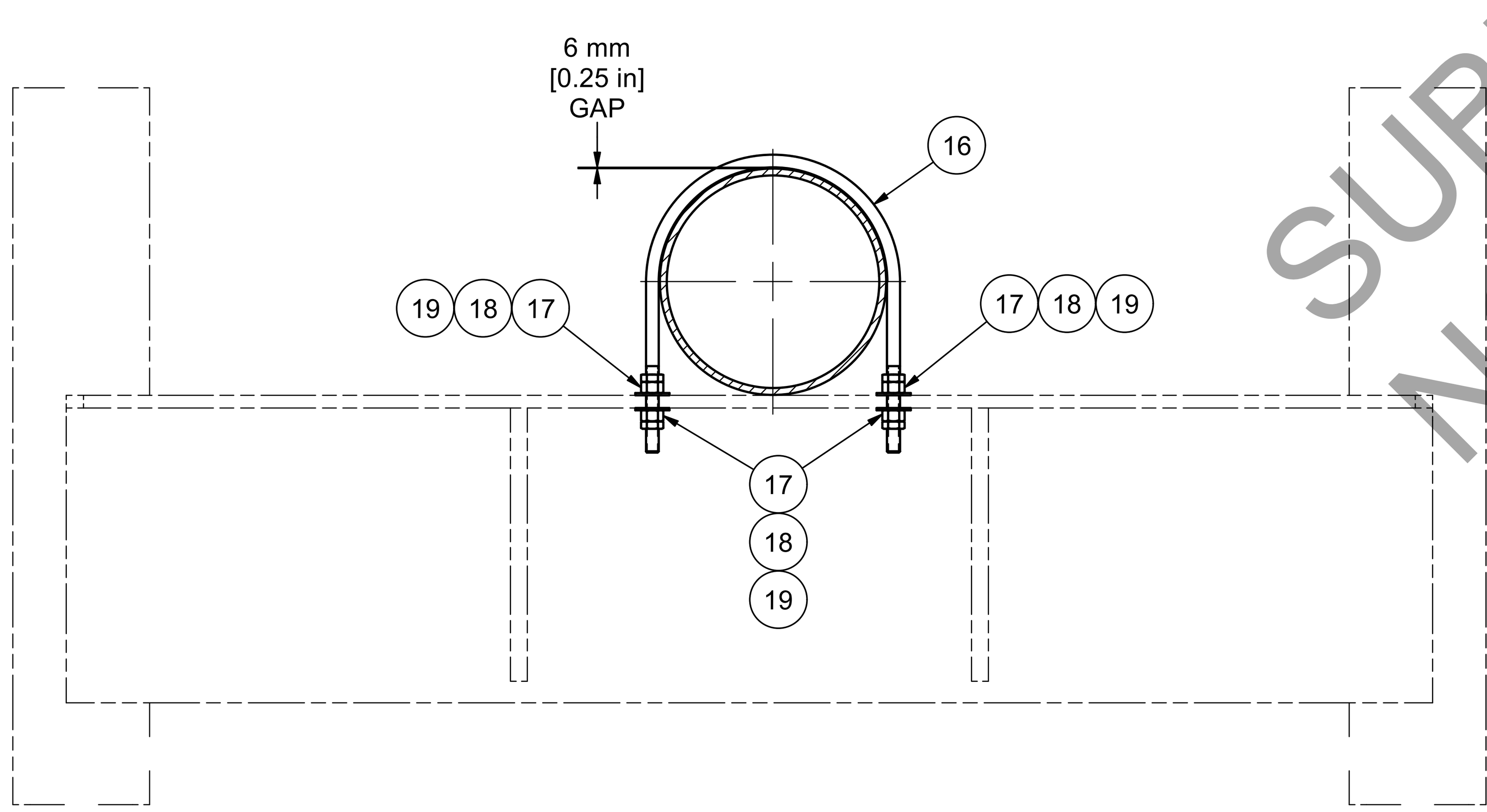
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-07
WEIGHT: | SHEET: 2 OF 3
DRAWING NUMBER: 9704419A30010 | SCALE: 1:48 | SIZE: D

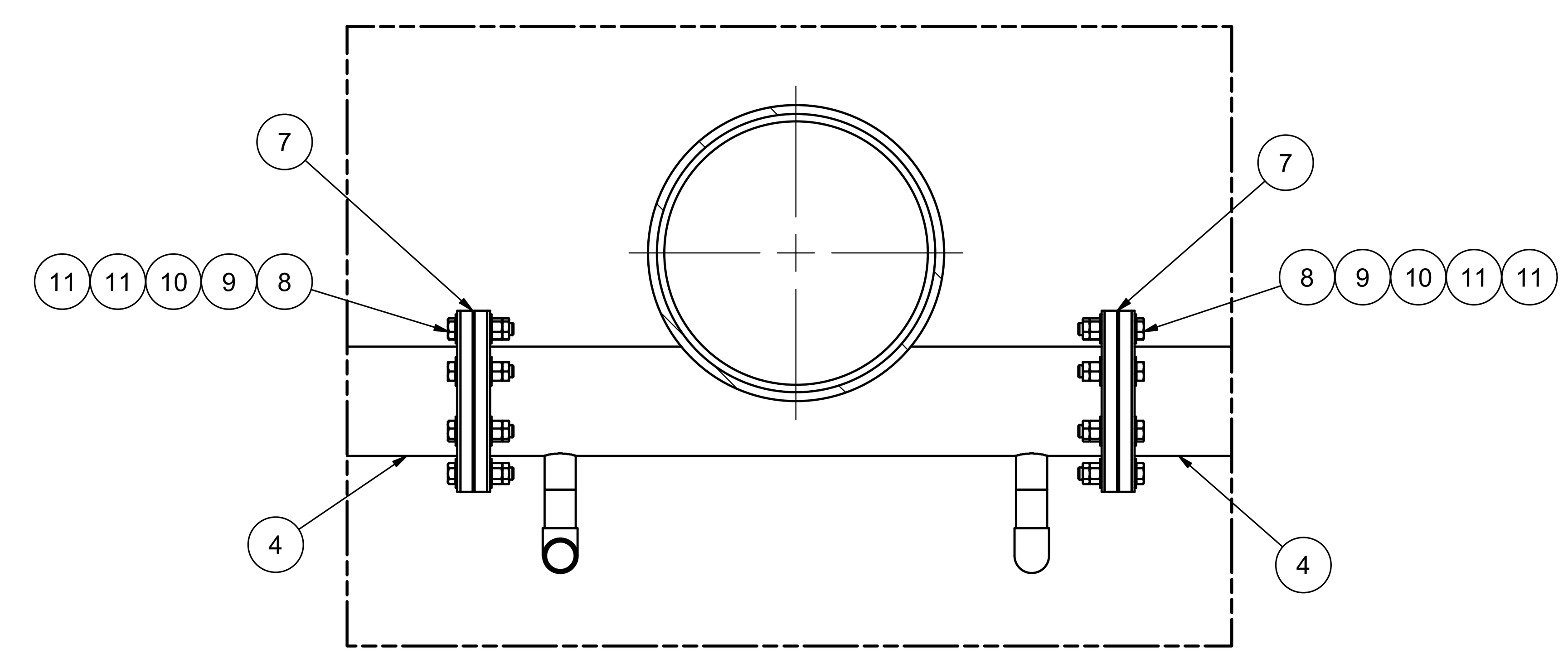


SECTION B-B

SUBMITTAL
NOT FOR CONSTRUCTION



SECTION G-G
TYP (24)



DETAIL F
TYP (6)

CONFIDENTIAL

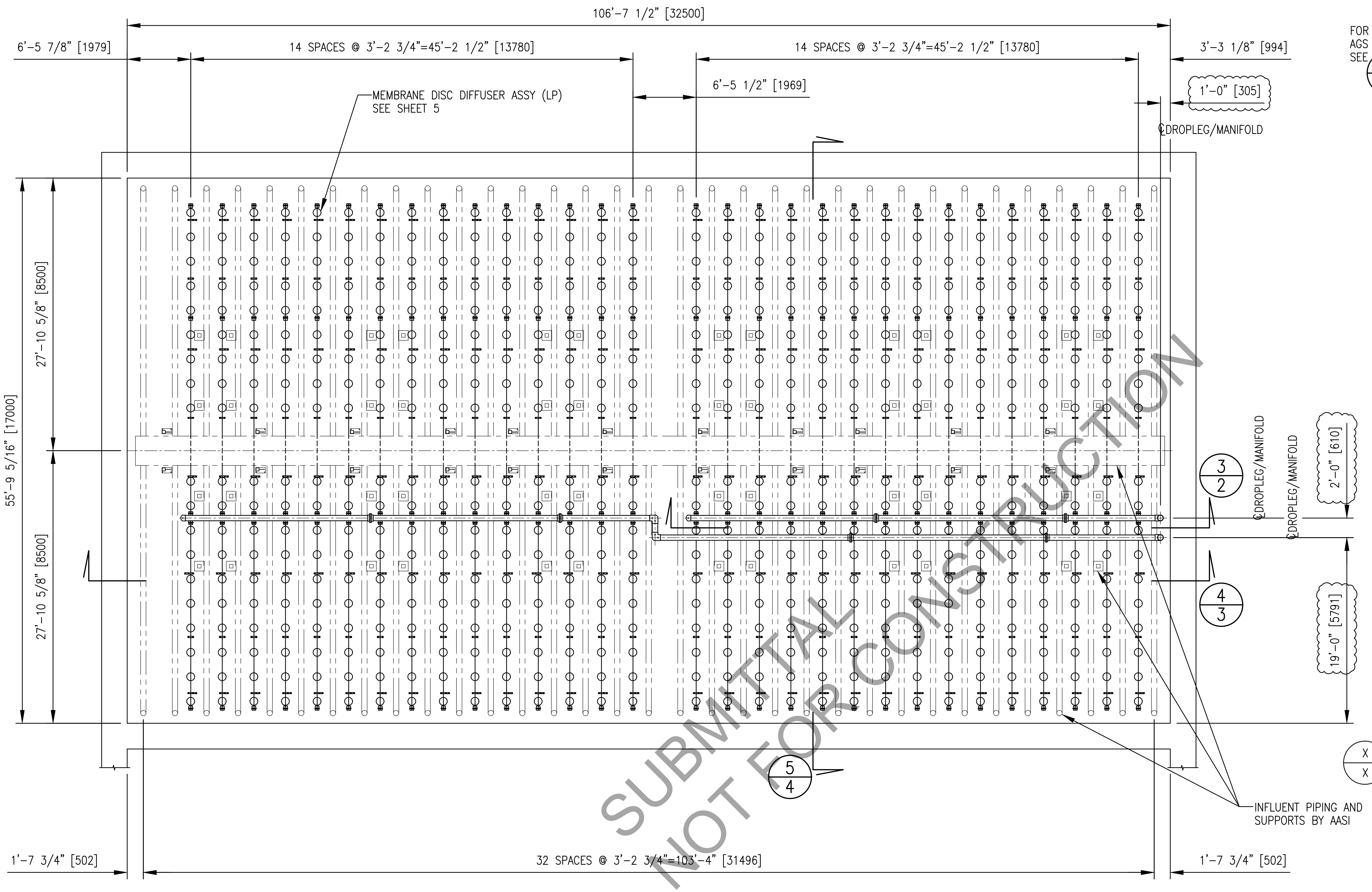
JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	JFM	SUBMITTAL
B		2025-02-14	CJC	FULL SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: SLUDGE DECANTER INSTL, AGS 3				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

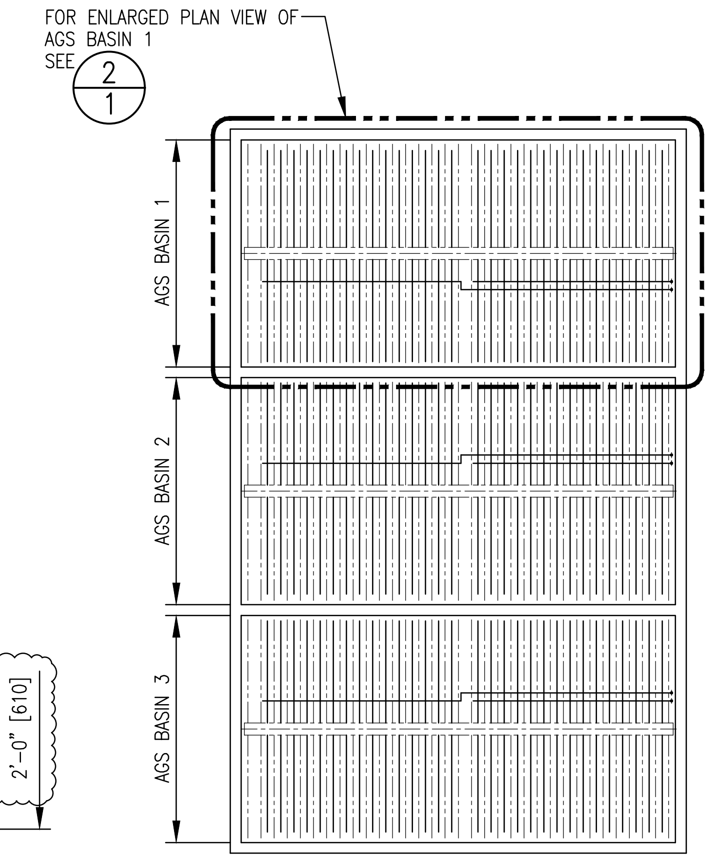
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 911689230008
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-07
WEIGHT: | SHEET: 3 OF 3
DRAWING NUMBER: 9704419A30010 | SCALE: 1:36 | SIZE: D



AGS BASIN 1
LOWER LEVEL
PLAN VIEW (2)



AGS BASINS 1–3
KEY PLAN (1)

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

X/X –DESIGNATES PLAN VIEW, SECTION OR DETAIL NUMBER
–DESIGNATES SHEET ON WHICH PLAN VIEW, SECTION OR DETAIL CAN BE FOUND

"X'–X"" –PLEASE VERIFY DIMENSION OR ELEVATION

AGS BASIN 1
GRID INFORMATION

1– TANK(S)
2– GRID(S) PER TANK
15– AIR HEADERS PER GRID
19– DIFFUSERS PER AIR HEADER
285– DIFFUSERS PER GRID
570– TOTAL DIFFUSERS INSTALLED

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

PLAN VIEW

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS1–S–1–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

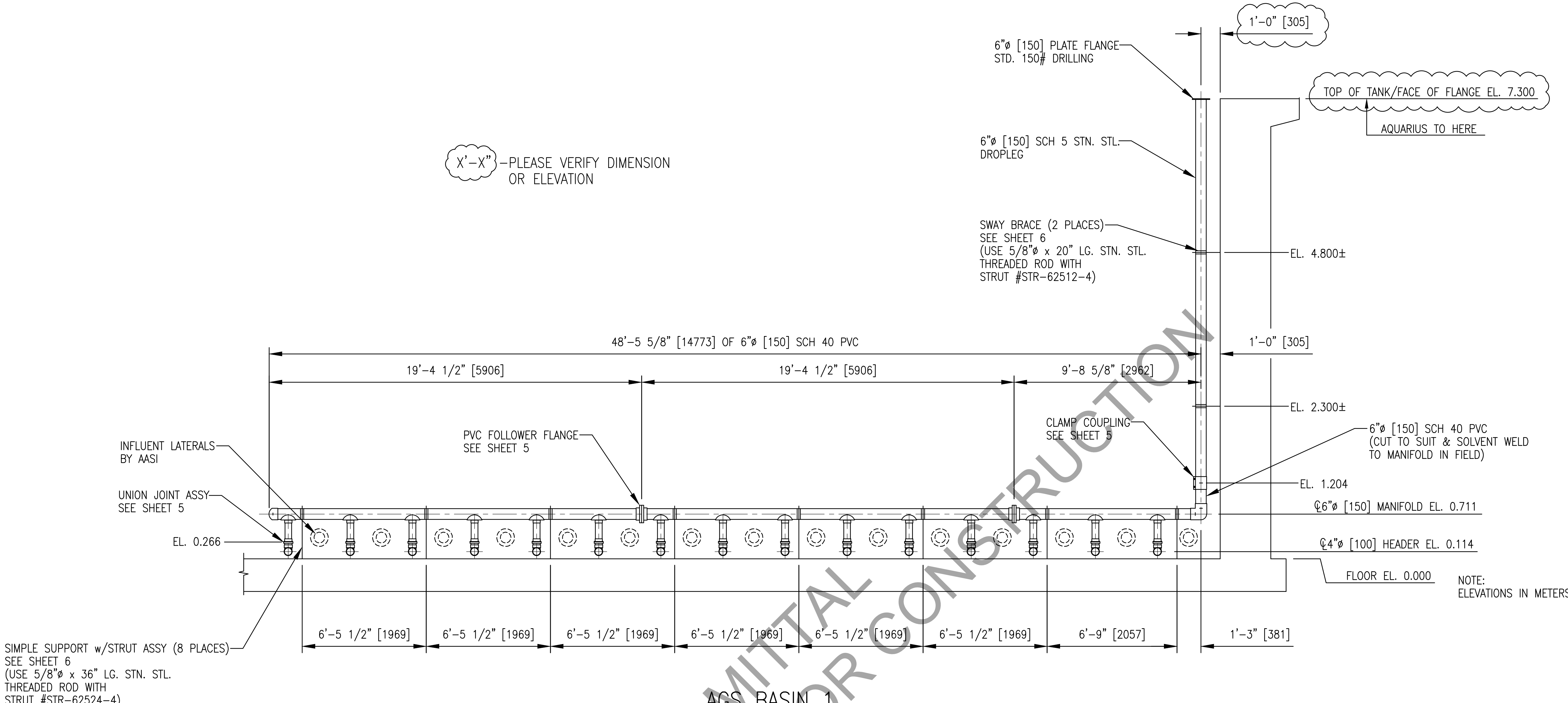
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 1 OF 7

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1
SCALE: 1/72
SIZE: D



AGS BASIN 1
DROPLEG/MANIFOLD
SECTION (3)

1 REQUIRED

FOR APPROVAL ONLY-
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	
APPRD BY: SI	DATE: 1-23-25	SHEET AGS1-S-2-R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

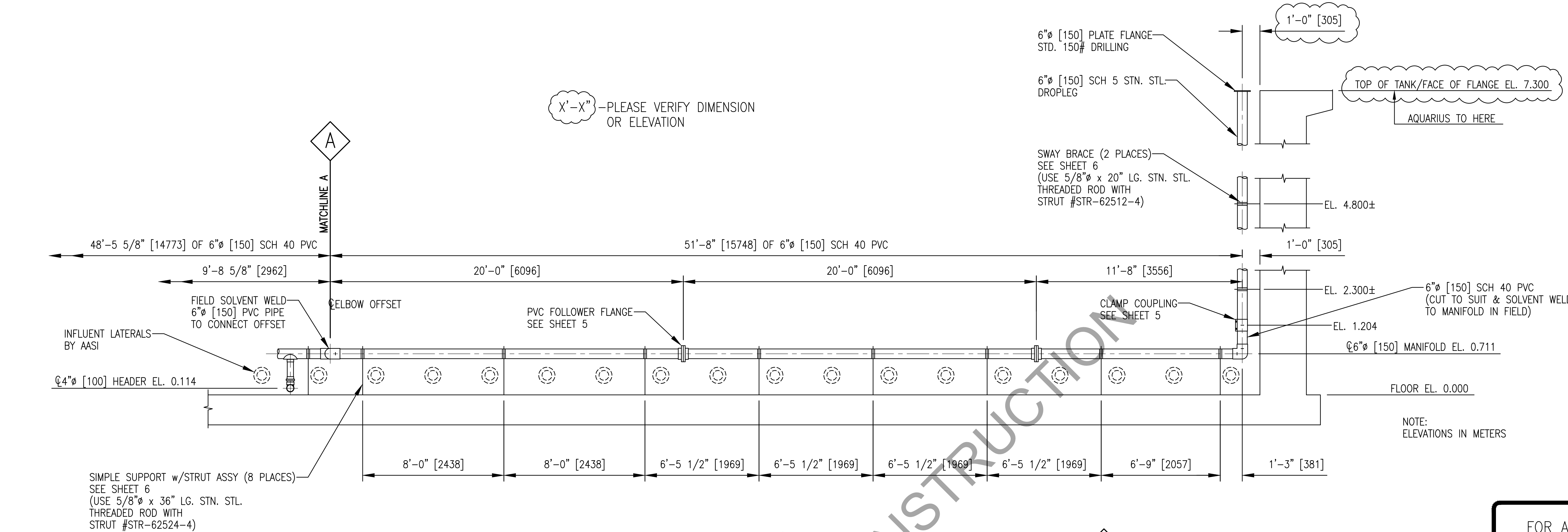
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

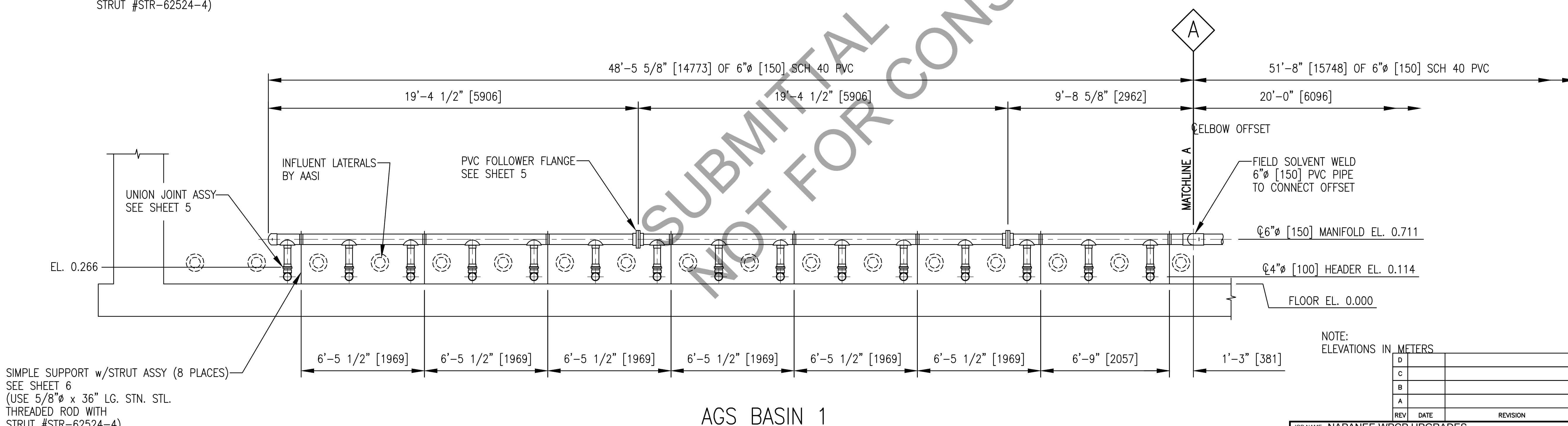
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 2 OF 7
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1 SCALE: 1/36 SIZE: D

CONFIDENTIAL



FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25



AGS BASIN 1
MANIFOLD
SECTION 4

1 REQUIRED

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	
APPRD BY: SI	DATE: 1-23-25	SHEET AGS1-S-3-R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

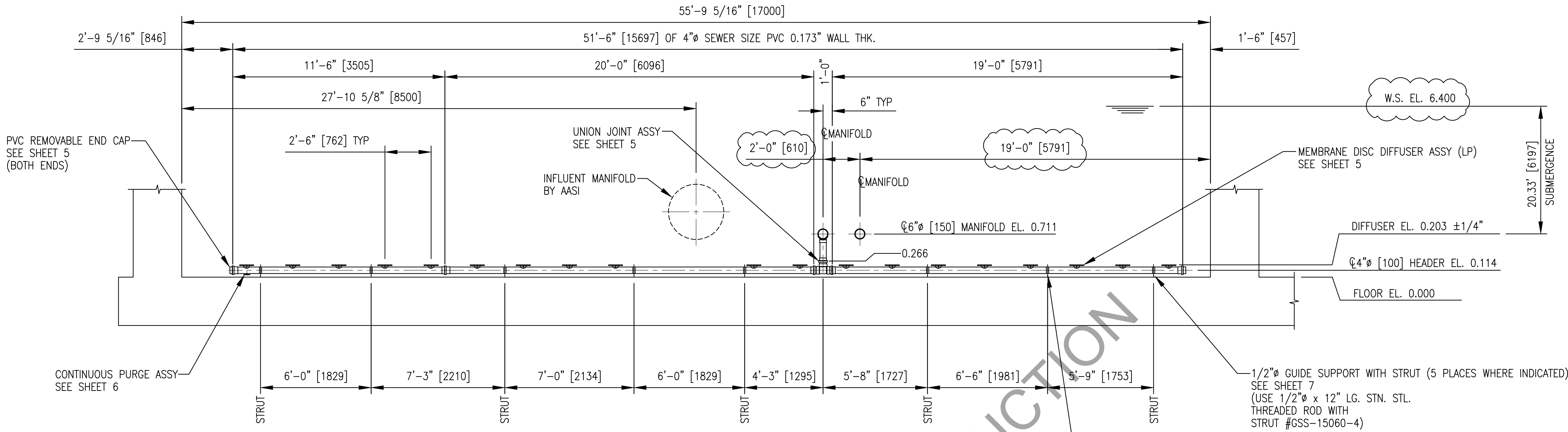
MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DRAWN BY: CJC
DATE: 2024-10-08
WEIGHT:
SHEET: 3 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1
SCALE: 1/36
SIZE: D



AIR HEADER SECTION 5

30 REQUIRED

SUBMITTAL NOT FOR CONSTRUCTION

"X'-X"" – PLEASE VERIFY DIMENSION OR ELEVATION

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	SHEET AGS1-S-4-R.1
APPRD BY: SI	DATE: 1-23-25	

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

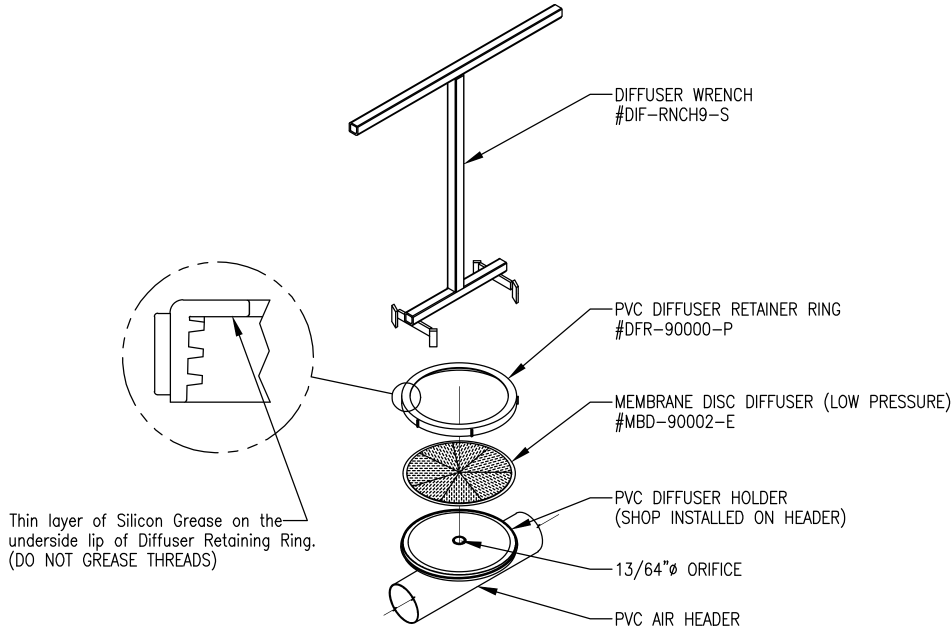
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC | DATE: 2024-10-08
WEIGHT: | SHEET: 4 OF 7

CONFIDENTIAL

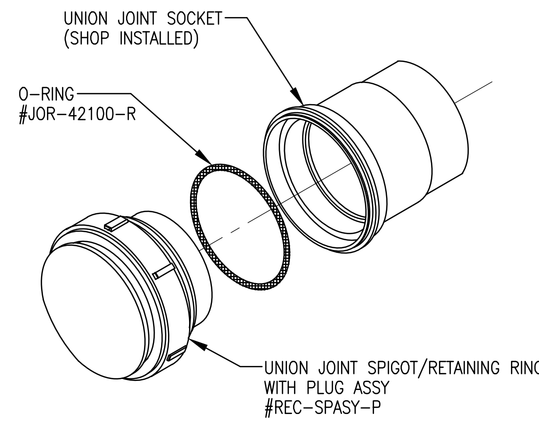
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1
SCALE: 1/36
SIZE: D



MEMBRANE DISC DIFFUSER ASSY (LP)

Installation Procedure:

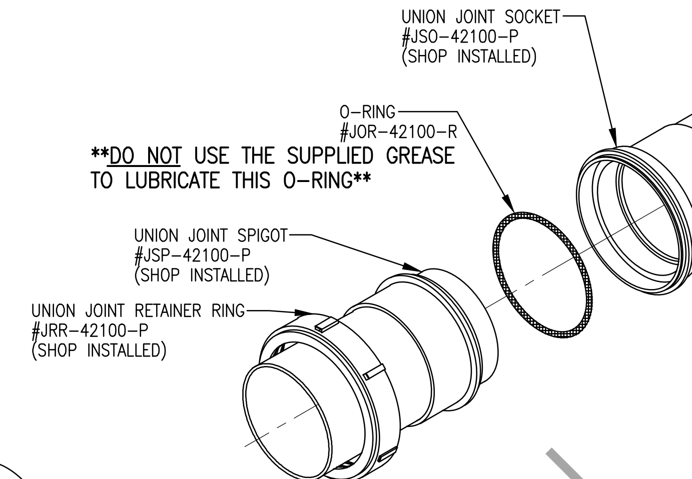
1. Place the Membrane Disc Diffuser on the Diffuser Holder.
2. Place a thin layer of the provided Silicon Grease on the underside lip of the Diffuser Retainer Ring. CAUTION– Do not place grease on the thread of the Difffuser Retainer Ring.
3. Install the Diffuser Retainer Ring on the Diffuser Holder and tighten "Hand–Tight". CAUTION– Do not cross thread the Diffuser Retainer Ring.
4. Use the Diffuser Wrench and continue tightening the Diffuser Retainer Ring to a position approx. 1/4 turn maximum past "Hand–Tight".

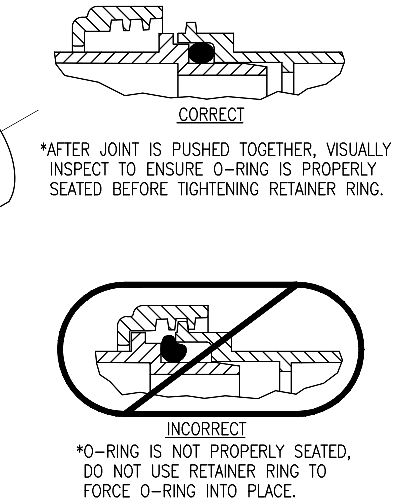


PVC REMOVABLE END CAP

Installation Procedure:

1. See "Union Joint Assy"

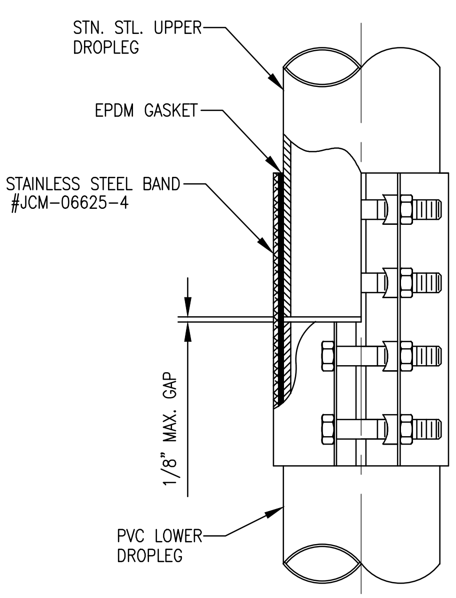




UNION JOINT ASSY

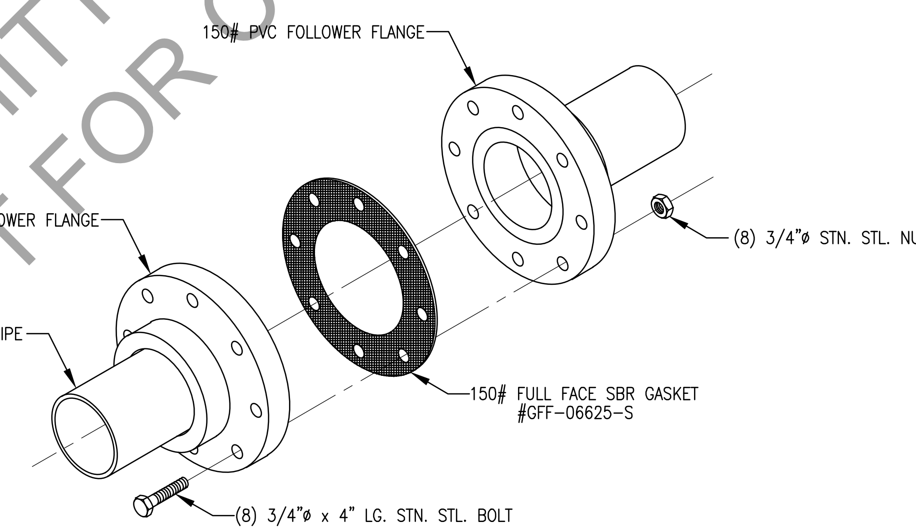
Installation Procedure:

1. Lubricate the O–ring with a solution of water and household dish soap. **CAUTION– Do not use grease to lubricate the O–ring.**
2. Place the O–ring on the Union Joint Spigot of the Union.
3. Join the Union Joint Spigot to the Union Joint Socket, compressing the soap lubricated O–ring into the Union Joint Socket.
4. Thread the Union Joint Retainer Ring "Hand–Tight" to the Union joint Socket. A strap wrench can be used to continue tightening the Retainer Ring to a position approx. 1/4 turn maximum past "Hand–Tight".



CLAMP COUPLING

Refer to installation instructions included with each clamp



PVC FOLLOWER FLANGE

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS1–S–5–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

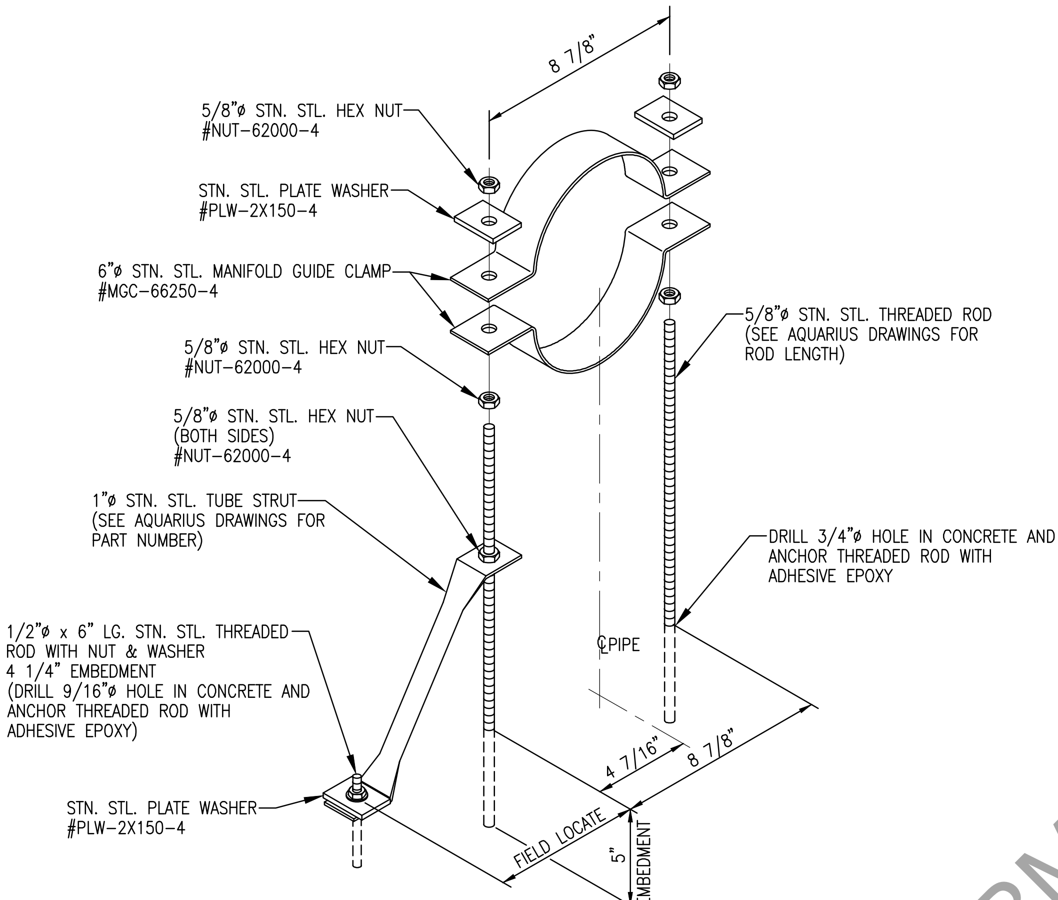
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC — DATE: 2024-10-08
WEIGHT: — SHEET: 5 OF 7

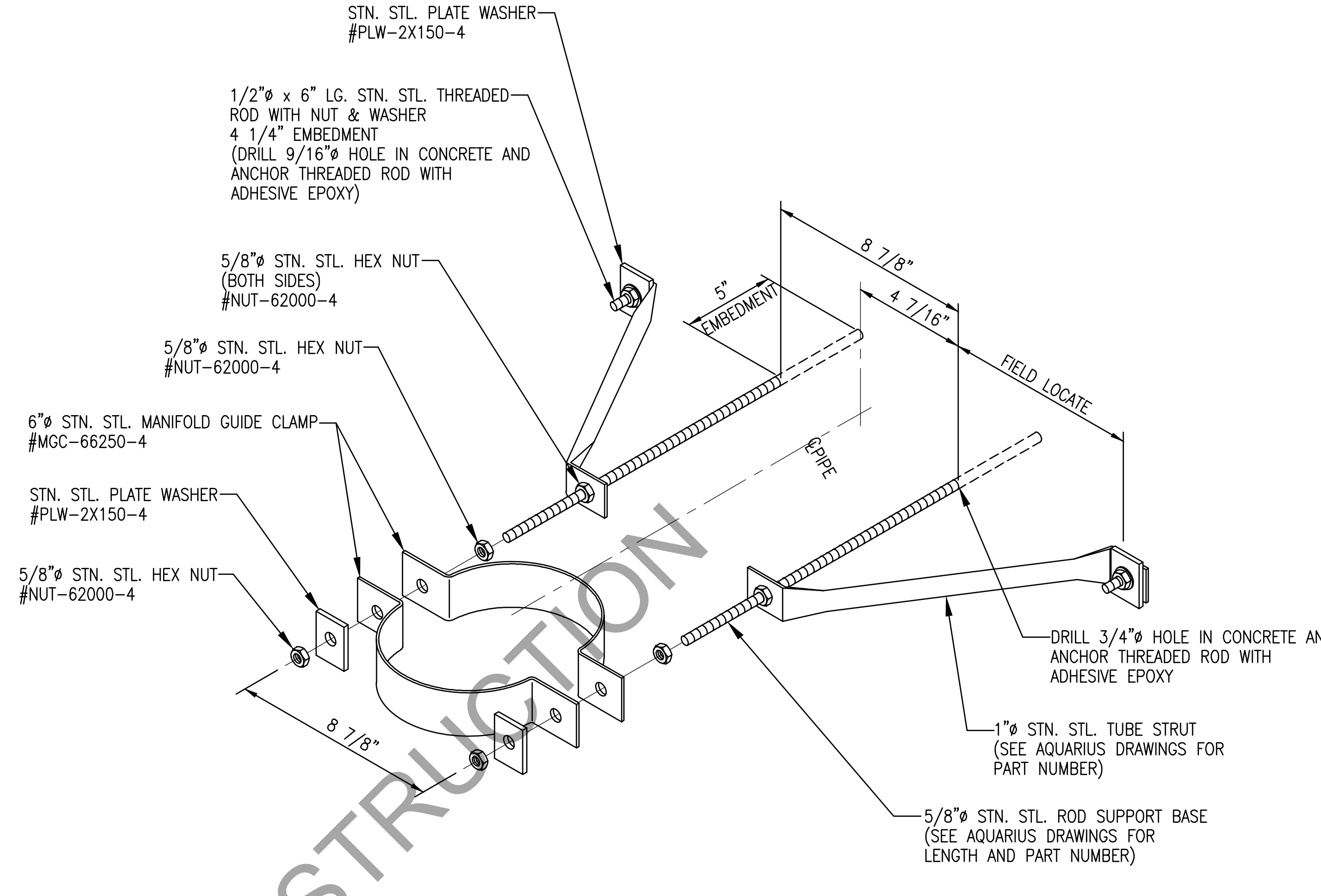
CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1
SCALE: NTS — SIZE: D

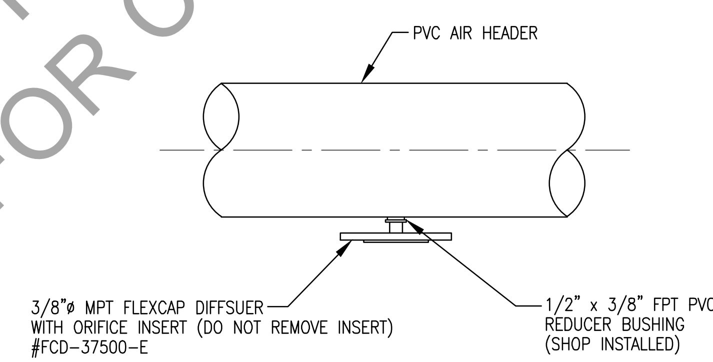
PLEASE CHECK ALL NUTS FOR TIGHTNESS



SIMPLE SUPPORT w/STRUT ASSY



SIMPLE SUPPORT w/STRUT ASSY (SWAY BRACE)



CONTINUOUS PURGE ASSEMBLY

Installation Procedure:
1. Apply teflon tape or pipe putty to threads of Flexcap Diffuser, install into bushing at invert of pipe and hand tighten.

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS1–S–6–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

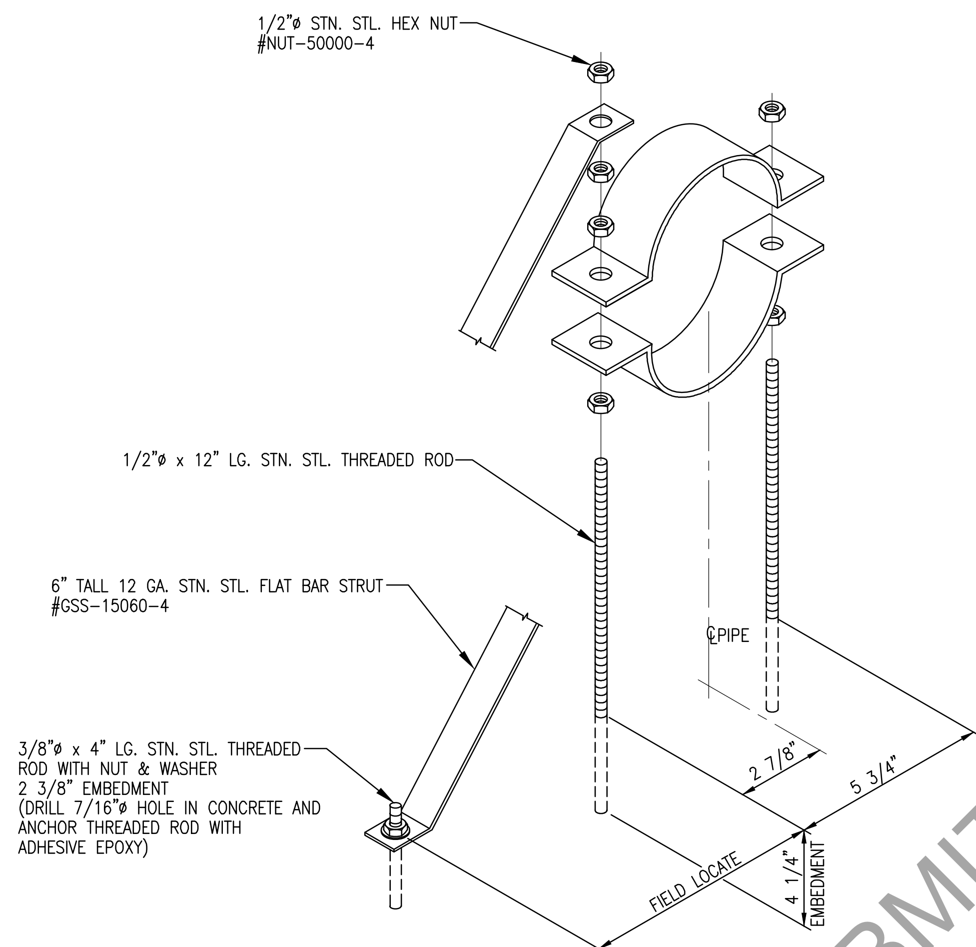
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 6 OF 7

CONFIDENTIAL

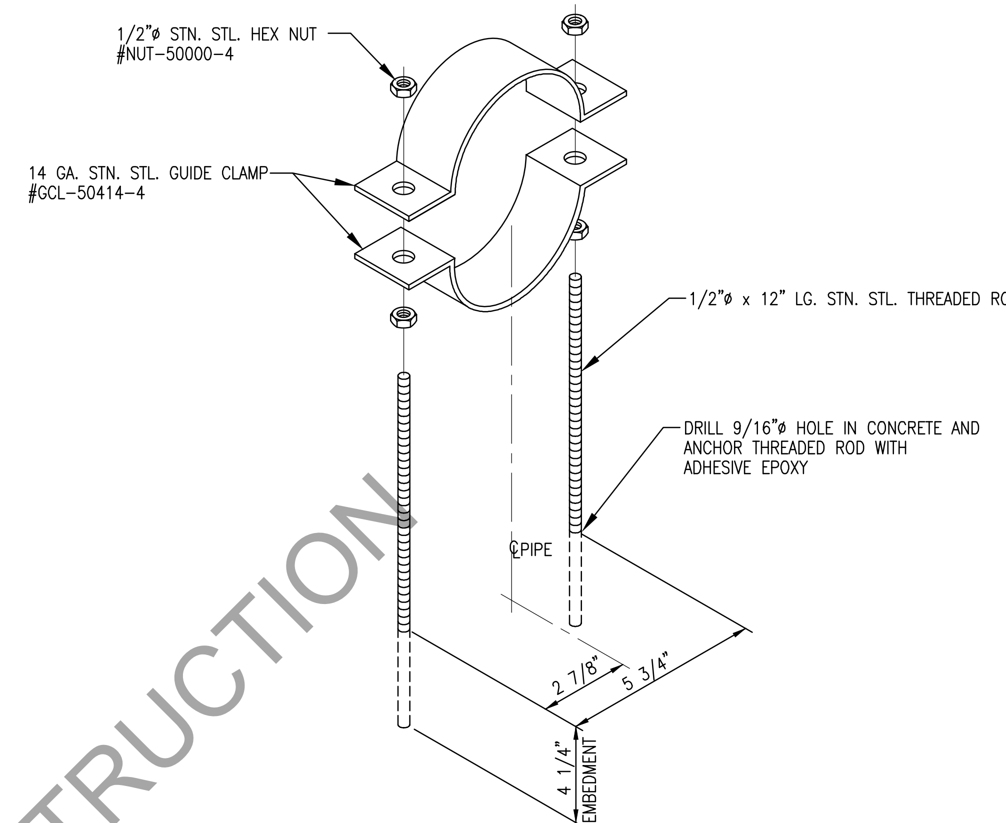
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1
DRAWING NUMBER: 9704419A30011-1
SCALE: NTS SIZE: D

PLEASE CHECK ALL NUTS FOR TIGHTNESS



1/2"ø GUIDE SUPPORT WITH STRUT

USE WHERE INDICATED ON PVC AIR HEADERS



1/2"ø GUIDE SUPPORT

USE WHERE INDICATED ON PVC AIR HEADERS

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 1

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS1–S–7–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 1

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

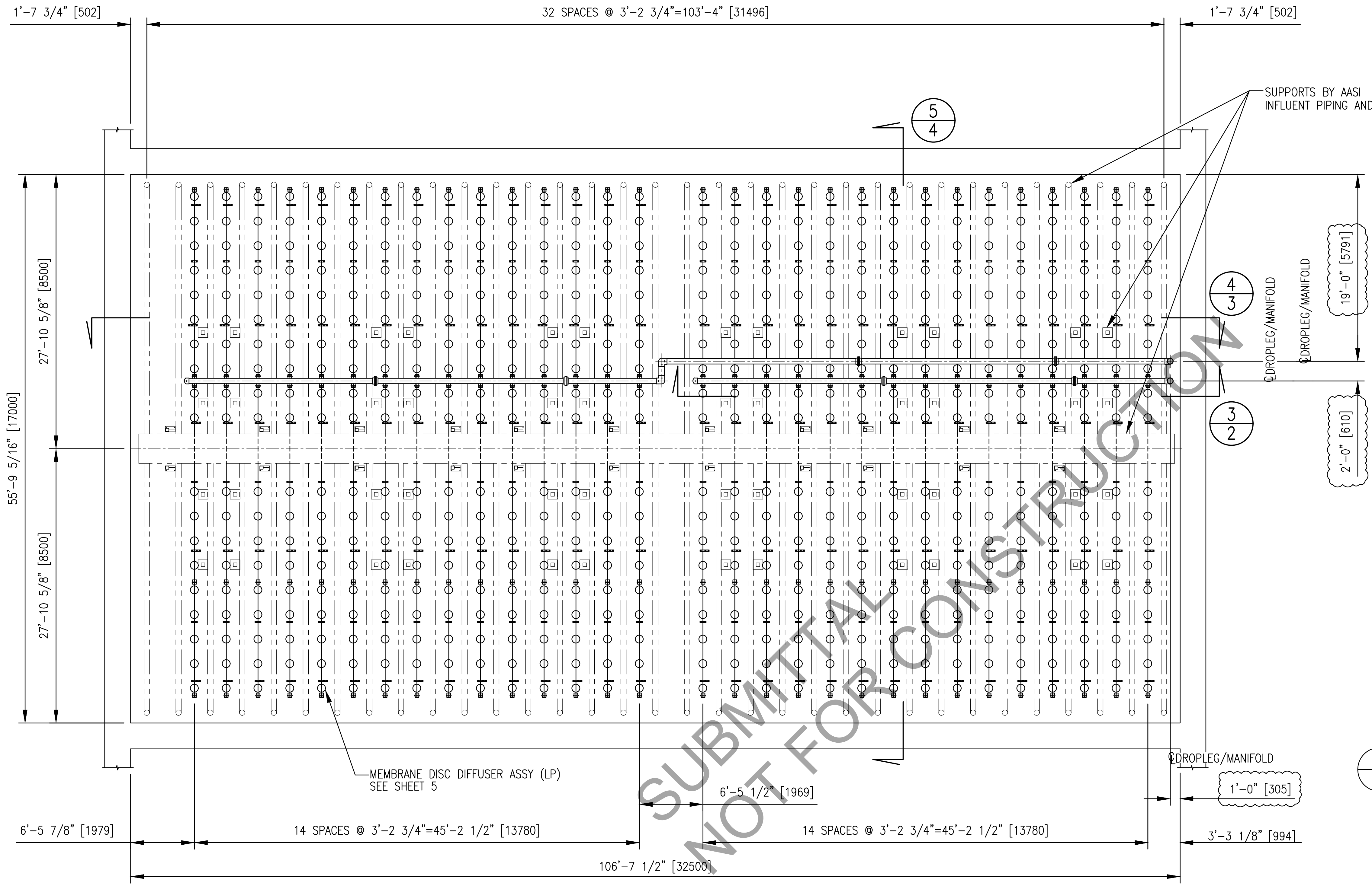
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

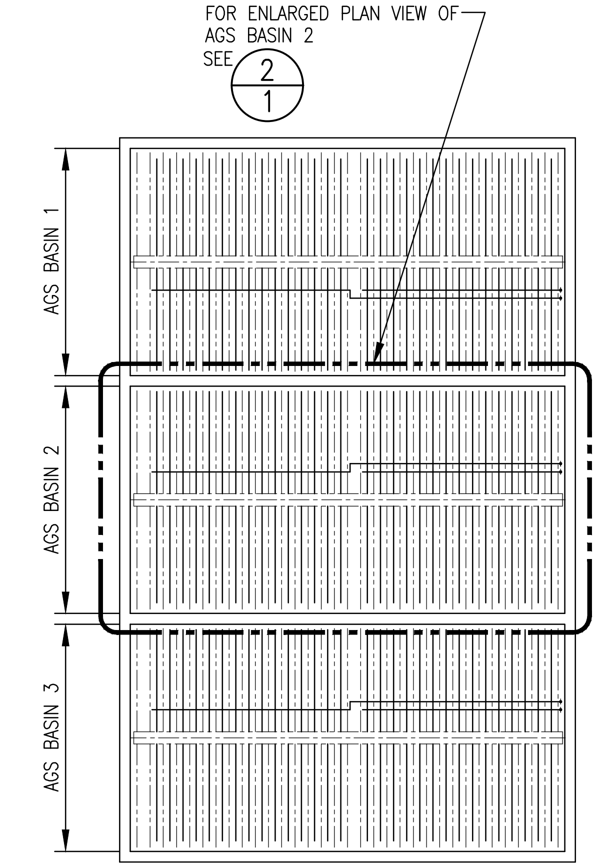
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC — DATE: 2024-10-08
WEIGHT: — SHEET: 7 OF 7
DRAWING NUMBER: 9704419A30011-1 — SCALE: NTS — SIZE: D

CONFIDENTIAL





AGS BASINS 1–3
KEY PLAN (1)

AGS BASIN 2
LOWER LEVEL
PLAN VIEW (2)

1 REQUIRED

AGS BASIN 2
GRID INFORMATION

1– TANK(S)
2– GRID(S) PER TANK
15– AIR HEADERS PER GRID
19– DIFFUSERS PER AIR HEADER
285– DIFFUSERS PER GRID
570– TOTAL DIFFUSERS INSTALLED

X / X —DESIGNATES PLAN VIEW, SECTION OR DETAIL NUMBER
—DESIGNATES SHEET ON WHICH PLAN VIEW, SECTION OR DETAIL CAN BE FOUND

"X'–X"" —PLEASE VERIFY DIMENSION OR ELEVATION

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

PLAN VIEW

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS2–S–1–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

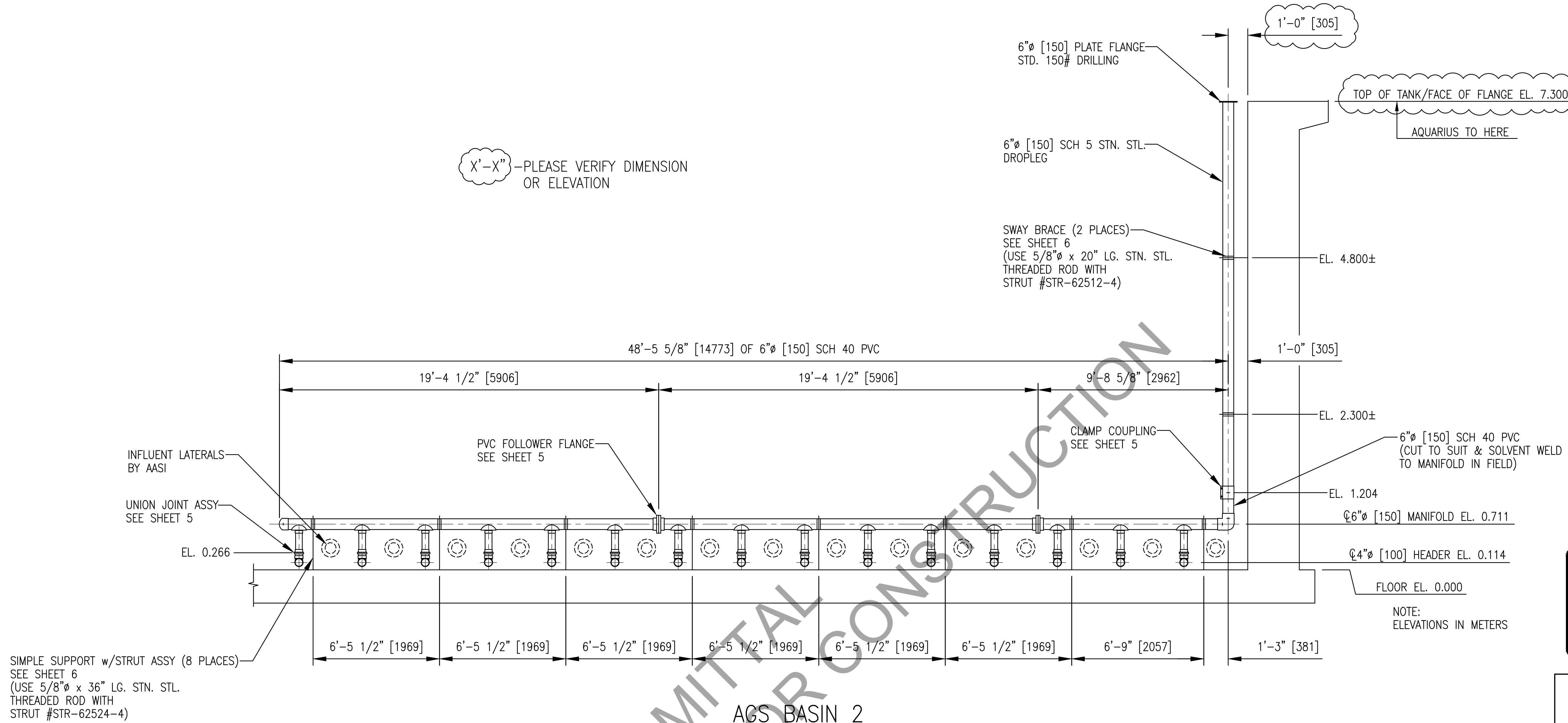
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 1 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: 1/72
SIZE: D



AGS BASIN 2
DROPLEG/MANIFOLD
SECTION (3)
1 REQUIRED

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	
APPRD BY: SI	DATE: 1-23-25	SHEET AGS2-S-2-R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

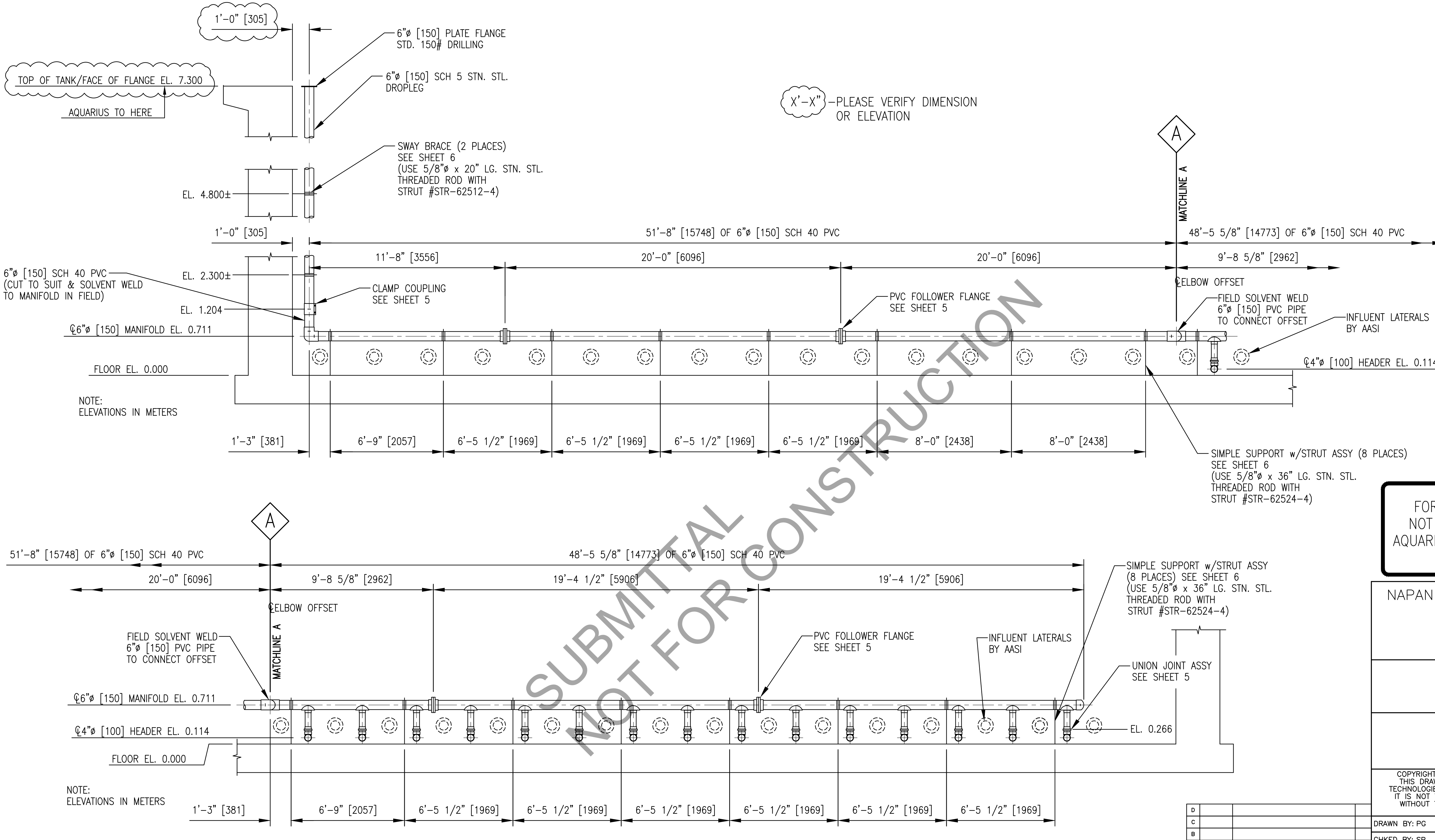
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 2 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: 1/36 SIZE: D



AGS BASIN 2
MANIFOLD
SECTION 4

1 REQUIRED

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	SHEET AGS2-S-3-R.1
APPRD BY: SI	DATE: 1-23-25	

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

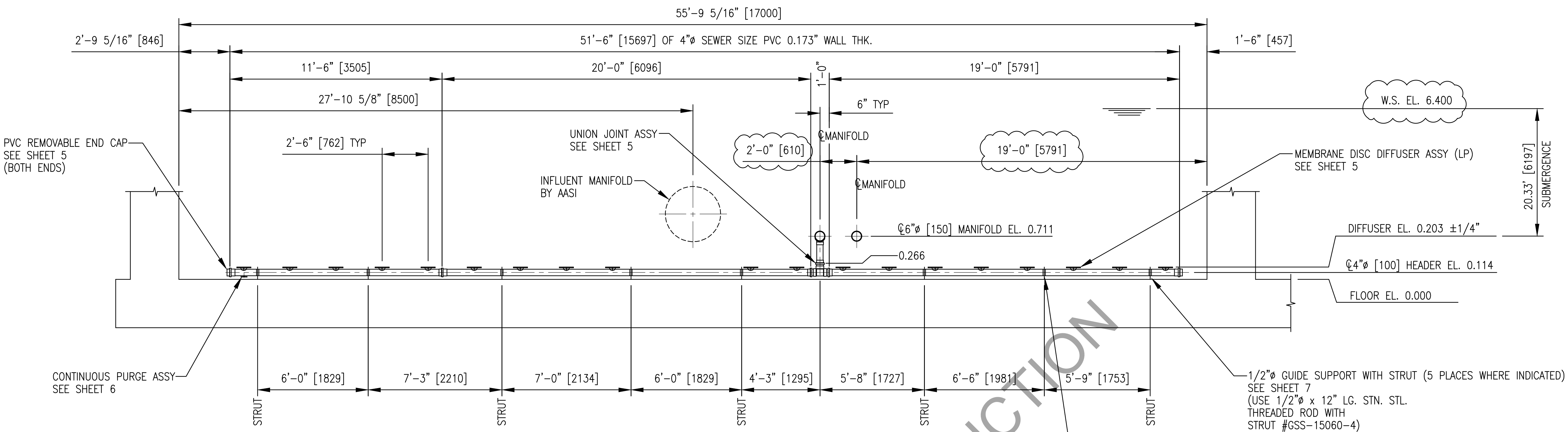
MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 3 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: 1/36
SIZE: D



AIR HEADER
SECTION (5)

30 REQUIRED

(X'-X") –PLEASE VERIFY DIMENSION OR ELEVATION

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

SECTIONS

DRAWN BY: PG	DATE: 1-23-25	JOB #:	24-3140
CHKED BY: SP	DATE: 1-23-25		
APPRD BY: SI	DATE: 1-23-25	SHEET	AGS2-S-4-R.1

REV	DATE	REVISION	BY
D			
C			
B			
A			

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

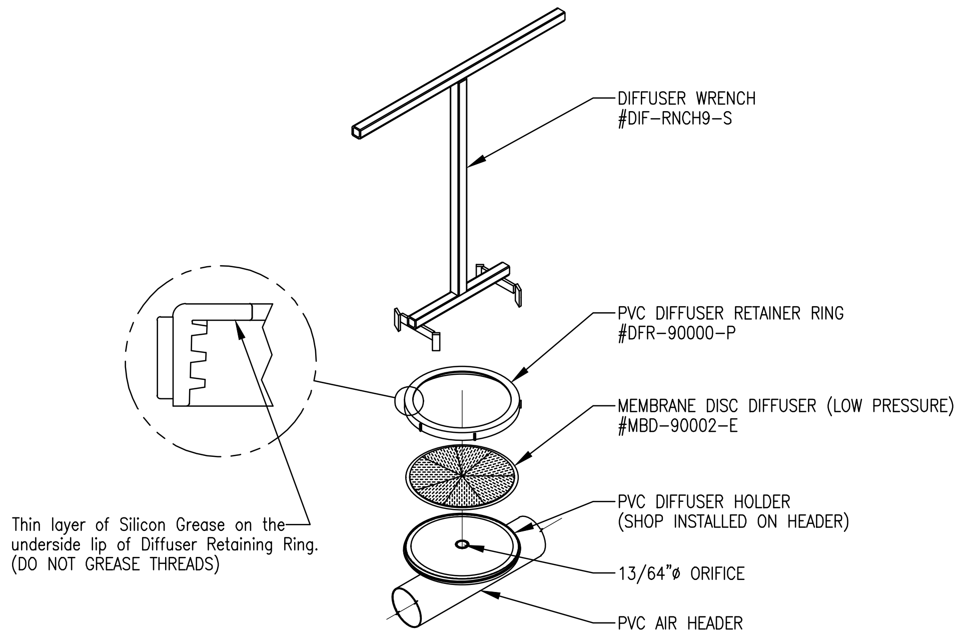
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 4 OF 7

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

CONFIDENTIAL

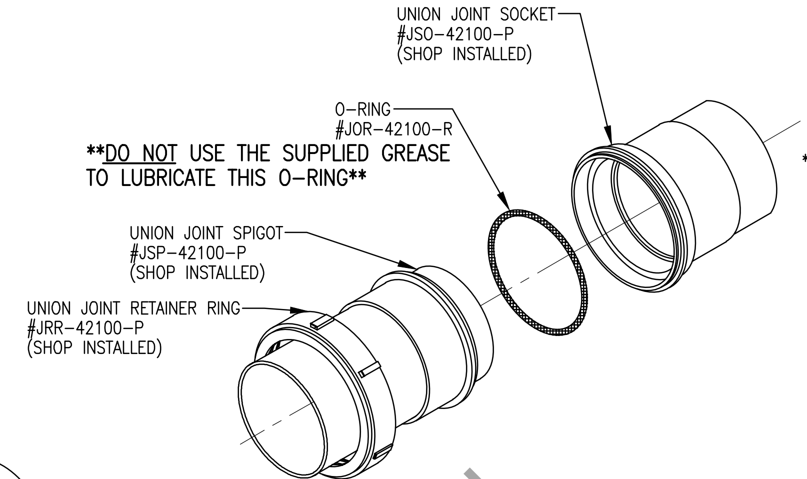
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: 1/36
SIZE: D

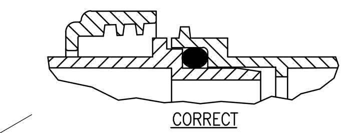


MEMBRANE DISC DIFFUSER ASSY (LP)

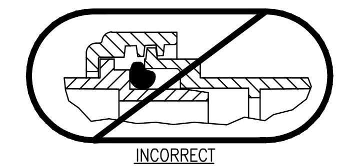
Installation Procedure:

1. Place the Membrane Disc Diffuser on the Diffuser Holder.
2. Place a thin layer of the provided Silicon Grease on the underside lip of the Diffuser Retainer Ring. CAUTION– Do not place grease on the thread of the Difffuser Retainer Ring.
3. Install the Diffuser Retainer Ring on the Diffuser Holder and tighten "Hand–Tight". CAUTION– Do not cross thread the Diffuser Retainer Ring.
4. Use the Diffuser Wrench and continue tightening the Diffuser Retainer Ring to a position approx. 1/4 turn maximum past "Hand–Tight".





*AFTER JOINT IS PUSHED TOGETHER, VISUALLY INSPECT TO ENSURE O-RING IS PROPERLY SEATED BEFORE TIGHTENING RETAINER RING.

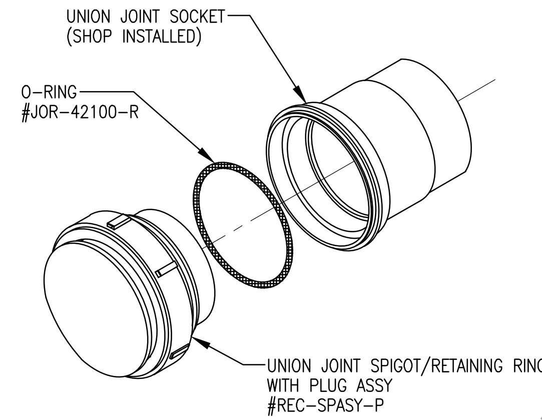


*O-RING IS NOT PROPERLY SEATED, DO NOT USE RETAINER RING TO FORCE O-RING INTO PLACE.

UNION JOINT ASSY

Installation Procedure:

1. Lubricate the O-ring with a solution of water and household dish soap. **CAUTION– Do not use grease to lubricate the O-ring.**
2. Place the O-ring on the Union Joint Spigot of the Union.
3. Join the Union Joint Spigot to the Union Joint Socket, compressing the soap lubricated O-ring into the Union Joint Socket.
4. Thread the Union Joint Retainer Ring "Hand-Tight" to the Union joint Socket. A strap wrench can be used to continue tightening the Retainer Ring to a position approx. 1/4 turn maximum past "Hand-Tight".

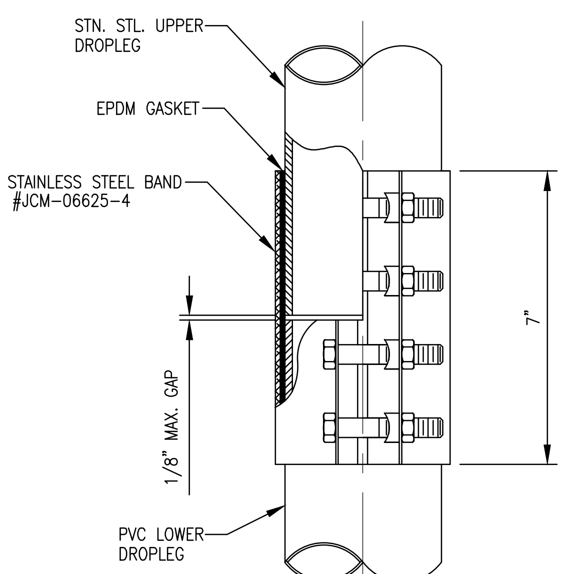


PVC REMOVABLE END CAP

Installation Procedure:

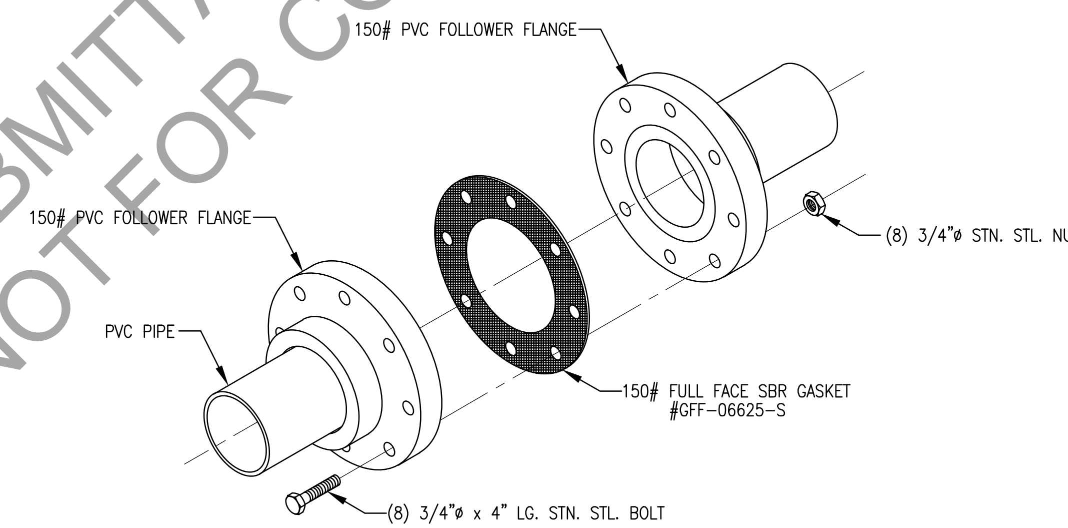
1. See "Union Joint Assy"

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25



CLAMP COUPLING

Refer to installation instructions included with each clamp



PVC FOLLOWER FLANGE

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	
APPRD BY: SI	DATE: 1-23-25	SHEET AGS2-S-5-R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS

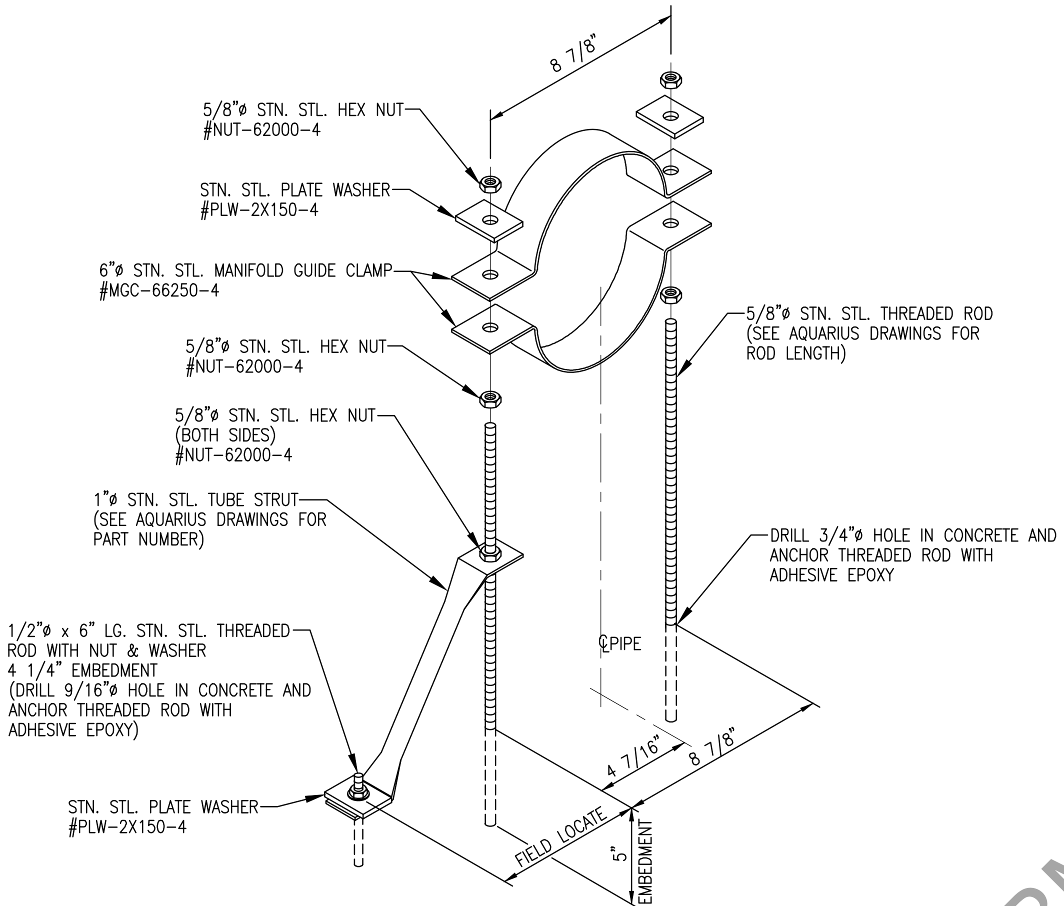
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DRAWN BY: CJC — DATE: 2024-10-08
WEIGHT: — SHEET: 5 OF 7

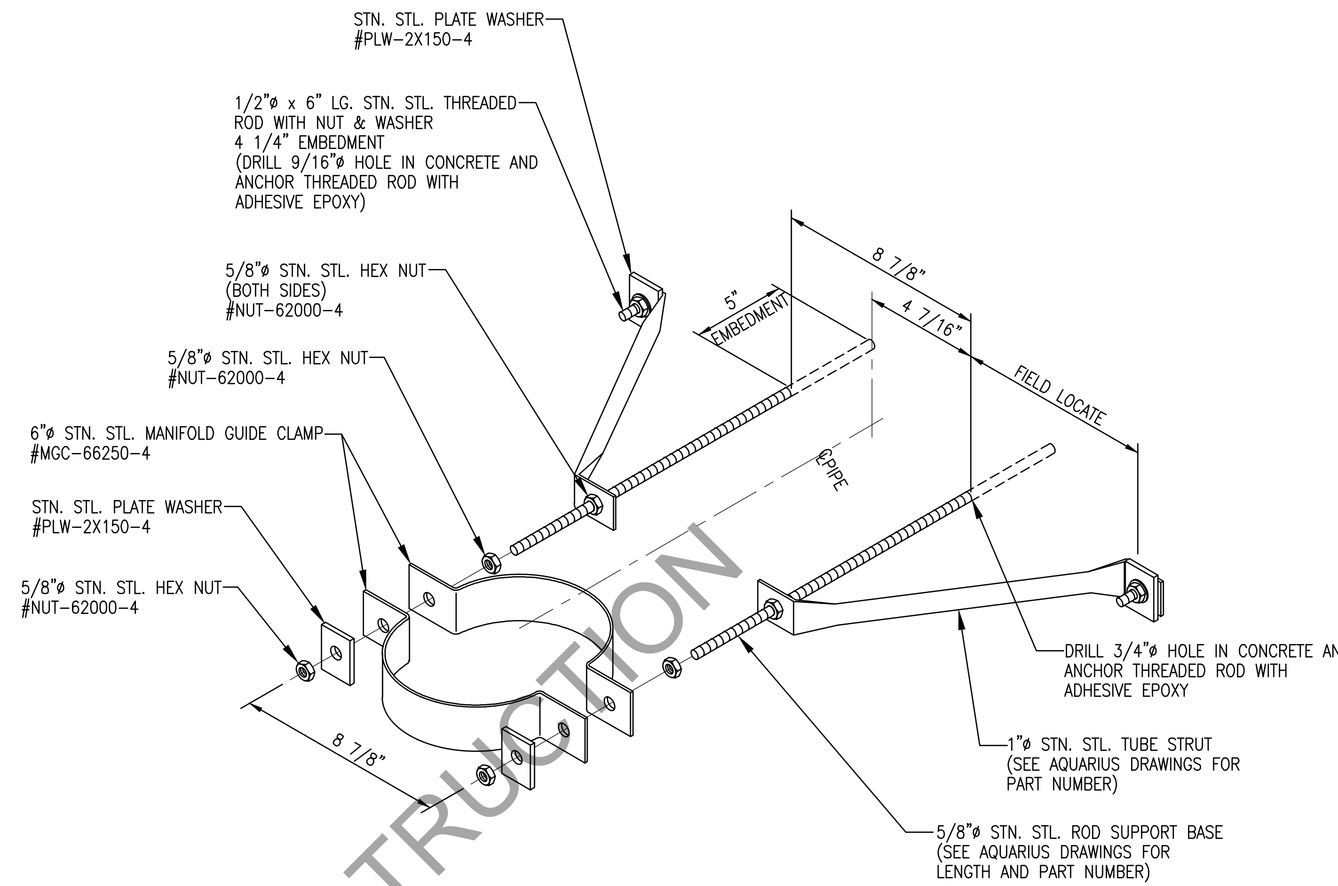
CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: NTS — SIZE: D

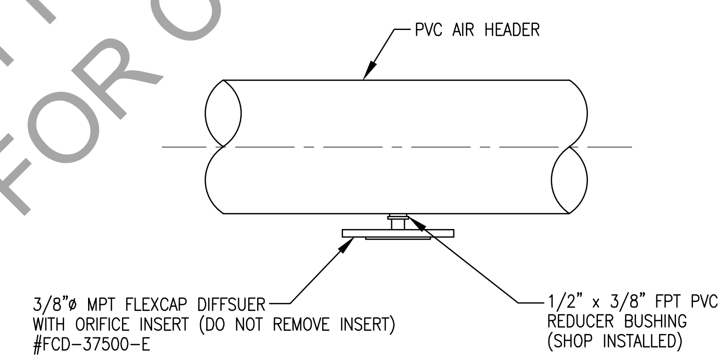
PLEASE CHECK ALL NUTS FOR TIGHTNESS



SIMPLE SUPPORT w/STRUT ASSY



SIMPLE SUPPORT w/STRUT ASSY (SWAY BRACE)



CONTINUOUS PURGE ASSEMBLY

Installation Procedure:

1. Apply teflon tape or pipe putty to threads of Flexcap Diffuser, install into bushing at invert of pipe and hand tighten.

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS2–S–6–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

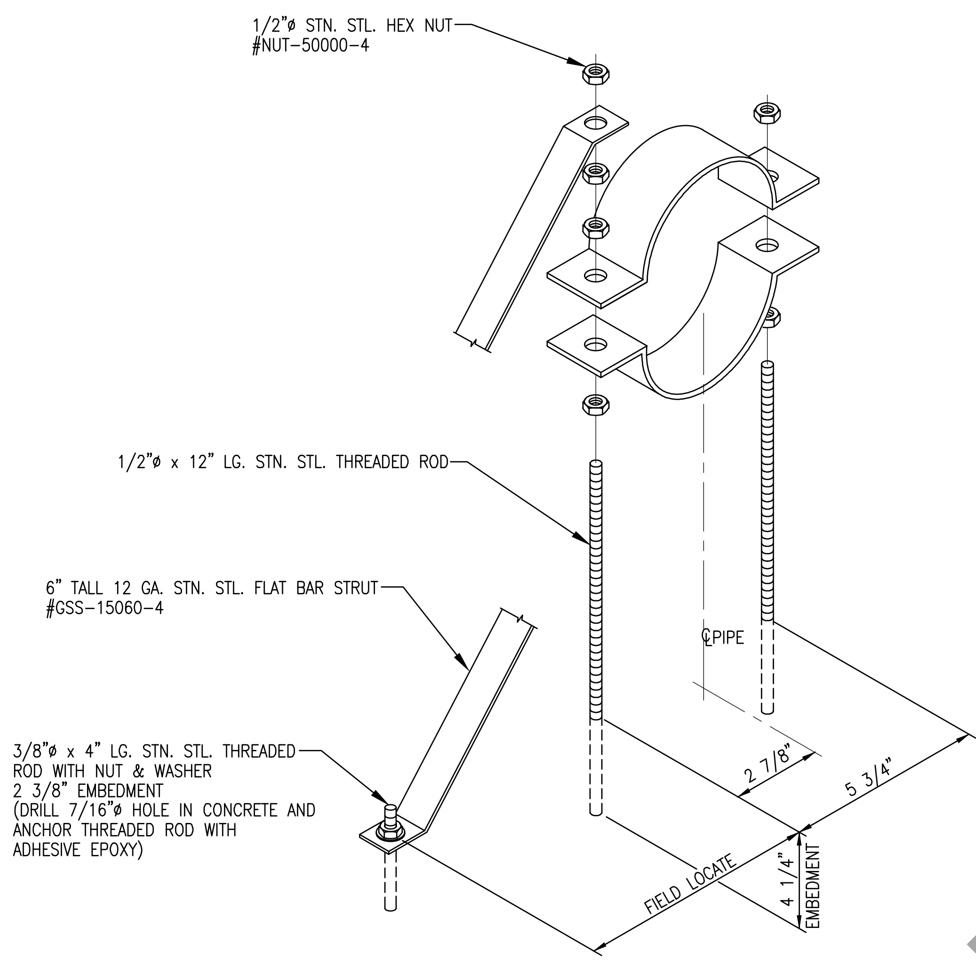
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 6 OF 7

CONFIDENTIAL

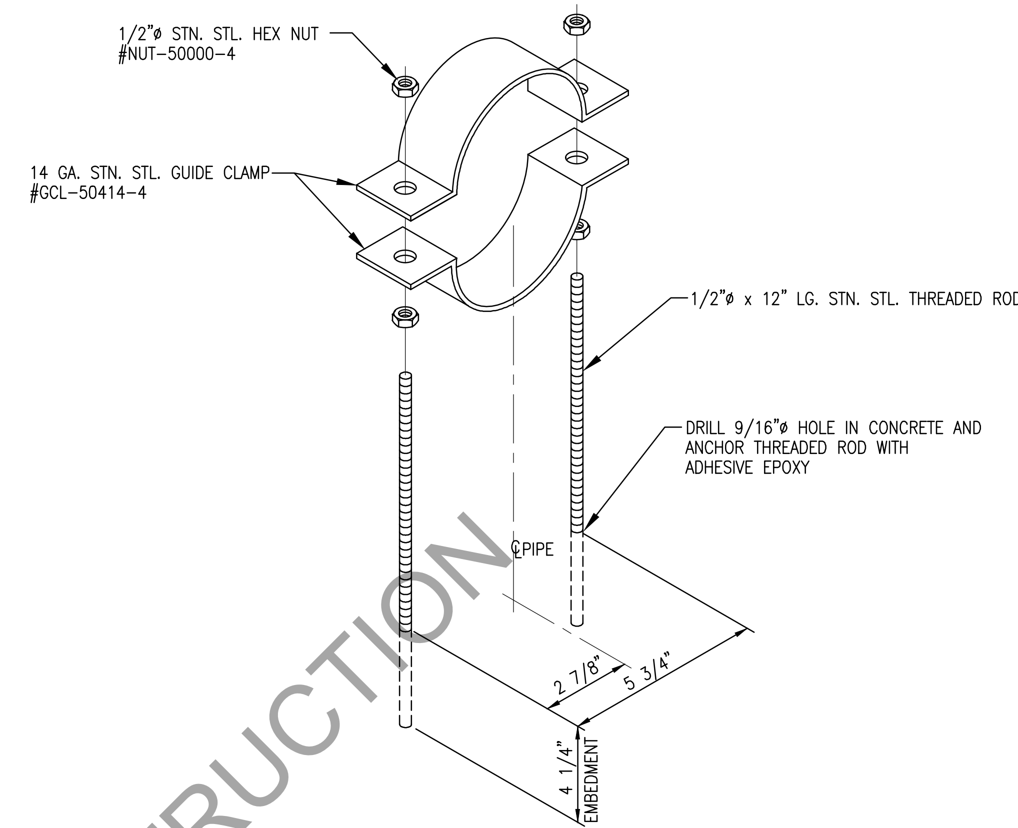
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2 SCALE: NTS SIZE: D

PLEASE CHECK ALL NUTS FOR TIGHTNESS



1/2"ø GUIDE SUPPORT WITH STRUT

USE WHERE INDICATED ON PVC AIR HEADERS



1/2"ø GUIDE SUPPORT

USE WHERE INDICATED ON PVC AIR HEADERS

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 2

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS3–S–7–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

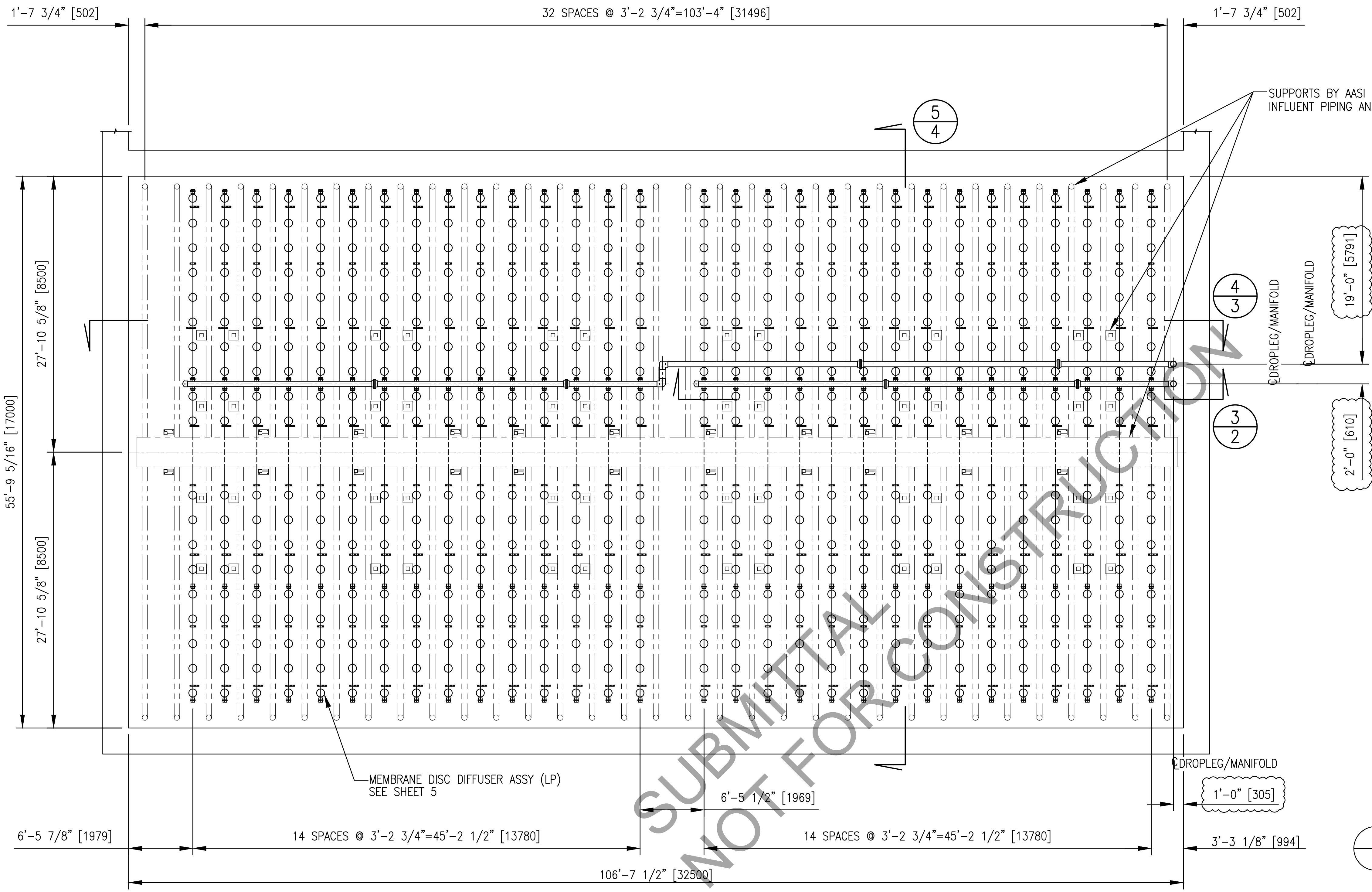
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 7 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 2
DRAWING NUMBER: 9704419A30011-2
SCALE: NTS SIZE: D



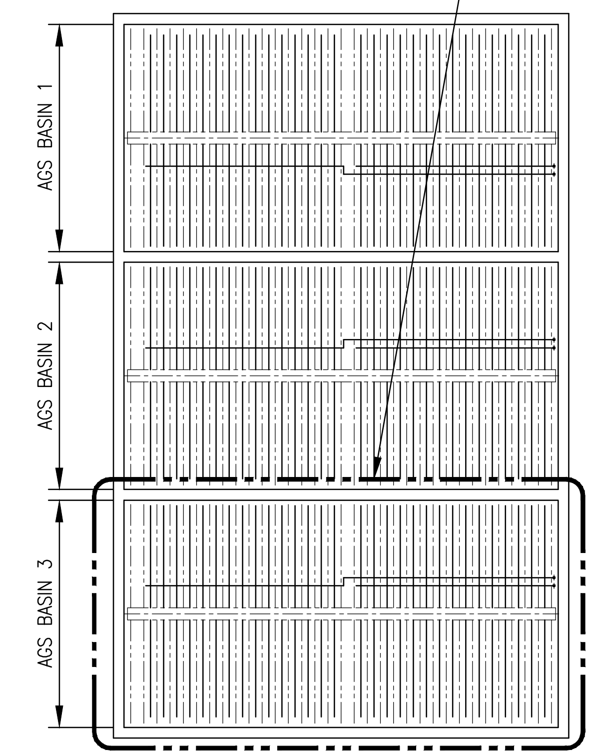
AGS BASIN 3
LOWER LEVEL
PLAN VIEW (2)

1 REQUIRED

AGS BASIN 3
GRID INFORMATION

1- TANK(S)
2- GRID(S) PER TANK
15- AIR HEADERS PER GRID
19- DIFFUSERS PER AIR HEADER
285- DIFFUSERS PER GRID
570- TOTAL DIFFUSERS INSTALLED

FOR ENLARGED PLAN VIEW OF AGS BASIN 3 SEE 2/1



AGS BASINS 1-3
KEY PLAN (1)

FOR APPROVAL ONLY-
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

X/X — DESIGNATES PLAN VIEW, SECTION OR DETAIL NUMBER; DESIGNATES SHEET ON WHICH PLAN VIEW, SECTION OR DETAIL CAN BE FOUND

X'-X" — PLEASE VERIFY DIMENSION OR ELEVATION

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

PLAN VIEW

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	
APPRD BY: SI	DATE: 1-23-25	SHEET AGS3-S-1-R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

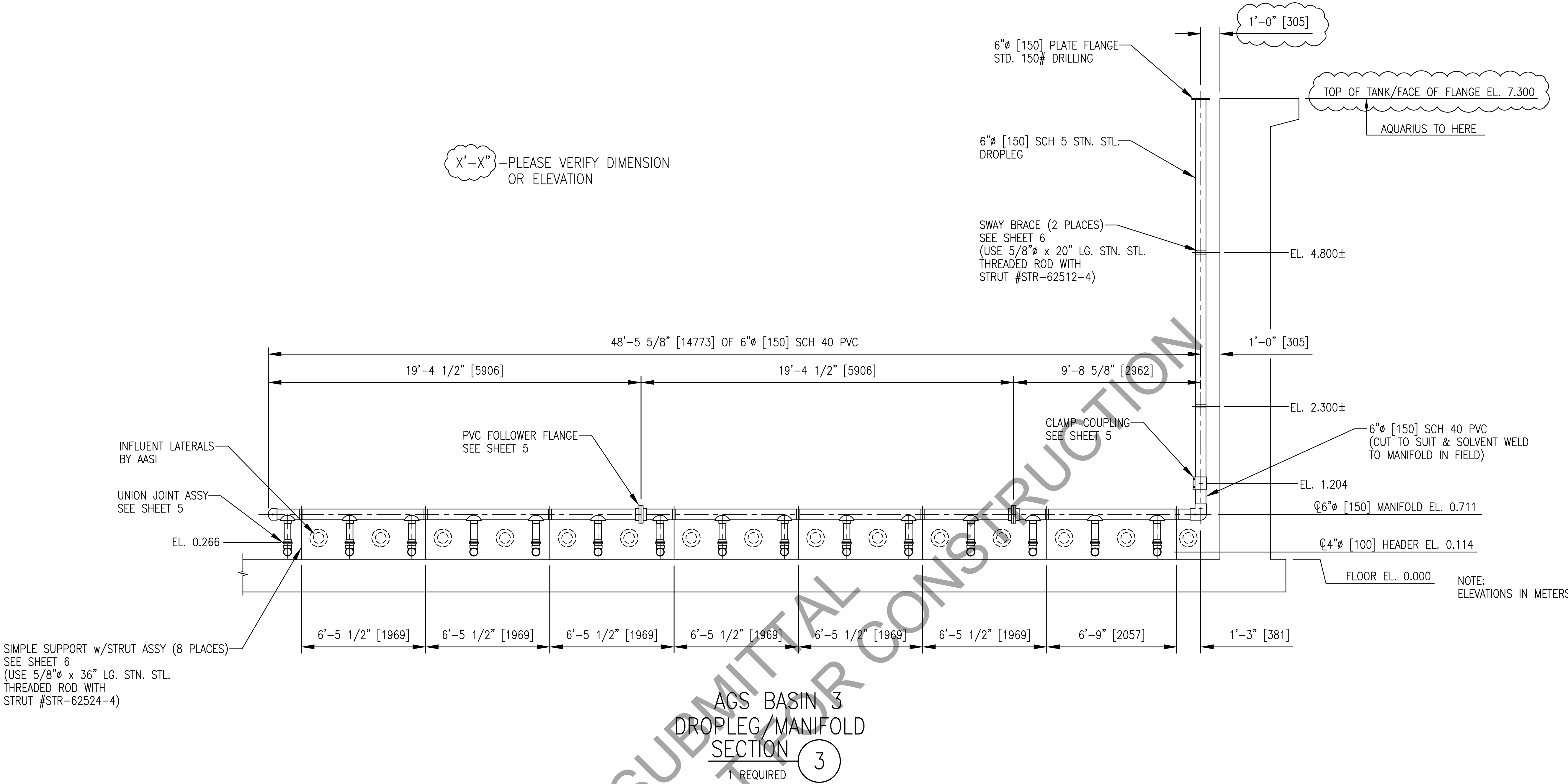
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 1 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3 SCALE: 1/72 SIZE: D



SUBMITTAL
NOT FOR CONSTRUCTION

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1-23-25	JOB #: 24-3140
CHKED BY: SP	DATE: 1-23-25	SHEET AGS3-S-2-R.1
APPRD BY: SI	DATE: 1-23-25	

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

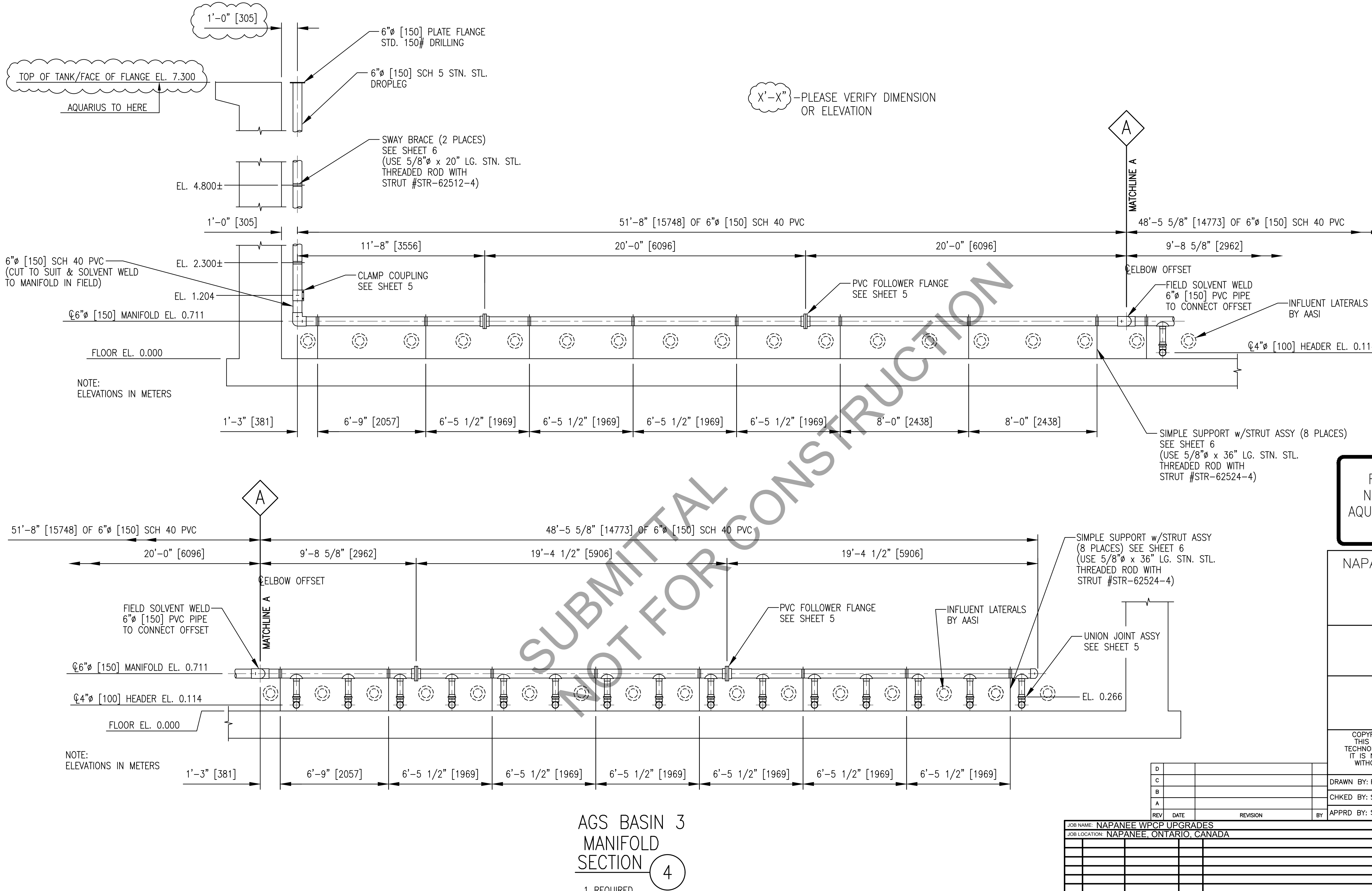
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 2 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: 1/36
SIZE: D



FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1-23-25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

SECTIONS

DRAWN BY: PG	DATE: 1-23-25	JOB #:	24-3140
CHKED BY: SP	DATE: 1-23-25		
APPRD BY: SI	DATE: 1-23-25	SHEET	AGS3-S-3-R.1

REV	DATE	REVISION	BY
D			
C			
B			
A			

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

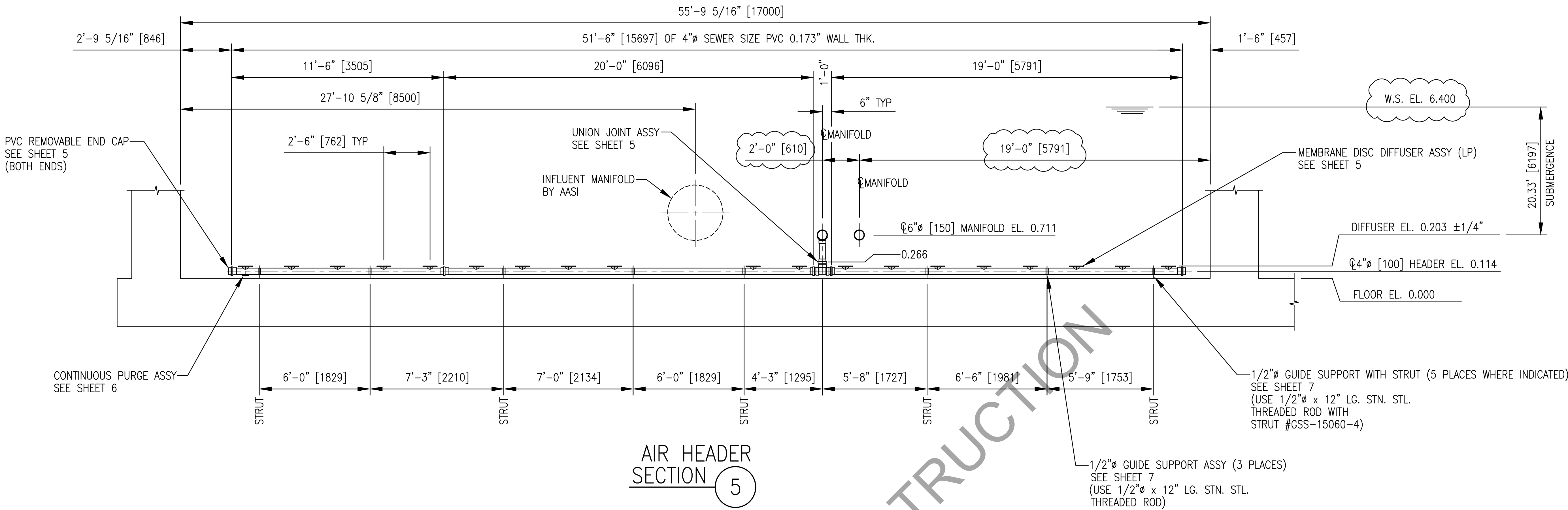
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 3 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: 1/36 SIZE: D



AIR HEADER SECTION (5)

30 REQUIRED

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

(X'-X") –PLEASE VERIFY DIMENSION OR ELEVATION

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

SECTIONS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	SHEET AGS3–S–4–R.1
APPRD BY: SI	DATE: 1–23–25	

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

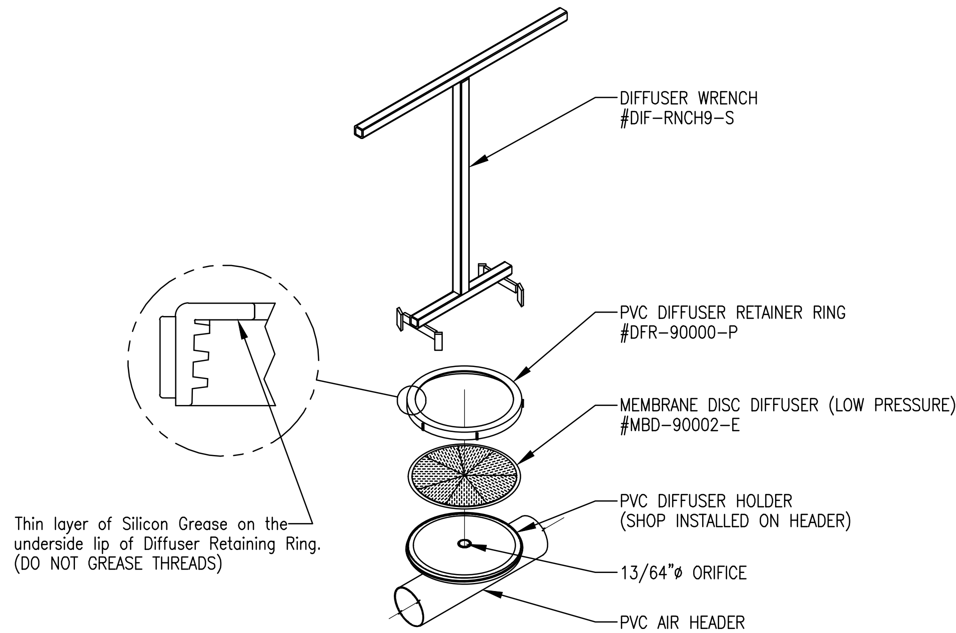
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 4 OF 7

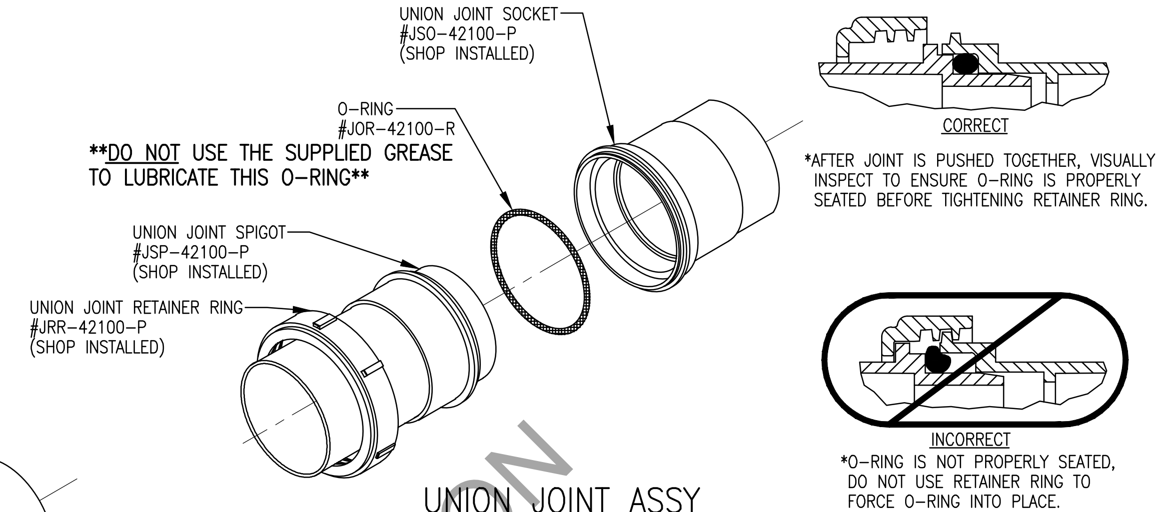
CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: 1/36 SIZE: D



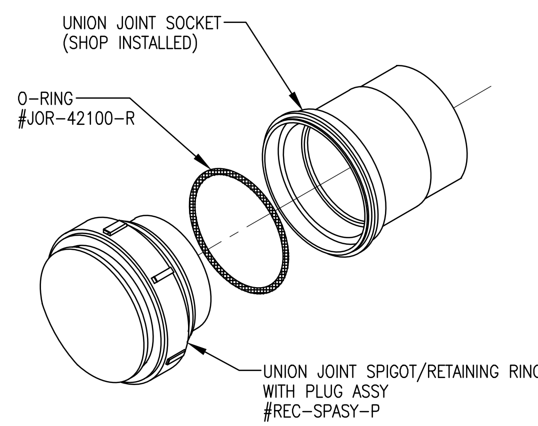
MEMBRANE DISC DIFFUSER ASSY (LP)

Installation Procedure:
1. Place the Membrane Disc Diffuser on the Diffuser Holder.
2. Place a thin layer of the provided Silicon Grease on the underside lip of the Diffuser Retainer Ring. CAUTION– Do not place grease on the thread of the Difffuser Retainer Ring.
3. Install the Diffuser Retainer Ring on the Diffuser Holder and tighten "Hand–Tight". CAUTION– Do not cross thread the Diffuser Retainer Ring.
4. Use the Diffuser Wrench and continue tightening the Diffuser Retainer Ring to a position approx. 1/4 turn maximum past "Hand–Tight".



UNION JOINT ASSY

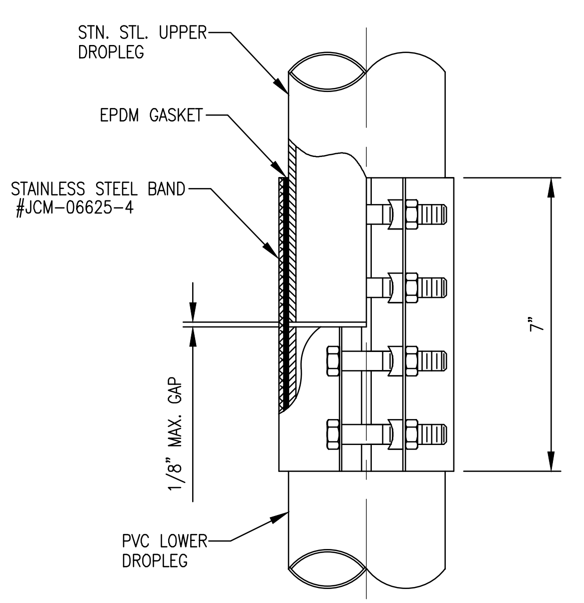
Installation Procedure:
1. Lubricate the O–ring with a solution of water and household dish soap. **CAUTION– Do not use grease to lubricate the O–ring.**
2. Place the O–ring on the Union Joint Spigot of the Union.
3. Join the Union Joint Spigot to the Union Joint Socket, compressing the soap lubricated O–ring into the Union Joint Socket.
4. Thread the Union Joint Retainer Ring "Hand–Tight" to the Union joint Socket. A strap wrench can be used to continue tightening the Retainer Ring to a position approx. 1/4 turn maximum past "Hand–Tight".



PVC REMOVABLE END CAP

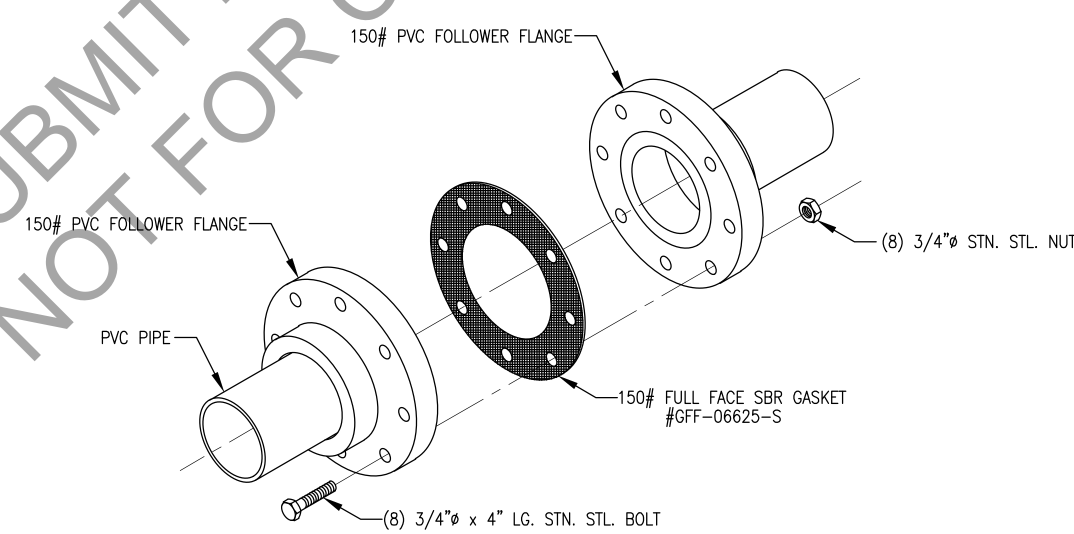
Installation Procedure:
1. See "Union Joint Assy"

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25



CLAMP COUPLING

Refer to installation instructions included with each clamp



PVC FOLLOWER FLANGE

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS3–S–5–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DO NOT SCALE DRAWING

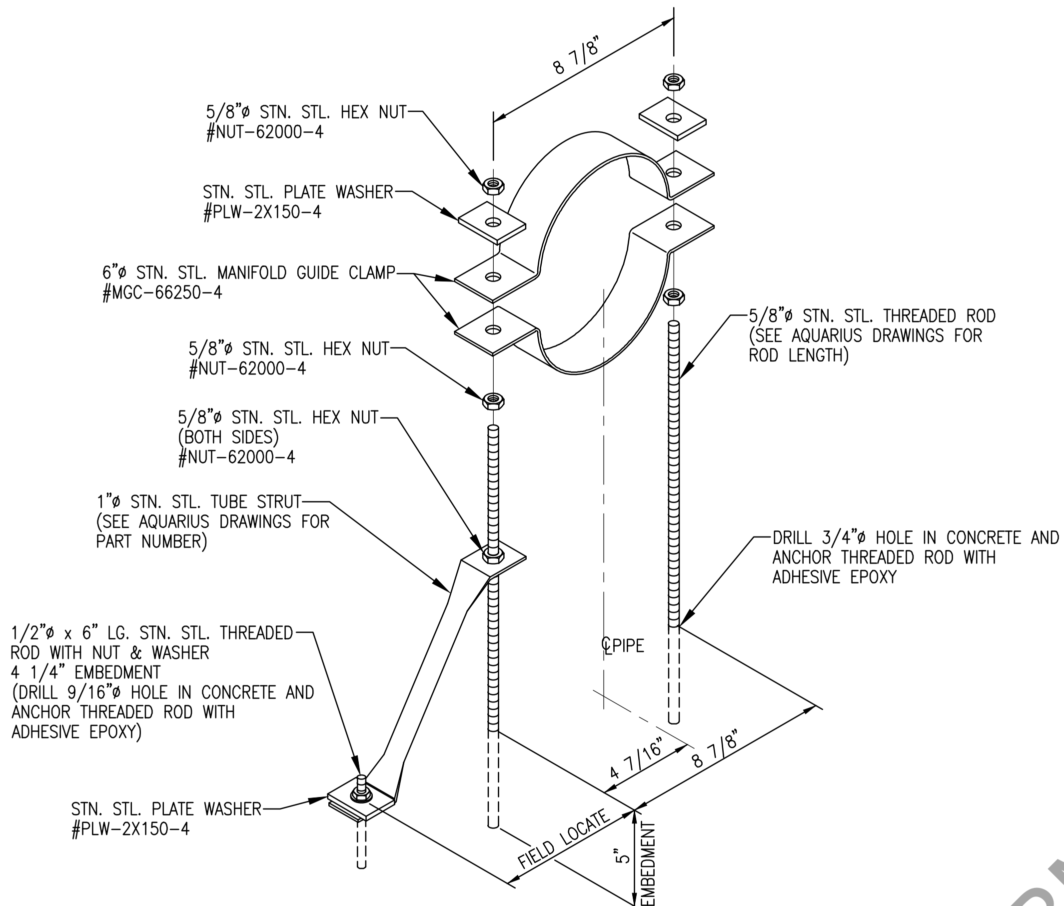
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 5 OF 7

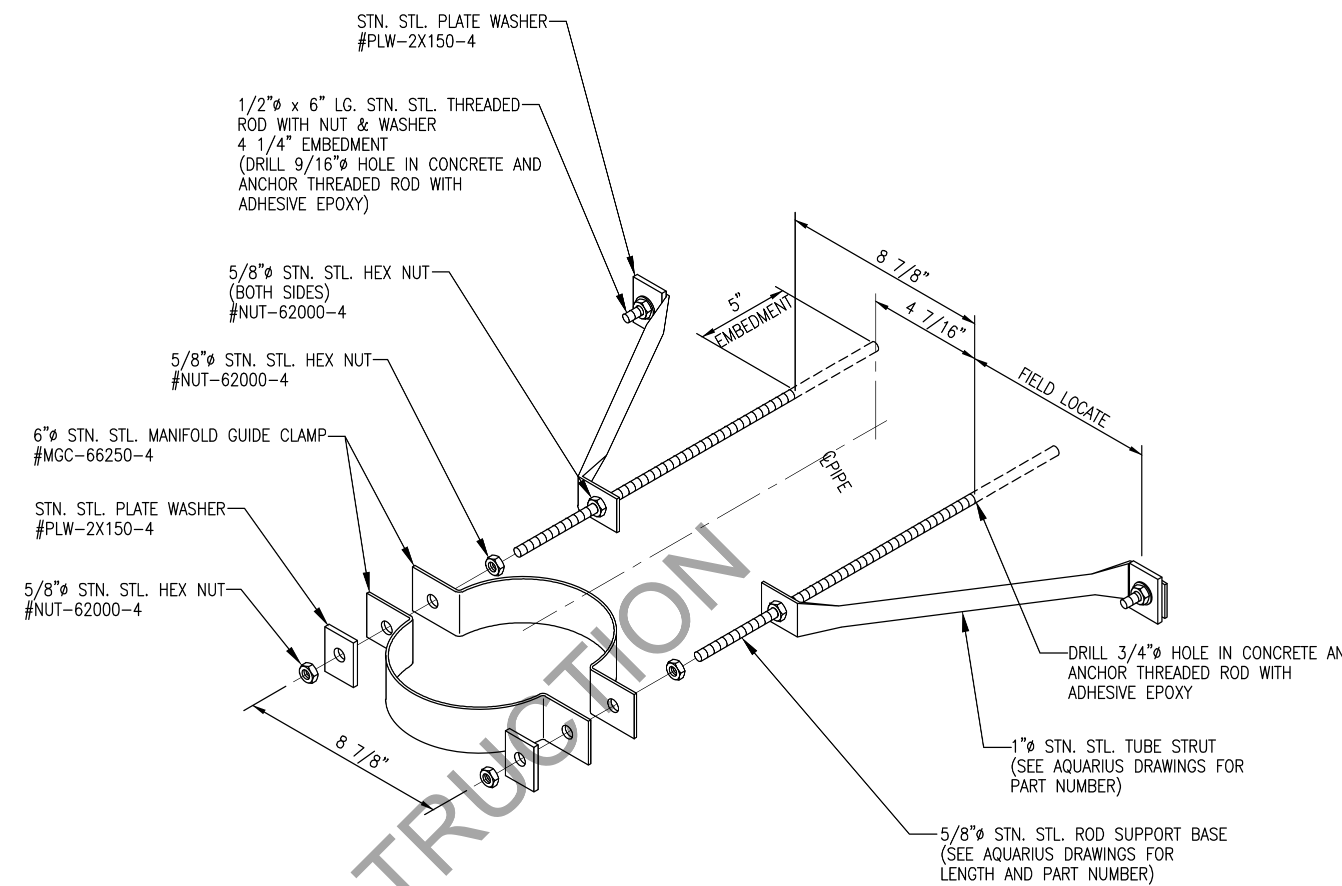
CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: NTS
SIZE: D

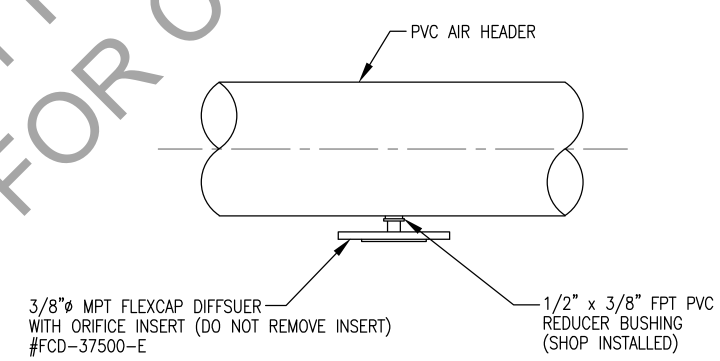
PLEASE CHECK ALL NUTS FOR TIGHTNESS



SIMPLE SUPPORT w/STRUT ASSY



SIMPLE SUPPORT w/STRUT ASSY (SWAY BRACE)



CONTINUOUS PURGE ASSEMBLY

Installation Procedure:
1. Apply teflon tape or pipe putty to threads of Flexcap Diffuser, install into bushing at invert of pipe and hand tighten.

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	SHEET AGS3–S–6–R.1
APPRD BY: SI	DATE: 1–23–25	

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

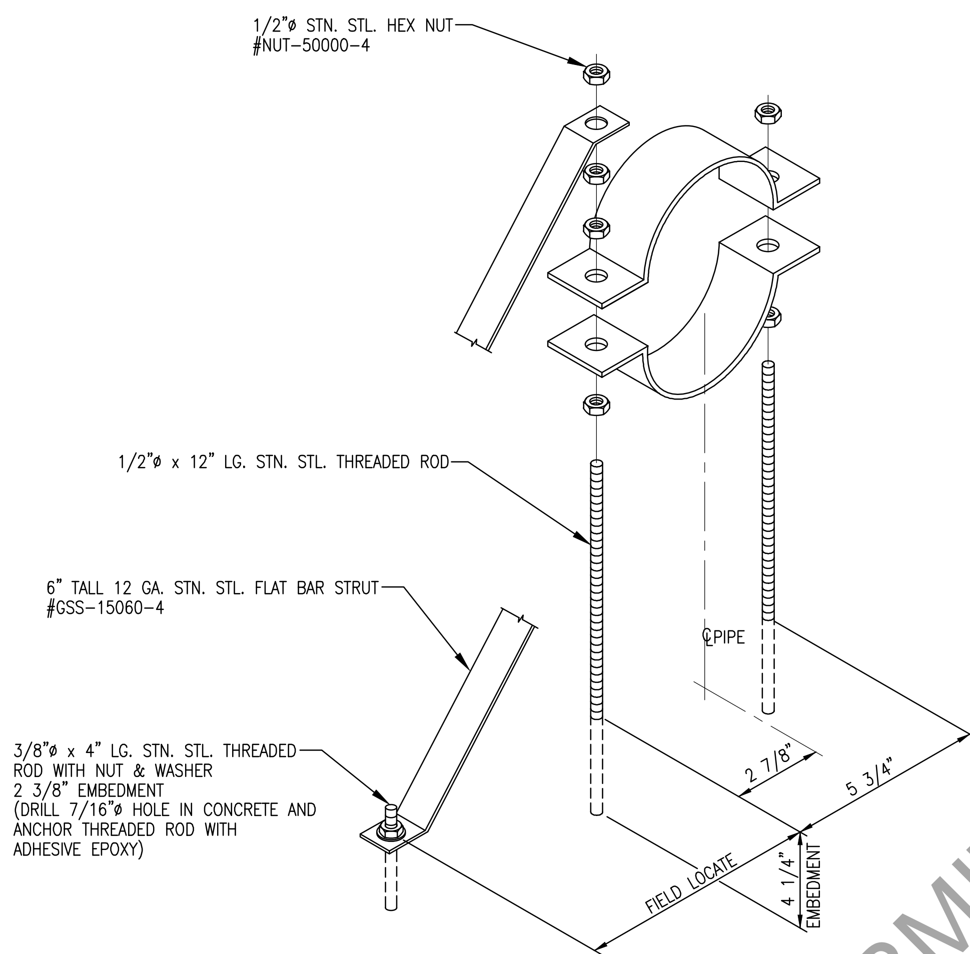
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 6 OF 7

CONFIDENTIAL

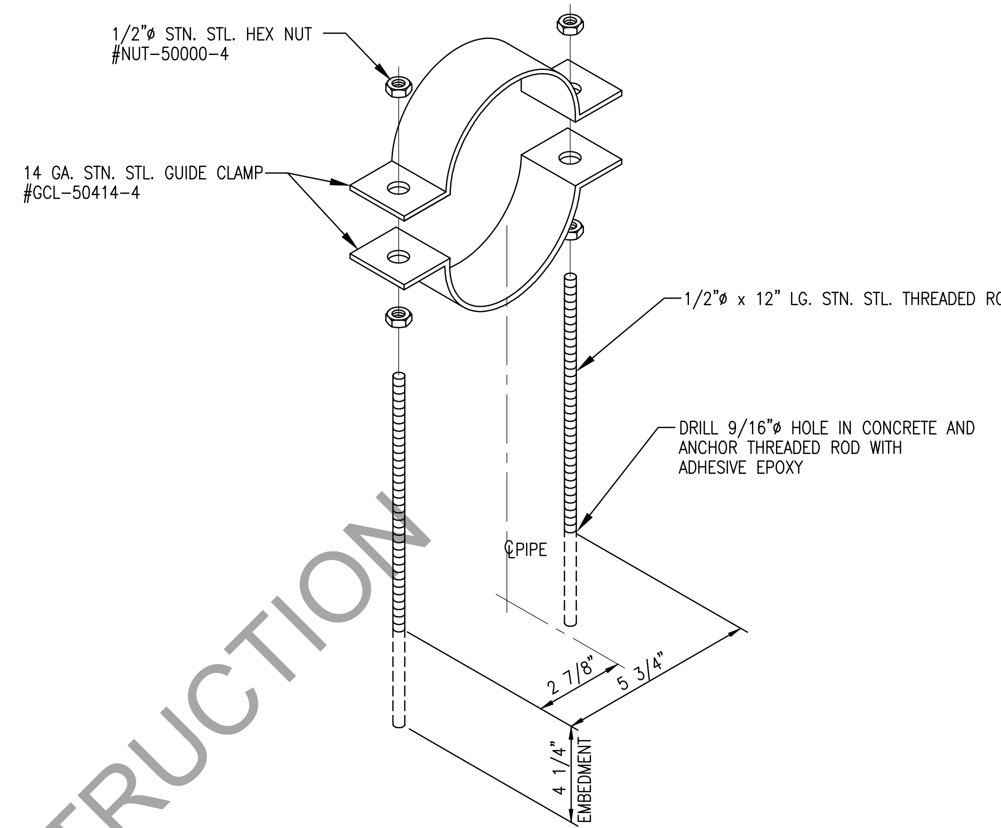
DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: NTS
SIZE: D

PLEASE CHECK ALL NUTS FOR TIGHTNESS



1/2"ø GUIDE SUPPORT WITH STRUT

USE WHERE INDICATED ON PVC AIR HEADERS



1/2"ø GUIDE SUPPORT

USE WHERE INDICATED ON PVC AIR HEADERS

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
1–23–25

NAPANEE, ONTARIO, CANADA

WWTP

AGS BASIN 3

DETAILS

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: PG	DATE: 1–23–25	JOB #: 24–3140
CHKED BY: SP	DATE: 1–23–25	
APPRD BY: SI	DATE: 1–23–25	SHEET AGS3–S–7–R.1

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R23188	2025-01-20	CJC	PRE-ORDER

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

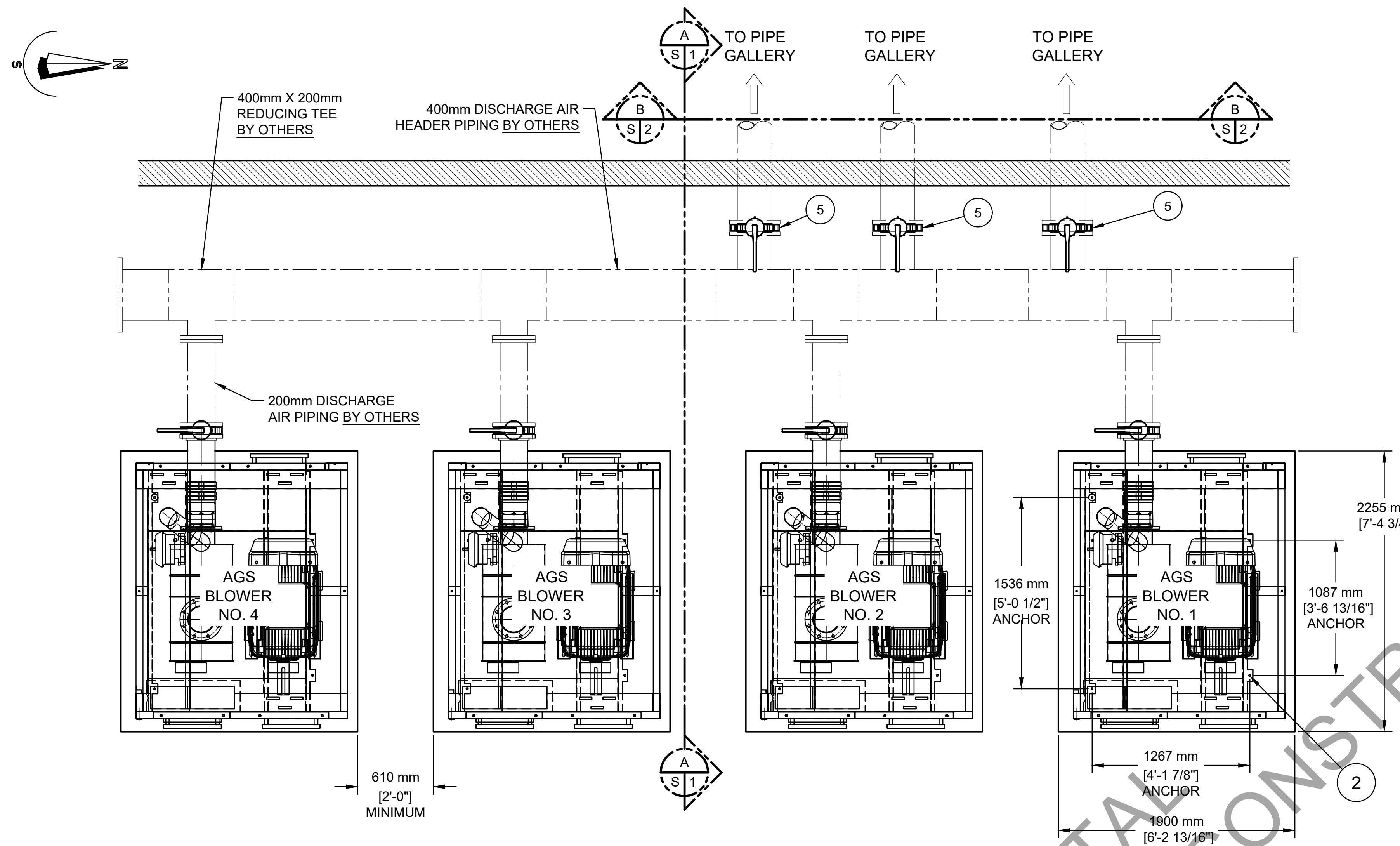
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

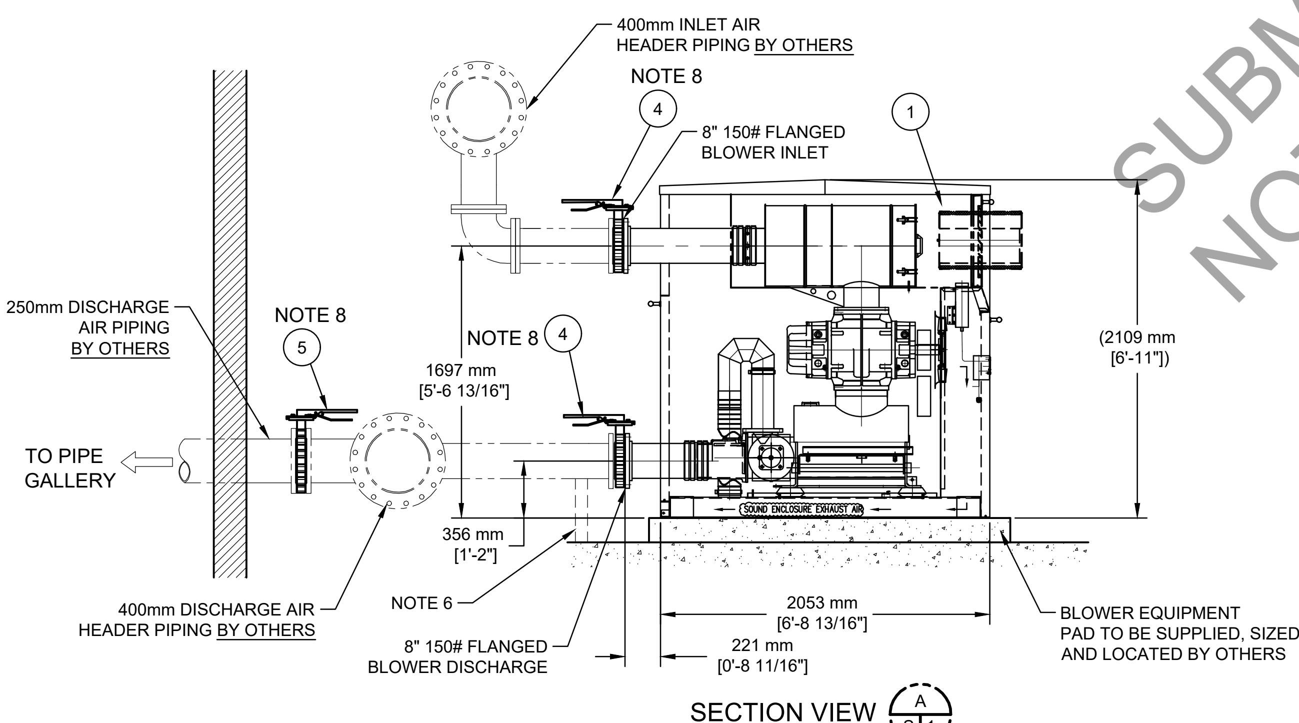
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AQUARIUS
DRAWN BY: CJC DATE: 2024-10-08
WEIGHT: SHEET: 7 OF 7

CONFIDENTIAL

DRAWING NAME: DIFFUSER INSTL, FIXED FB, AGS 3
DRAWING NUMBER: 9704419A30011-3
SCALE: NTS
SIZE: D





SECTION VIEW A S1

SUBMITTAL
NOT FOR CONSTRUCTION

PERFORMANCE DATA:

MANUFACTURER:	AERZEN
MODEL:	D 52S
HORSEPOWER:	125 [93kW]
VOLTAGE:	575V/3/60Hz.
VOLUME (DESIGN):	1,434 SCFM
VOLUME (MINIMUM):	376 SCFM
PRESSURE:	10.67 PSIG
BLOWER SPEED (DESIGN):	2,407 RPM
BLOWER SPEED (MINIMUM):	898 RPM
MOTOR SPEED (DESIGN):	1,780 RPM
MOTOR SPEED (MINIMUM):	664 RPM
DISCHARGE TEMPERATURE: (DESIGN SPEED)	226 DEG. F. [108 DEG. C]
DISCHARGE TEMPERATURE: (MINIMUM SPEED)	284 DEG. F. [140 DEG. C]
NOISE LEVEL w/ ENCLOSURE (ESTIMATED):	80 dBA
BLOWER PACKAGE WEIGHT:	3115 LBS. [1413 kg]
BLOWER MOTOR WEIGHT:	1651 LBS. [749 kg]
TOTAL:	4766 LBS. [2162 kg]

INSTALLATION NOTES:

1. PLEASE REVIEW ALL INSTALLATION DRAWINGS AND ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS BE STAINLESS STEEL AND SECURED WITH A FULL NUT AND A JAM NUT.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. UNLESS OTHERWISE NOTED, ELECTRIC VALVE ACTUATORS SHALL BE SUPPLIED WITH A 12 FT. [3.6m] LONG CORD SET. ELECTRICAL DISCONNECT / JUNCTION BOXES (PROVIDED BY OTHERS) MUST BE LOCATED WITHIN REACH OF THE PROVIDED CORD SET.

5. ALL AIR MANIFOLD PIPING AND BRANCH AIR PIPING IS SHOWN FOR REFERENCE ONLY AND IS TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. AIR MANIFOLD PIPING MUST BE PROPERLY SUPPORTED TO PREVENT DAMAGE TO THE BLOWER PACKAGE ASSEMBLY. THE BLOWER DISCHARGE PIPING MAY NOT BE USED TO SUPPORT THE AIR MANIFOLD PIPING.

7. REFER TO ANCHOR KIT DRAWING FOR INSTALLATION INSTRUCTIONS.

8. ALL VALVES ARE SHIPPED LOOSE AND ARE TO BE LOCATED AND INSTALLED BY OTHERS.

9. PRESSURE TRANSMITTER IS SUPPLIED LOOSE FOR INSTALLATION BY OTHERS. PRESSURE TRANSMITTER IS SUPPLIED WITH A 1/2" FEMALE NPT CONNECTION. INSTALLING CONTRACTOR/ELECTRICIAN IS RESPONSIBLE FOR SUPPLY AND INSTALLATION OF ELECTRIC CABLE AND FITTINGS.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
12	36 FT	2702210	CABLE, 2-PAIR 18AWG	-	-
11	3	2612931-12	CORDSET, 12P SINGLE FEMALE, 12' CORD	-	-
10	3	2620949	PRESSURE TRANSMITTER, 3051T, C1D2	-	-
9	3	2620686-100-10	FLOW CONDITIONER, 10", S10 VIP VORTAB A	316L SS	-
8	3	9704419A30402	AIR FLOW METER, 10" PIPE, FCI ST51A	-	-
7	6	9704419A30129	VALVE ASSY, 4", BFLY, AUMA SQEX07.2, 115V	304 SS	Y
6	3	9704419A30128	VALVE ASSY, 6", BFLY, AUMA SQR07.2, 575V	304 SS	Y
5	3	2617003	VALVE, BFLY, 10", ABZ FIGURE 397, LVR	CAST IRON	-
4	8	2617002	VALVE, BFLY, 8", ABZ FIGURE 397, LVR	CAST IRON	-
3	3	2617000	VALVE, BFLY, 4", ABZ FIGURE 397, LVR	CAST IRON	-
2	16	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
1	4	9704419A30400	BLOWER PACKAGE, 125HP	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL

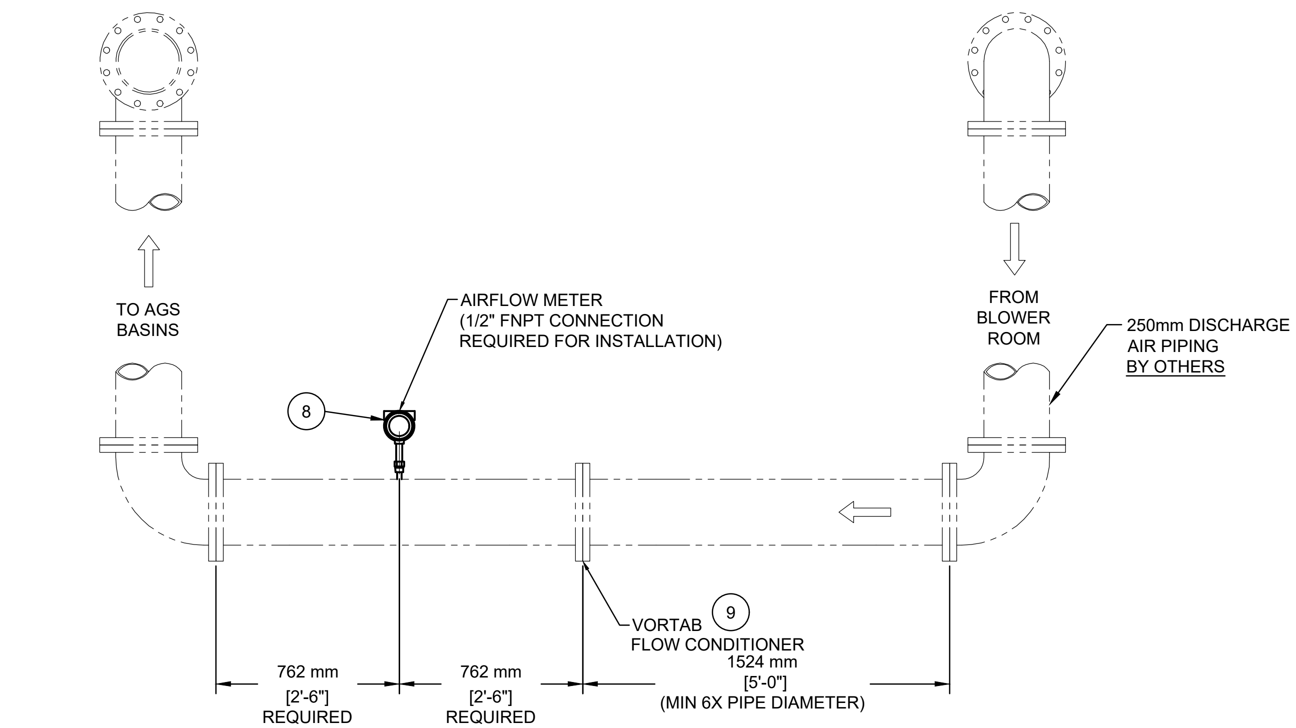
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

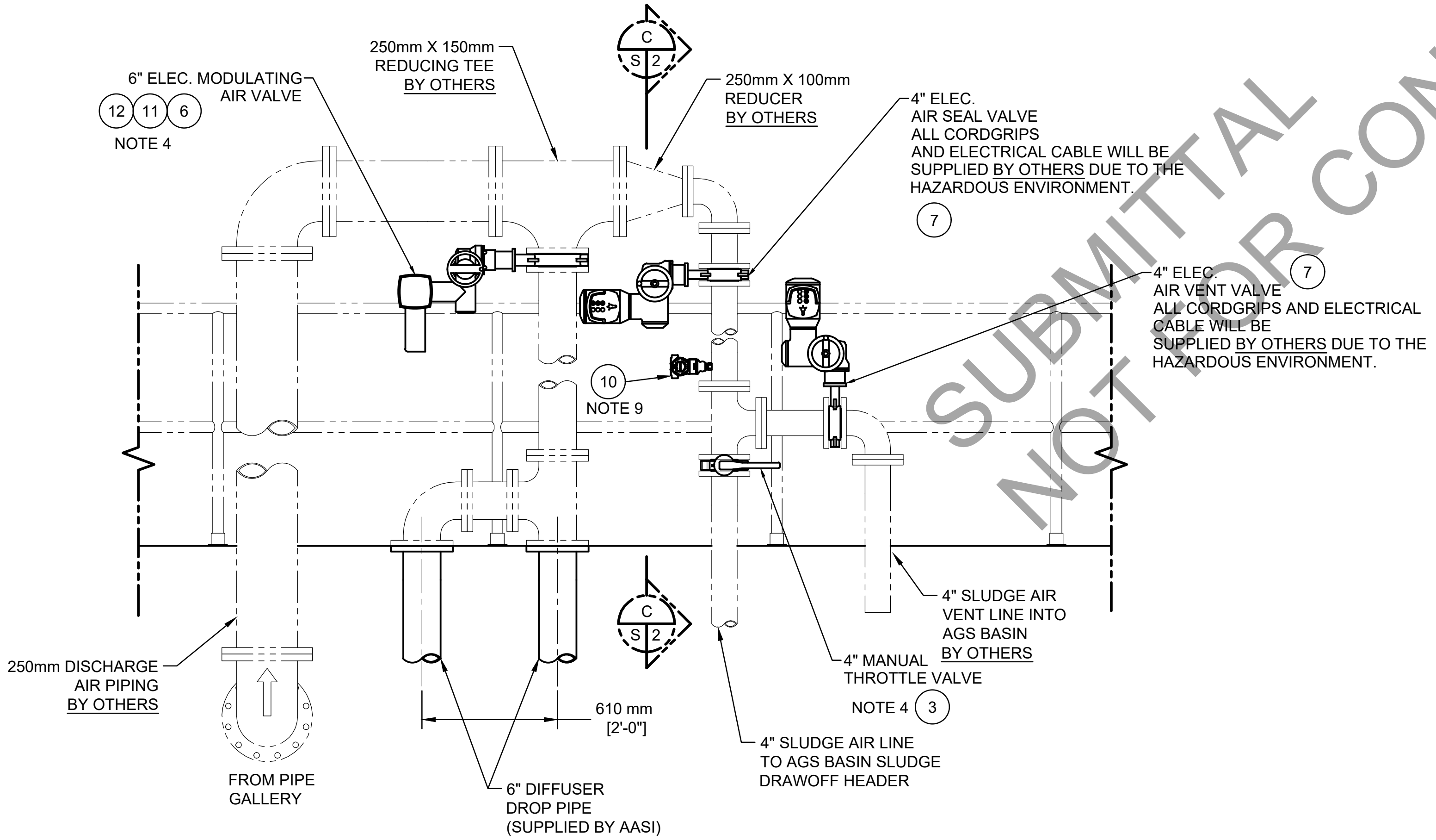
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC
DATE: 2024-10-04
WEIGHT:
SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: BLOWER AND AIR VALVE INSTL
DRAWING NUMBER: 9704419A30012
SCALE: 1/24
SIZE: D



SECTION VIEW B S2
TYPICAL ORIENTATION FOR ALL AGS AIR PIPING



AGS AIR VENT PIPING
TYPICAL ORIENTATION FOR ALL AGS AIR PIPING

INSTALLATION NOTES:

1. PLEASE REVIEW ALL INSTALLATION DRAWINGS AND ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS BE STAINLESS STEEL AND SECURED WITH A FULL NUT AND A JAM NUT.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.

4. UNLESS OTHERWISE NOTED, ELECTRIC VALVE ACTUATORS SHALL BE SUPPLIED WITH A 12 FT. [3.6m] LONG CORD SET. ELECTRICAL DISCONNECT / JUNCTION BOXES (PROVIDED BY OTHERS) MUST BE LOCATED WITHIN REACH OF THE PROVIDED CORD SET.

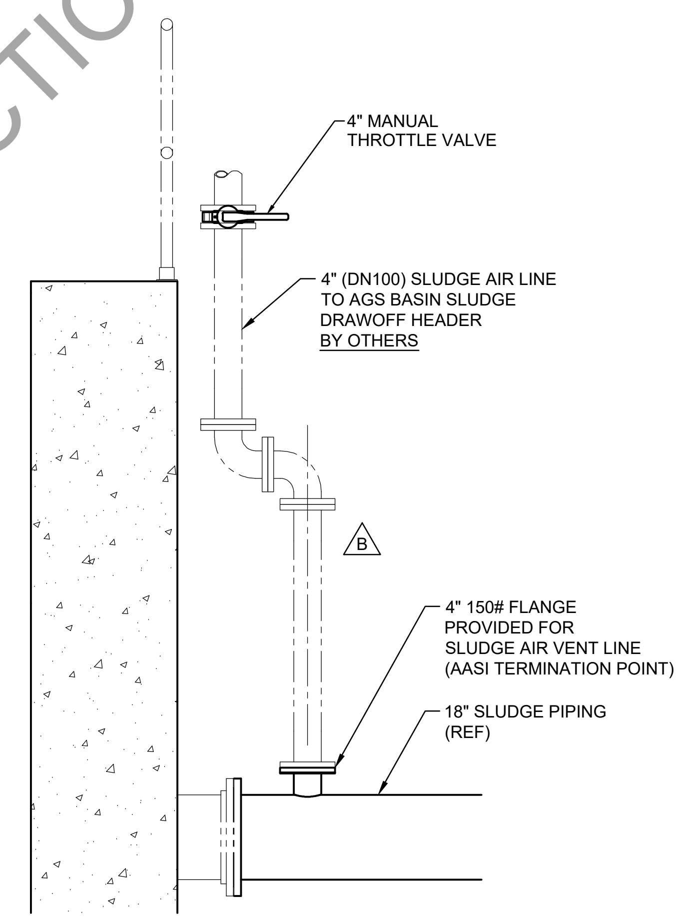
5. ALL AIR MANIFOLD PIPING AND BRANCH AIR PIPING IS SHOWN FOR REFERENCE ONLY AND IS TO BE SUPPLIED AND INSTALLED BY OTHERS.

6. AIR MANIFOLD PIPING MUST BE PROPERLY SUPPORTED TO PREVENT DAMAGE TO THE BLOWER PACKAGE ASSEMBLY. THE BLOWER DISCHARGE PIPING MAY NOT BE USED TO SUPPORT THE AIR MANIFOLD PIPING.

7. REFER TO ANCHOR KIT DRAWING FOR INSTALLATION INSTRUCTIONS.

8. ALL VALVES ARE SHIPPED LOOSE AND ARE TO BE LOCATED AND INSTALLED BY OTHERS.

9. PRESSURE TRANSMITTER IS SUPPLIED LOOSE FOR INSTALLATION BY OTHERS. PRESSURE TRANSMITTER IS SUPPLIED WITH A 1/2" FEMALE NPT CONNECTION. INSTALLING CONTRACTOR/ELECTRICIAN IS RESPONSIBLE FOR SUPPLY AND INSTALLATION OF ELECTRIC CABLE AND FITTINGS.



SECTION VIEW C S2

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

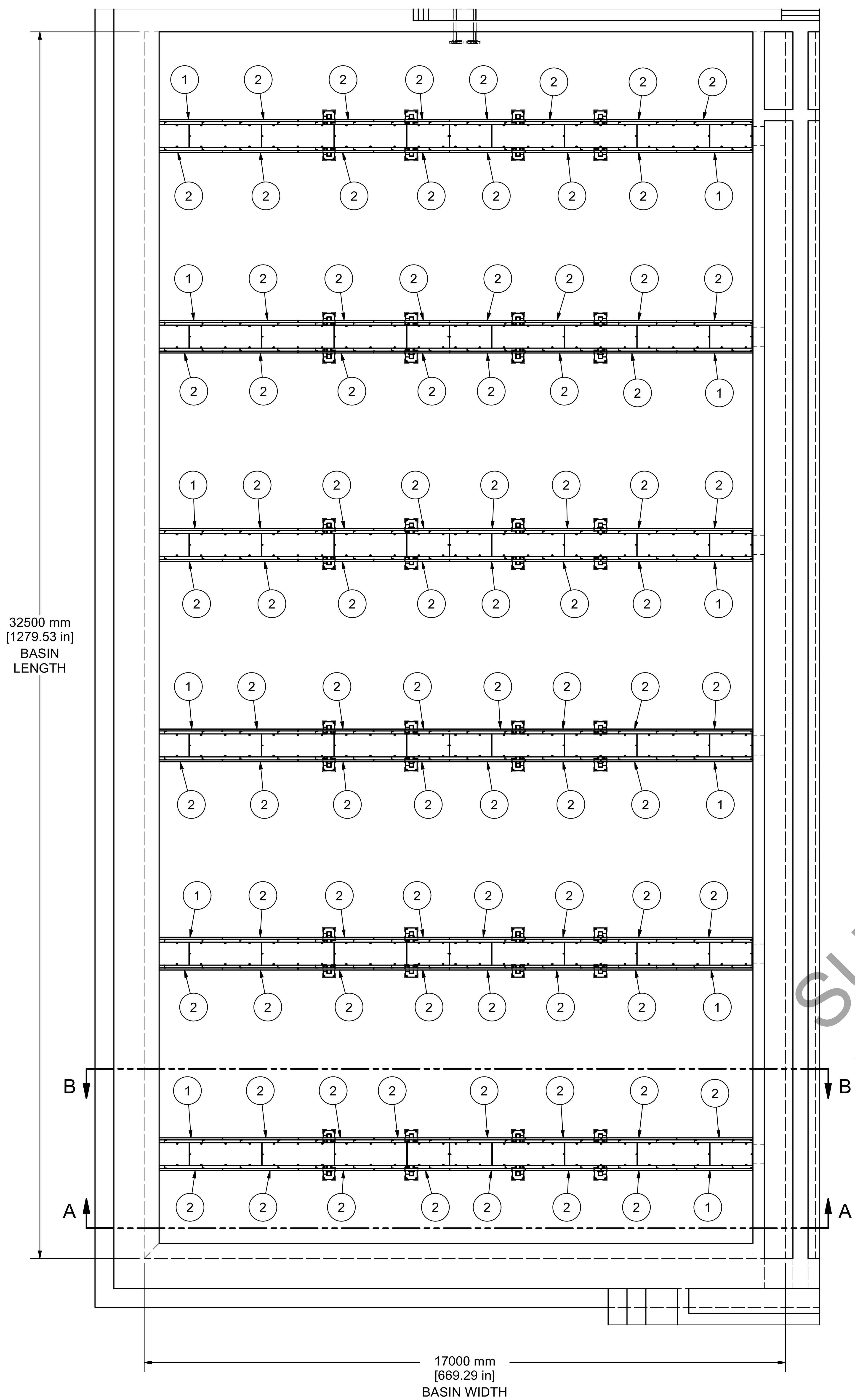
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

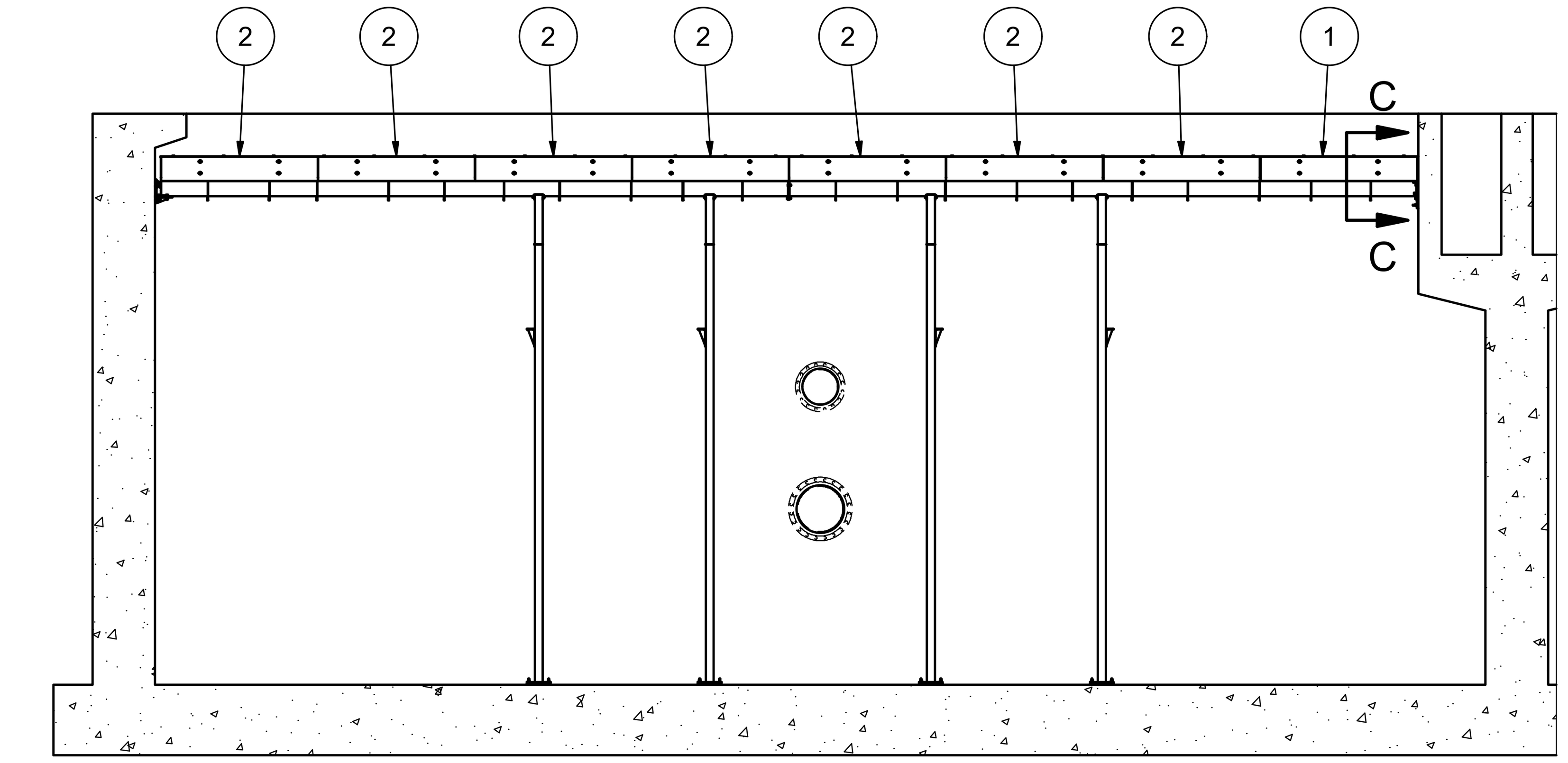
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

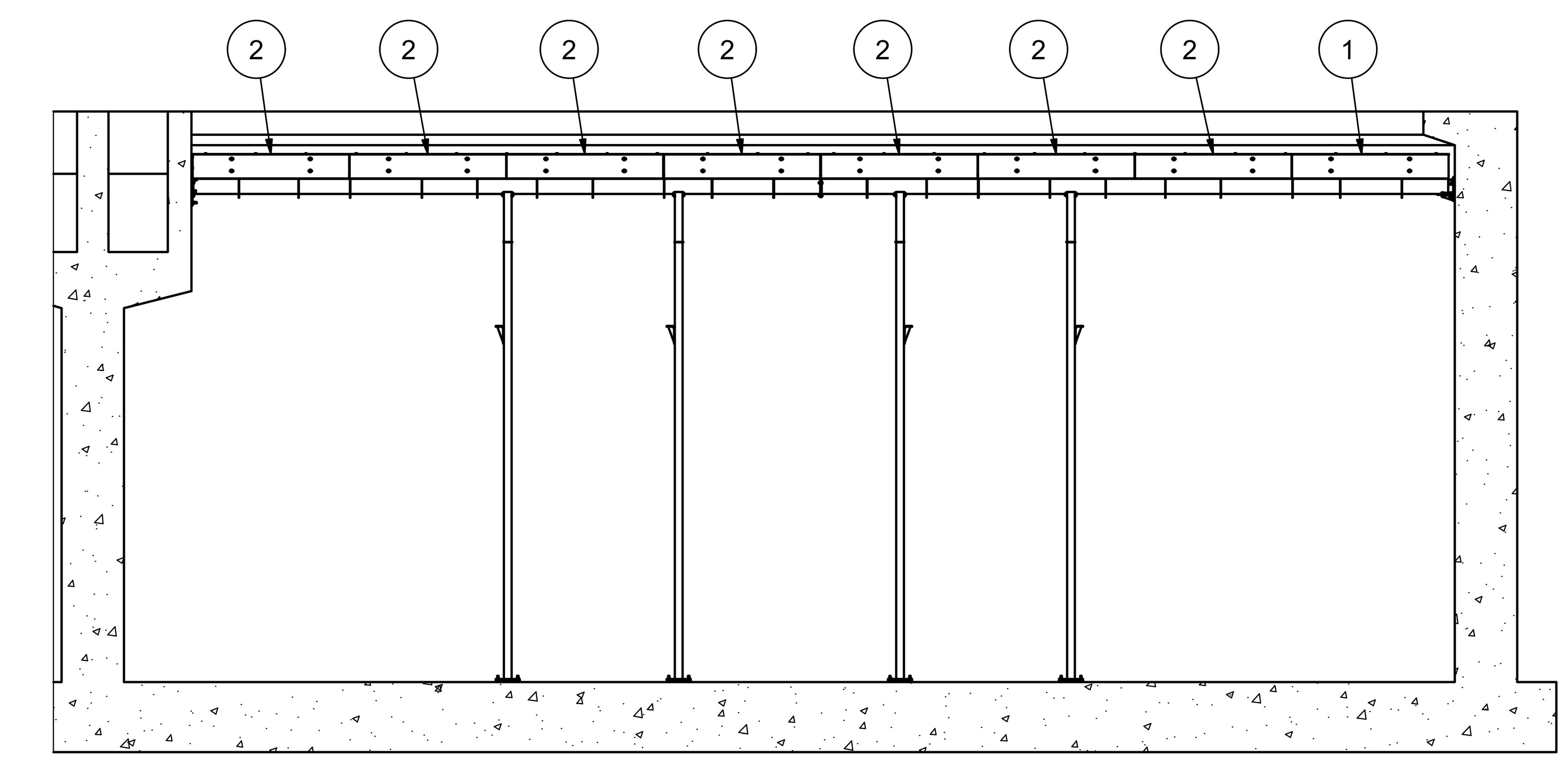
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC
DATE: 2024-10-04
WEIGHT:
SHEET: 2 OF 2
CONFIDENTIAL
DRAWING NAME: BLOWER AND AIR VALVE INSTL
DRAWING NUMBER: 9704419A30012
SCALE: 1/16
SIZE: D

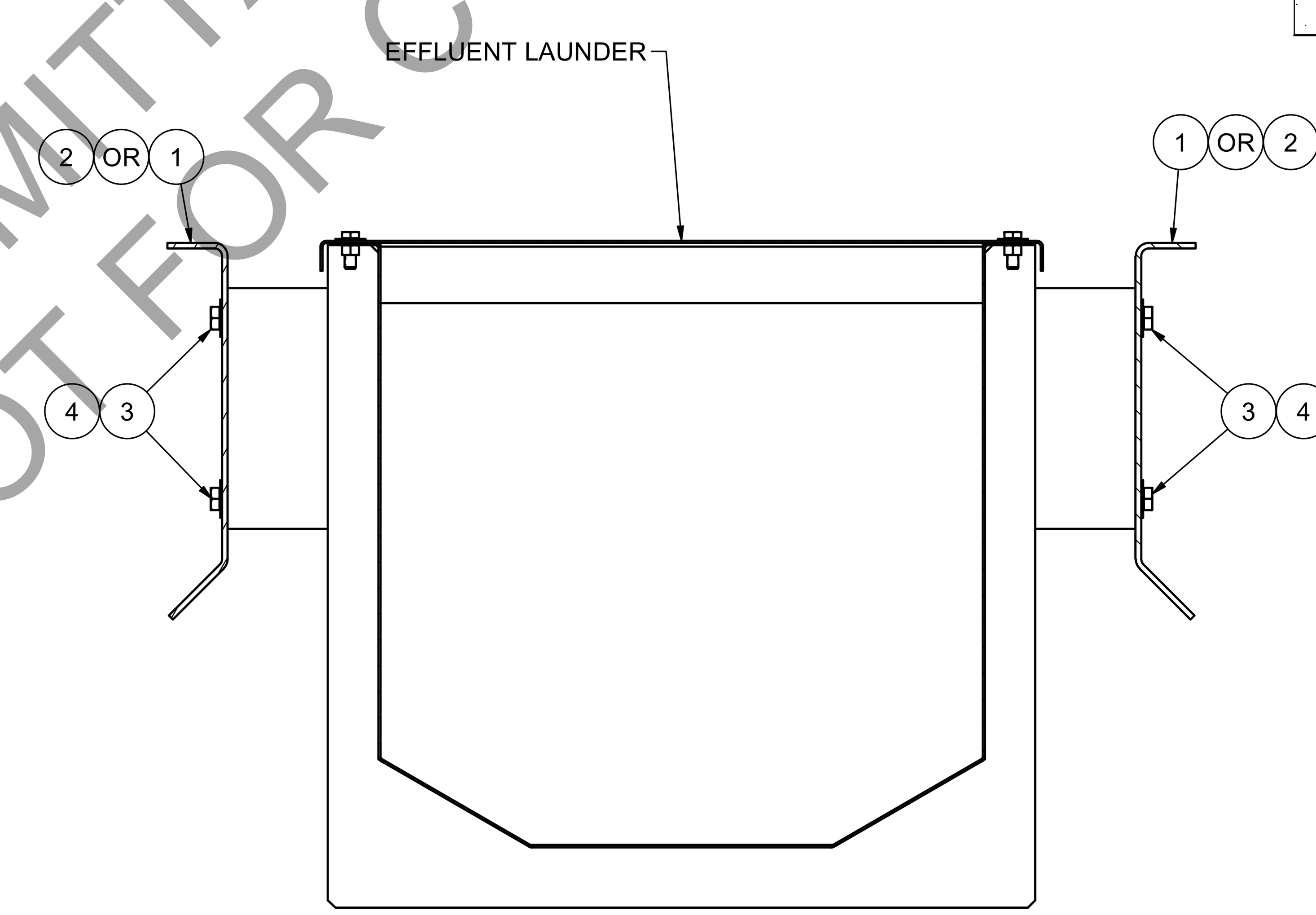




SECTION A-A
TYP (6)



SECTION B-B
TYP (6)



SECTION C-C
TYP

NOTES:

1. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

2. TORQUE FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

3. COMPONENT WEIGHTS:
   - SCUM BAFFLE: 29 KG [64 LB]
   - SCUM BAFFLE WELDMENT: 30 KG [65 LB]

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-08	JFM	SUBMITTAL
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: SCUM BAFFLE INSTL, AGS 1				

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

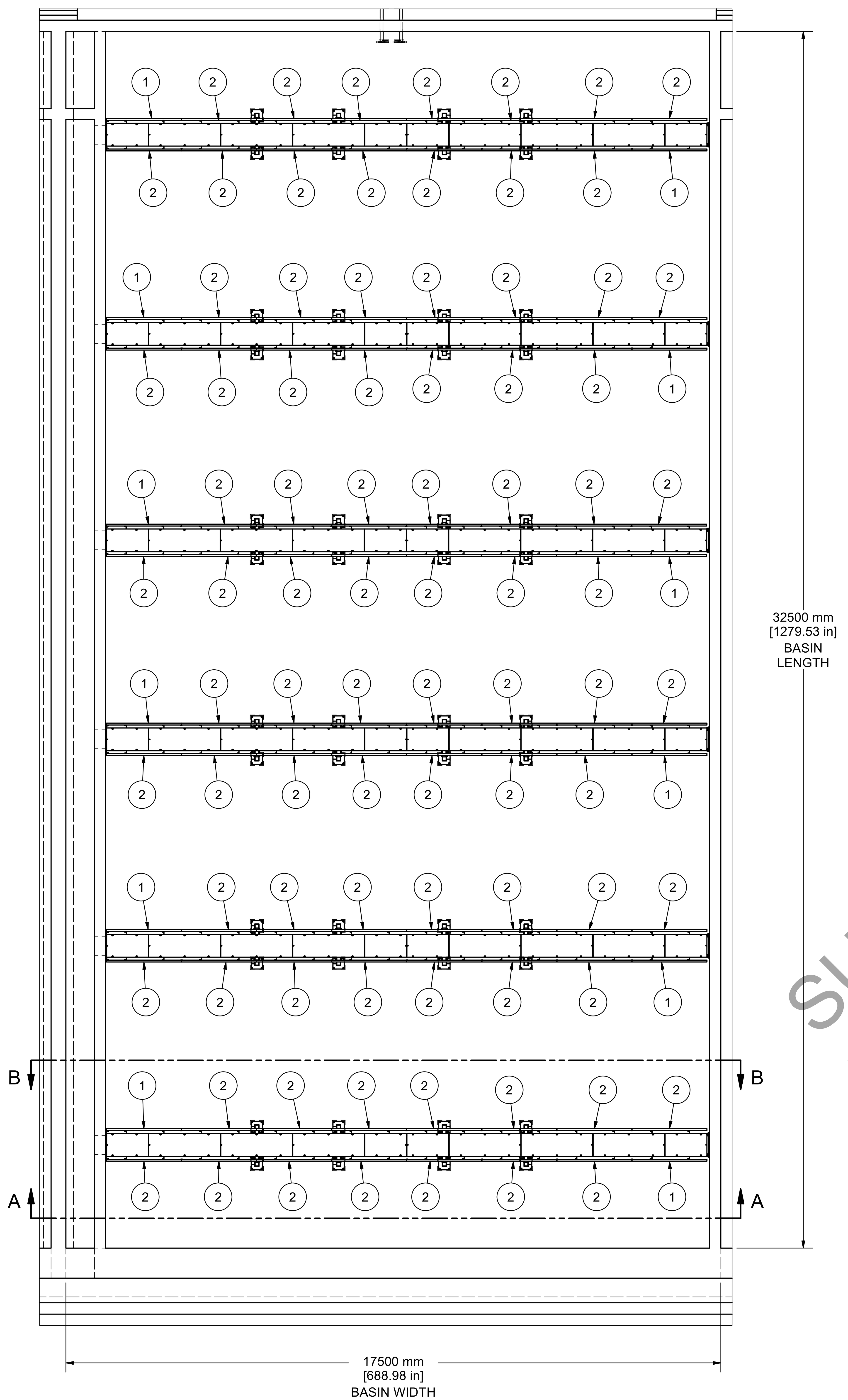
DO NOT SCALE DRAWING

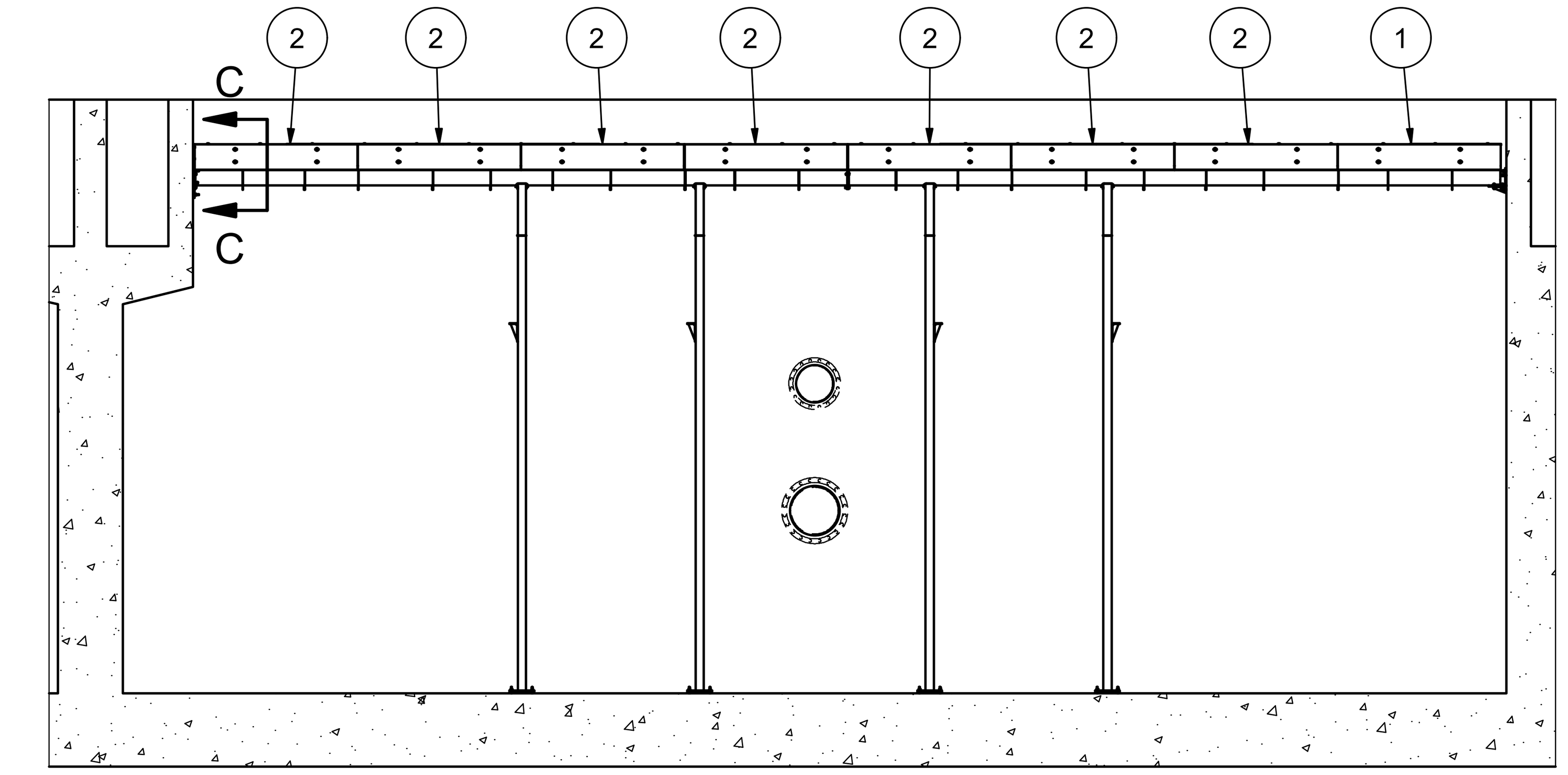
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

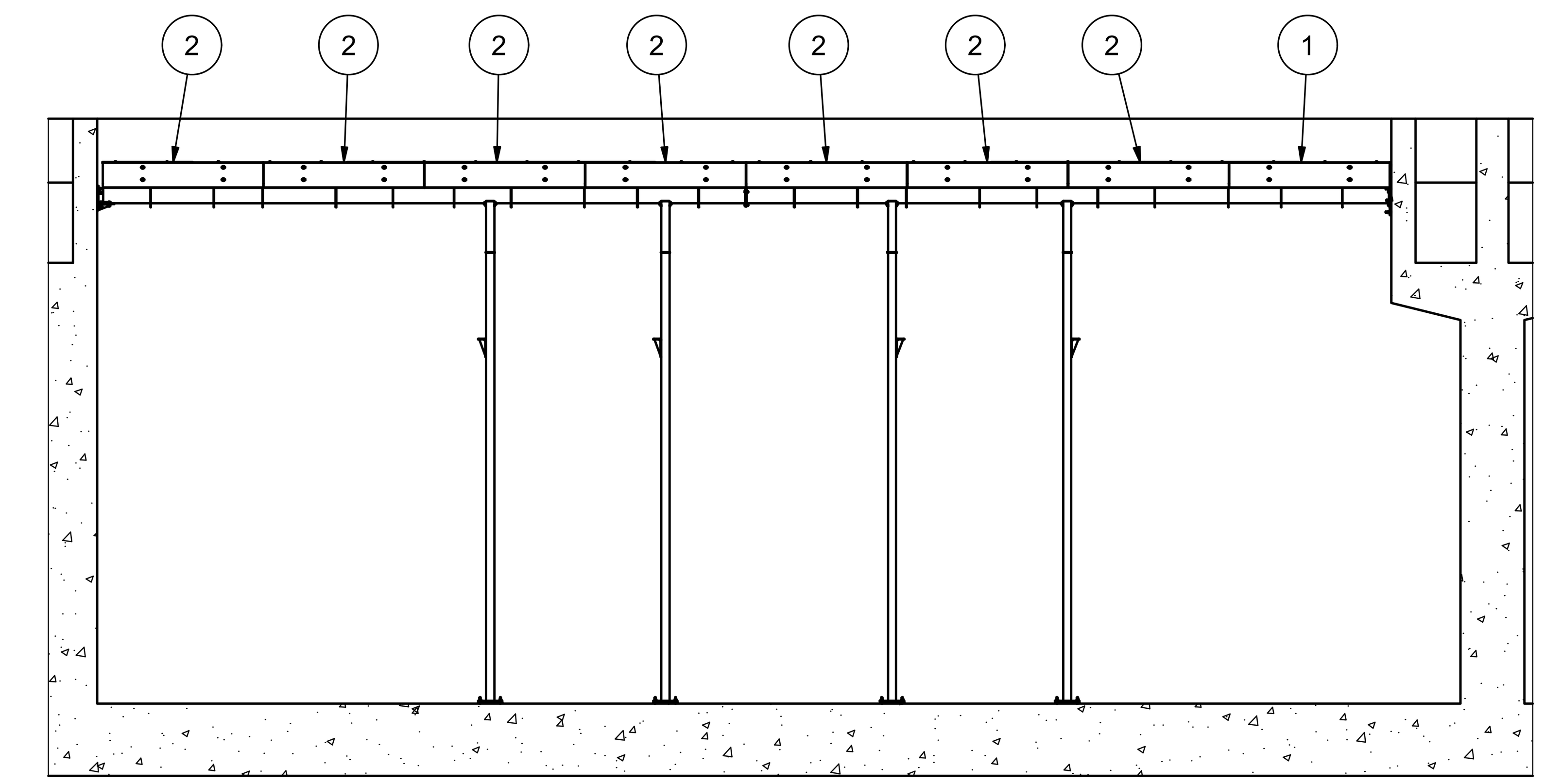
ANSI

MATERIAL: 304 SS	
SIMILAR TO: 911689230021	
TYPE: AQUANEREDA	
DRAWN BY: JFM	DATE: 2024-10-08
WEIGHT:	SHEET: 1 OF 1
DRAWING NUMBER: 9704419A30013	SCALE: 1:78 SIZE: D

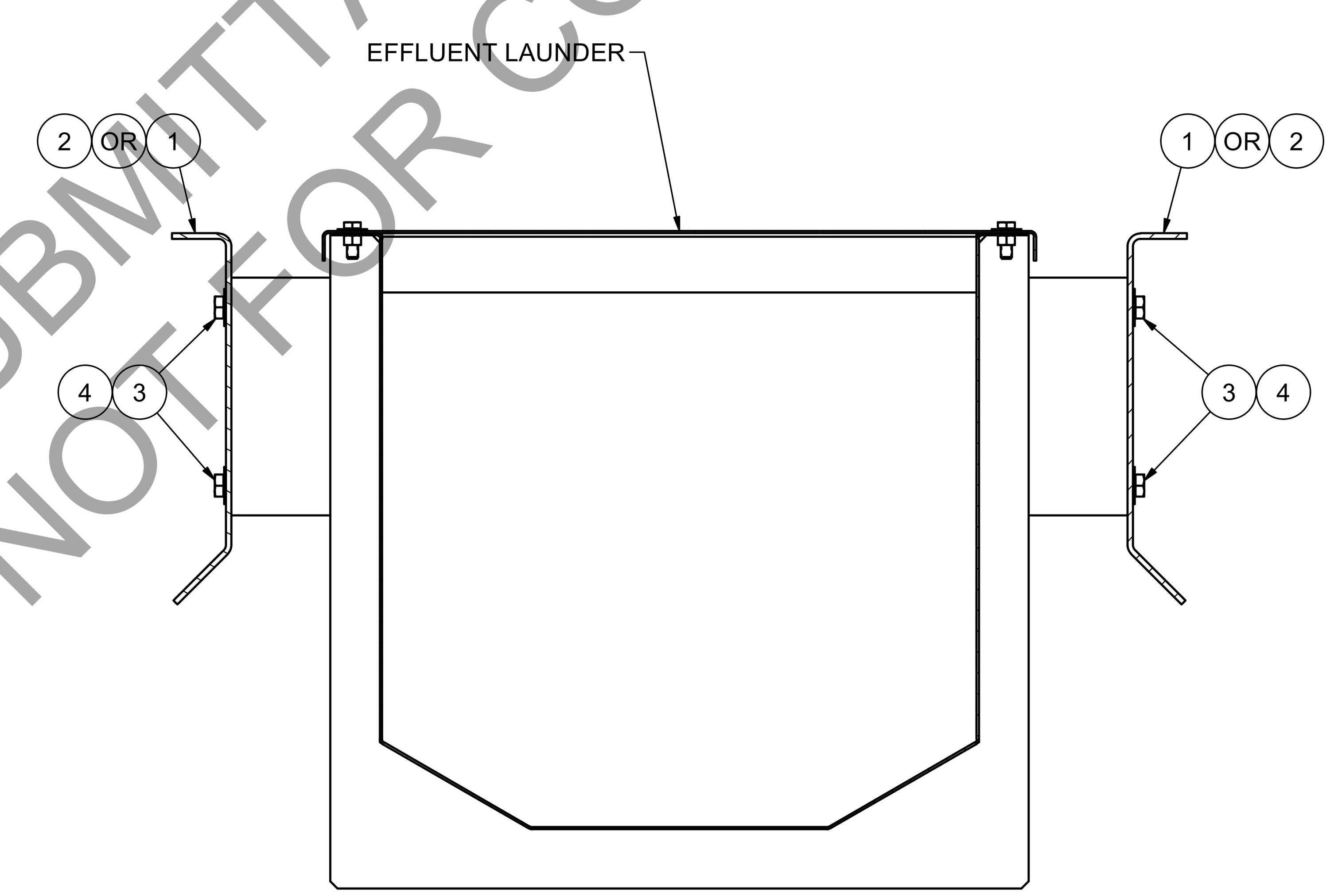




SECTION A-A
TYP (6)



SECTION B-B
TYP (6)



SECTION C-C
TYP

NOTES:

1. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

2. TORQUE FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

3. COMPONENT WEIGHTS:
   - SCUM BAFFLE: 29 KG [64 LB]
   - SCUM BAFFLE WELDMENT: 30 KG [65 LB]

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

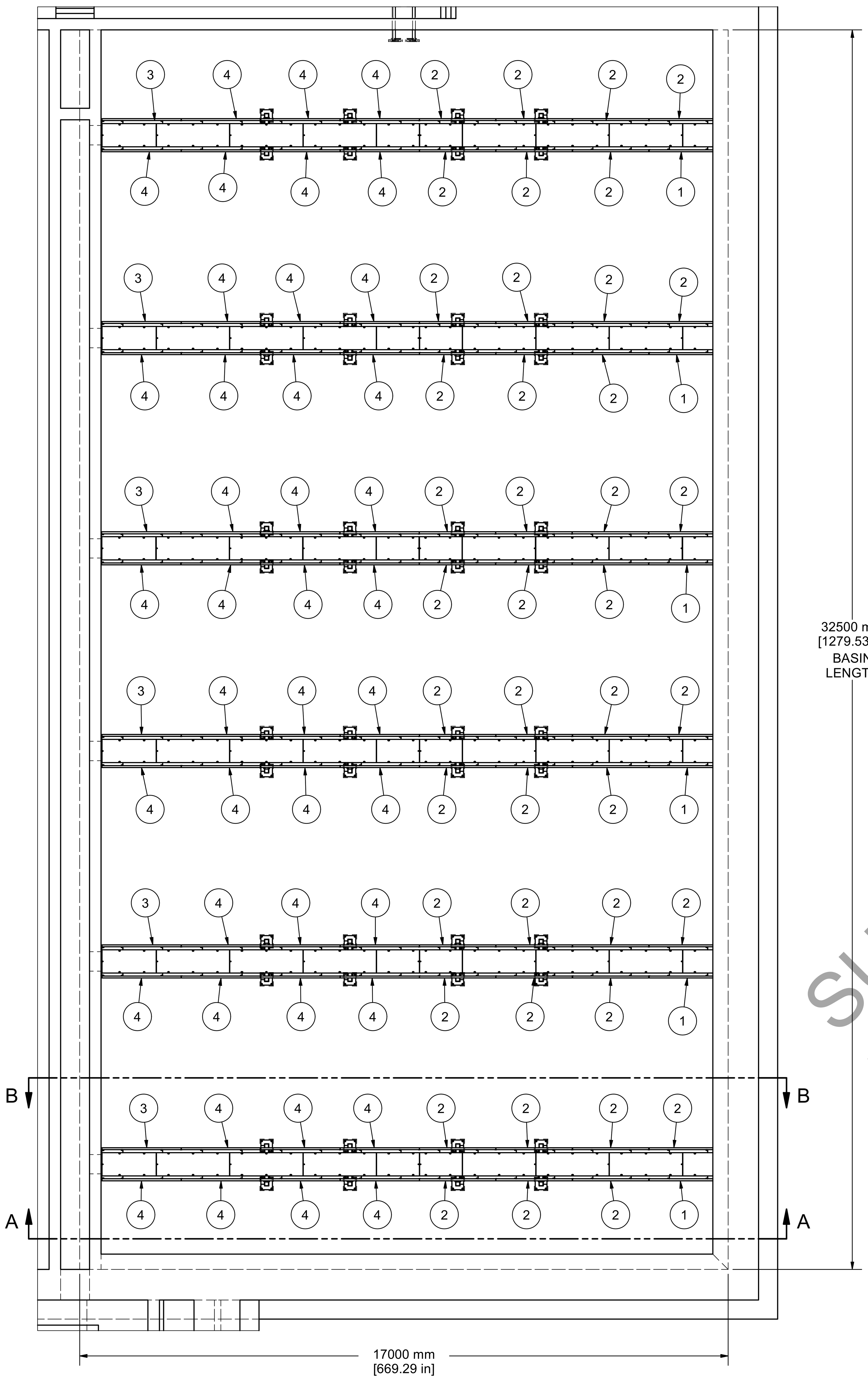
DO NOT SCALE DRAWING

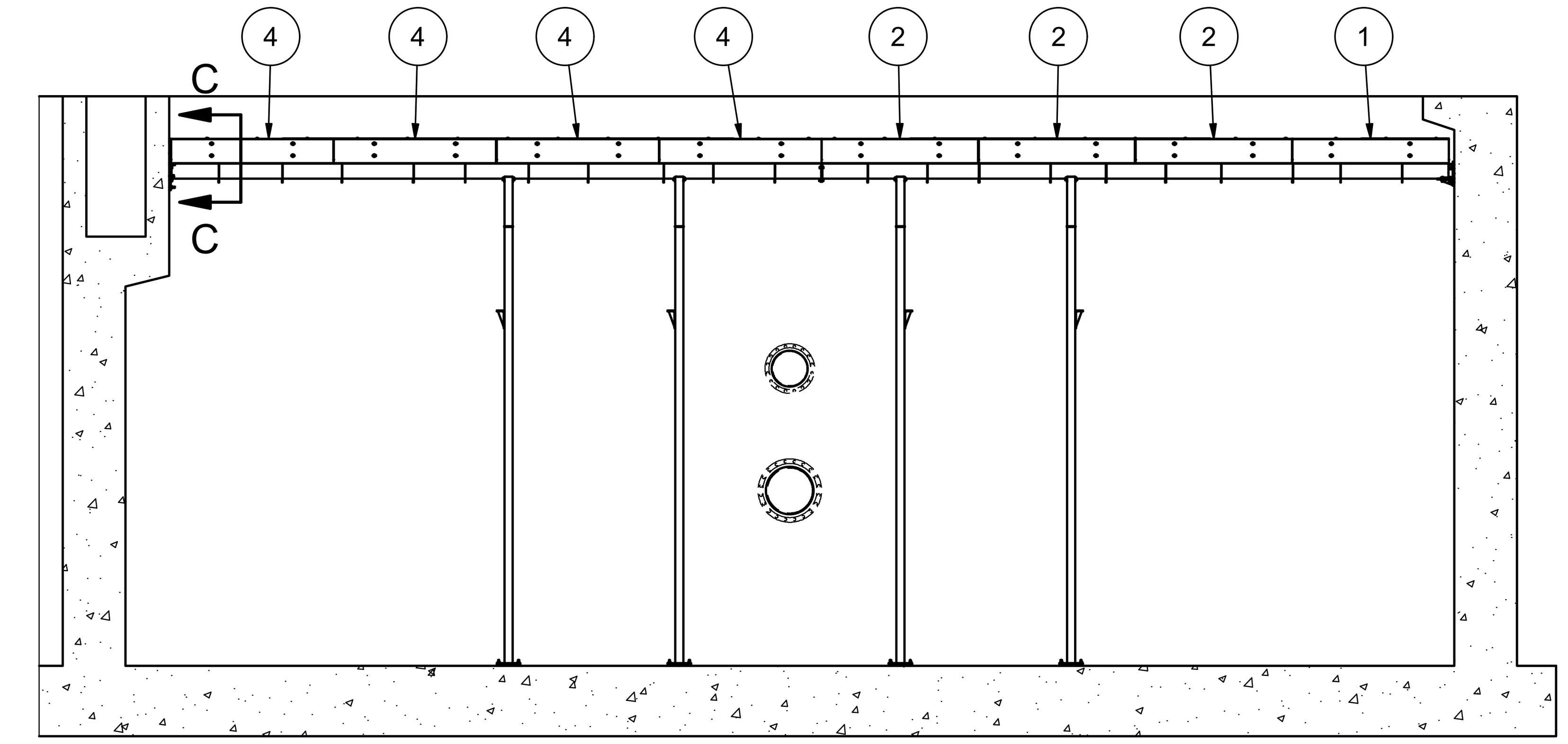
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

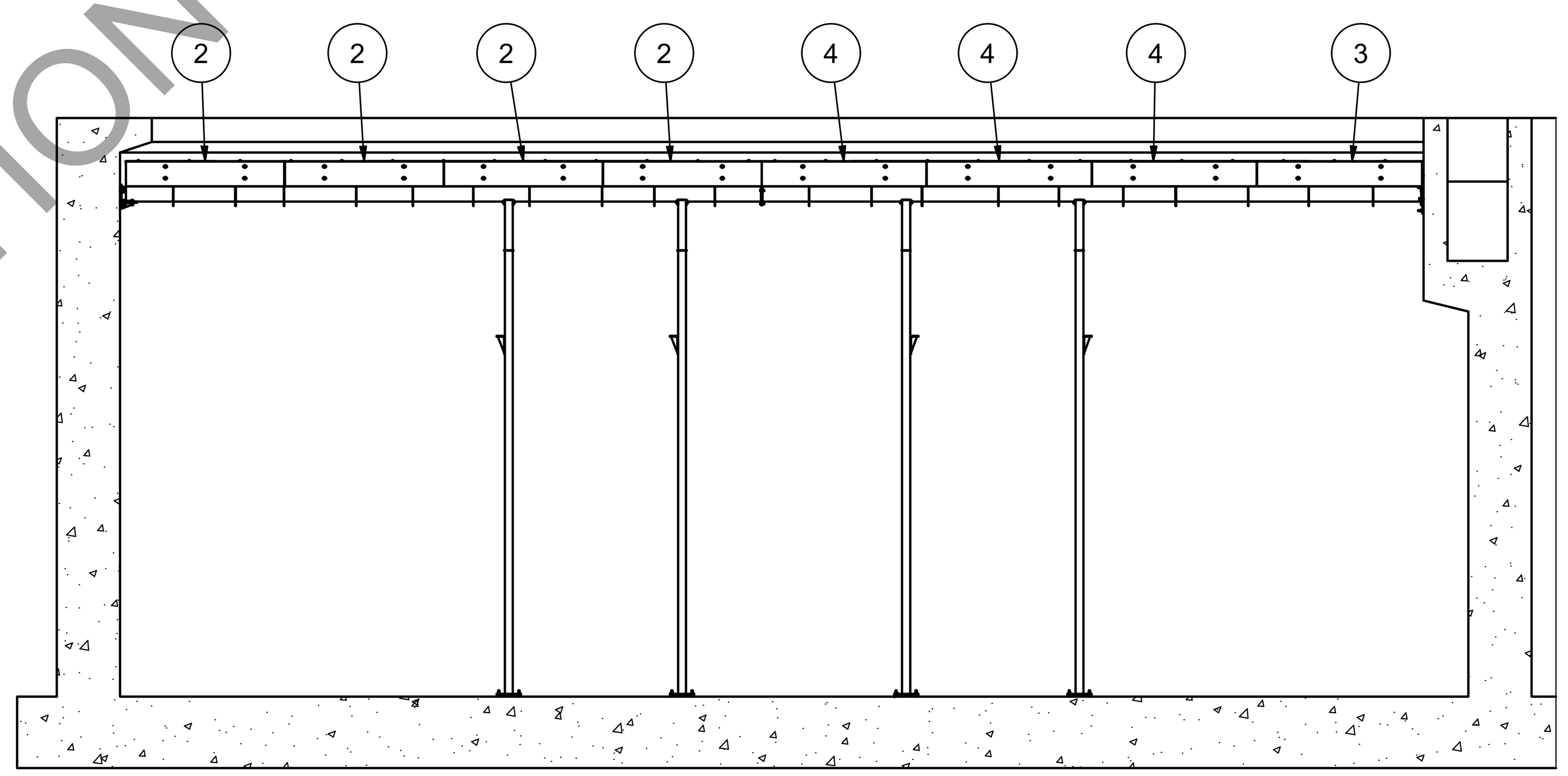
ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230021
TYPE: AQUANEREDA
DRAWN BY: JFM DATE: 2024-10-08
WEIGHT: SHEET: 1 OF 1
DRAWING NAME: SCUM BAFFLE INSTL, AGS 2
DRAWING NUMBER: 9704419A30014 SCALE: 1:78 SIZE: D

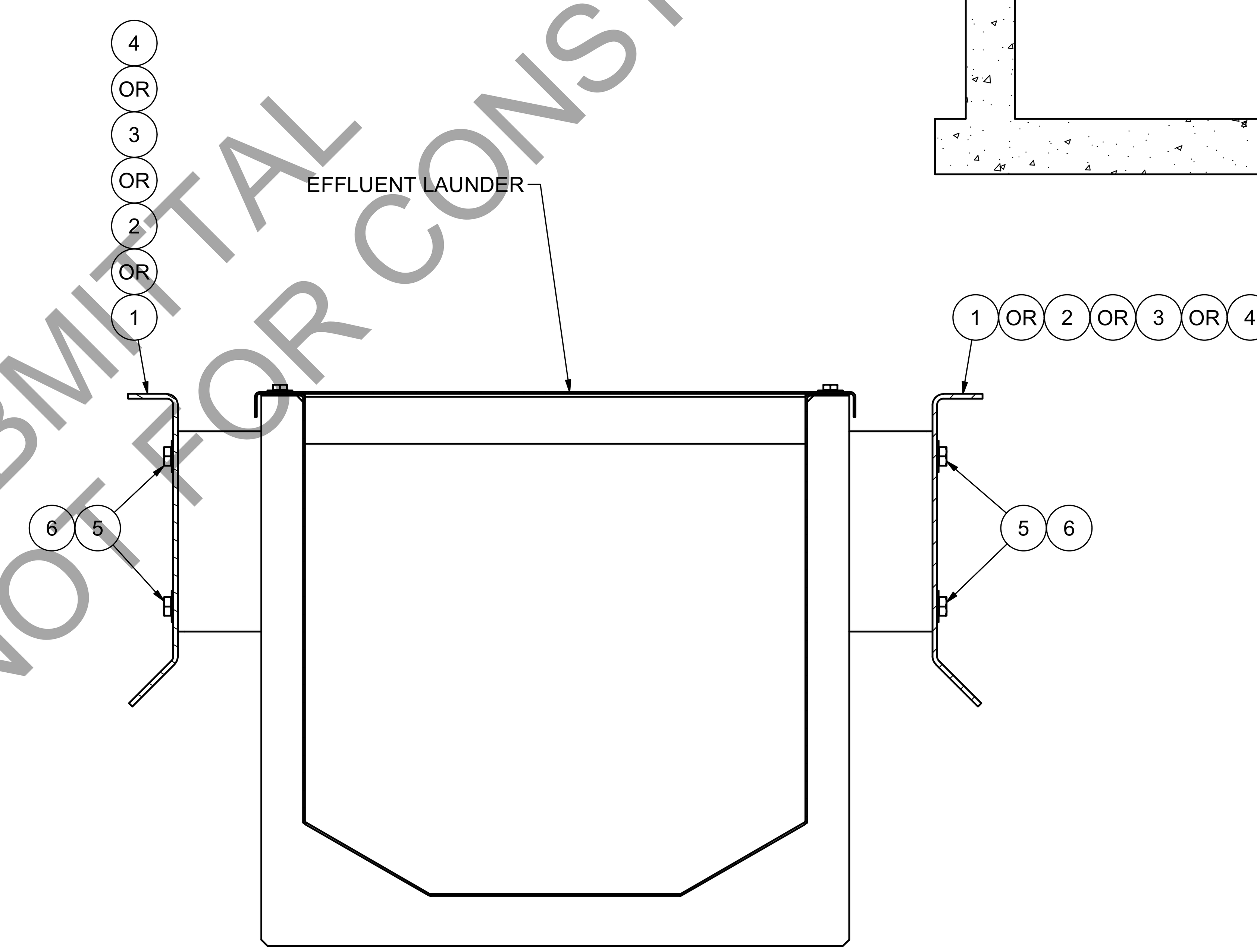




SECTION A-A
TYP (6)



SECTION B-B
TYP (6)



SECTION C-C
TYP

NOTES:

1. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

2. TORQUE FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

3. COMPONENT WEIGHTS:
   - SCUM BAFFLE: 29 KG [64 LB]
   - SCUM BAFFLE WELDMENT: 30 KG [65 LB]
   - SCUM BAFFLE, LONG: 30 KG [66 LB]
   - SCUM BABBLE WELDMENT, LONG: 31 KG [67 LB]

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-08	JFM	SUBMITTAL

DRAWING NAME: SCUM BAFFLE INSTL, AGS 3

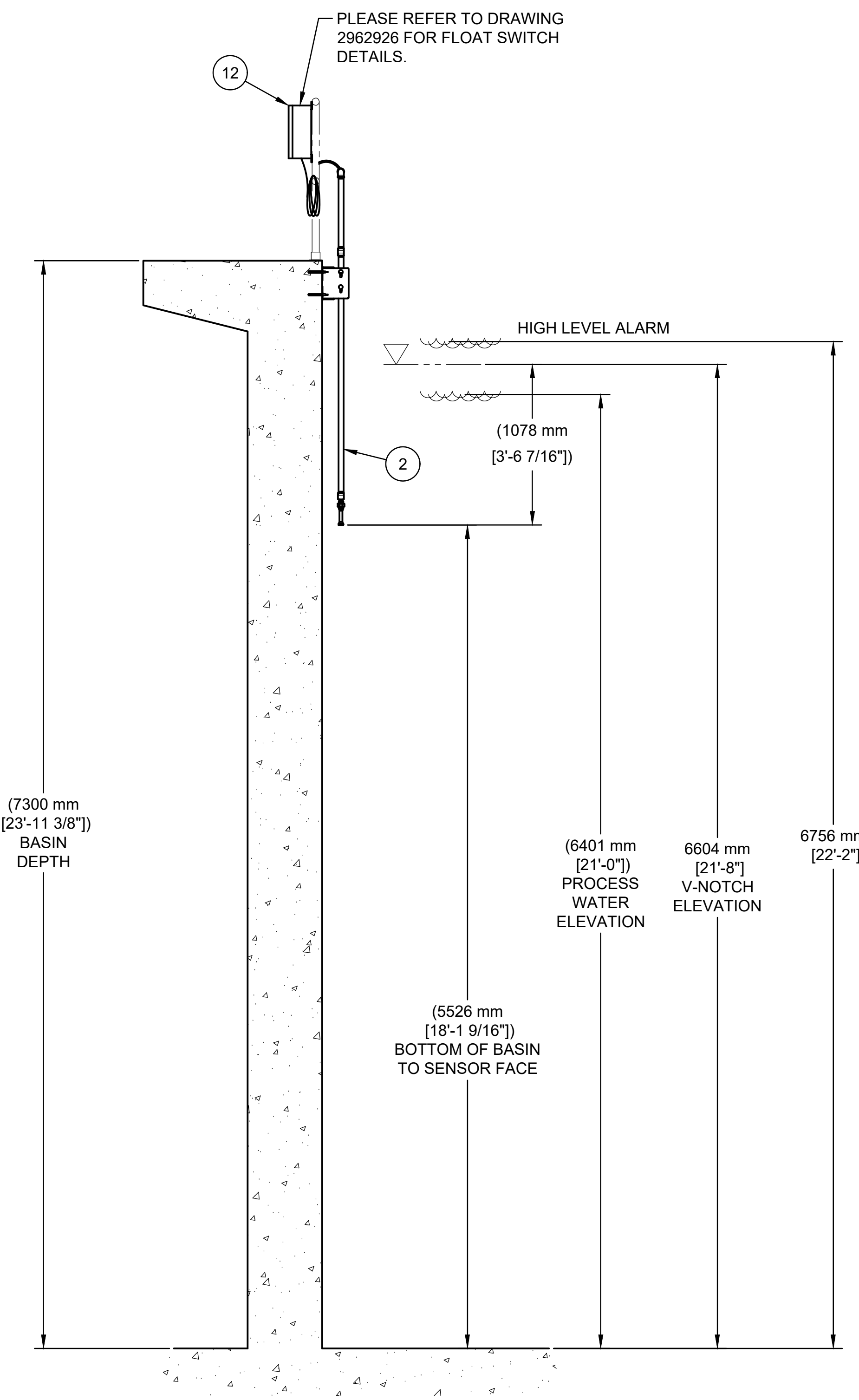
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

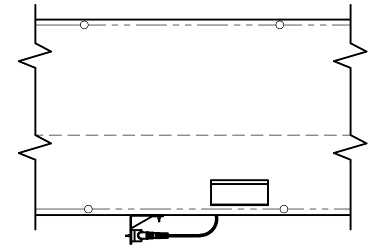
DO NOT SCALE DRAWING

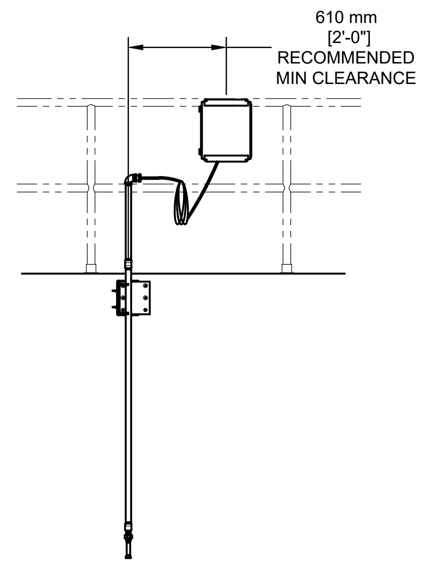
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°

ANSI

MATERIAL: 304 SS
SIMILAR TO: 911689230021
TYPE: AQUANEREDA
DRAWN BY: JFM | DATE: 2024-10-08
WEIGHT: | SHEET: 1 OF 1
DRAWING NUMBER: 9704419A30015 | SCALE: 1:78 | SIZE: D

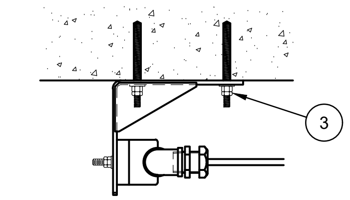


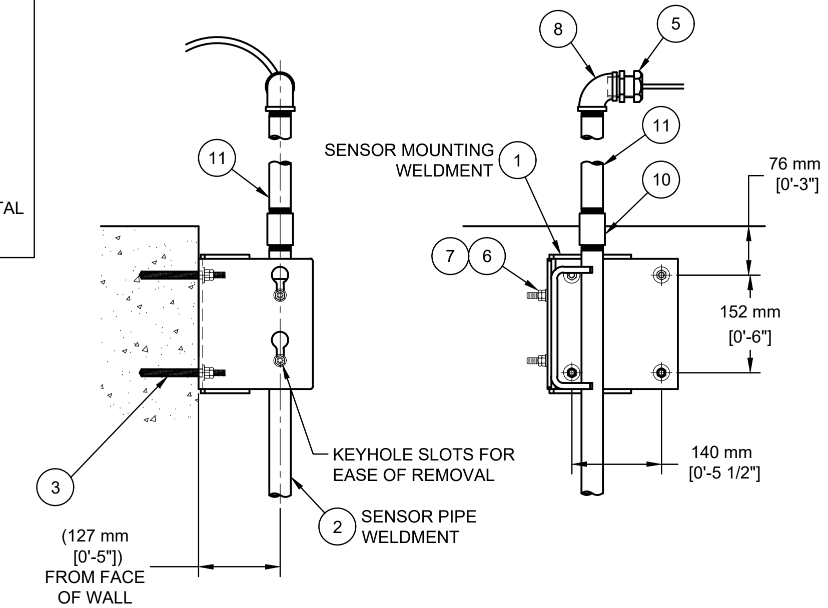


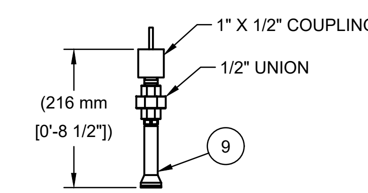


SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
3. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS OF THE SENSOR.
4. USE TY-WRAPS PROVIDED TO COIL EXCESS LENGTH OF SENSOR CABLE TOGETHER.
5. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.
7. DO NOT CRIMP OR DISTORT SENSOR CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES [50mm]. PROTECT EXPOSED CABLE FROM SOURCES OF POSSIBLE ACCIDENTAL DAMAGE.







SUBMITTAL
NOT FOR CONSTRUCTION

CORD GRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #5). USE A 23/64" [9.12mm] BIT TO DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH O THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.

SENSOR COMPONENT WEIGHTS:

SENSOR PIPE WELDMENT	13 LBS [6 kg]
SENSOR ASSEMBLY (LEVEL)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
12	1	2969295	INTRINSICALLY SAFE JUNCTION BOX	304 SS	Y
11	1	2521313-SX0	PIPE, 1", S40, TBE, 20" LG	304 SS	-
10	1	2607353	COUPLING, 1"NPT, 150#	304 SS	-
9	1	2968884-10-050-SX0	PRESSURE TRANS. SUB ASSY, 1", LEVELRAT, 10 PSI, 50 FT	304 SS	Y
8	1	2605207	ELBOW, 90DEG, THD, 1", 150#	304 SS	-
7	2	2614404	NUT, HEX, SERRATED FLANGE, 3/8-16	316 SS	-
6	2	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
5	1	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
4	2	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
3	4	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
2	1	2915092-6-SX0	SENSOR PIPE WELDMENT, 6 FT	304 SS	Y
1	1	2915093-SX0	SENSOR MOUNTING WELDMENT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

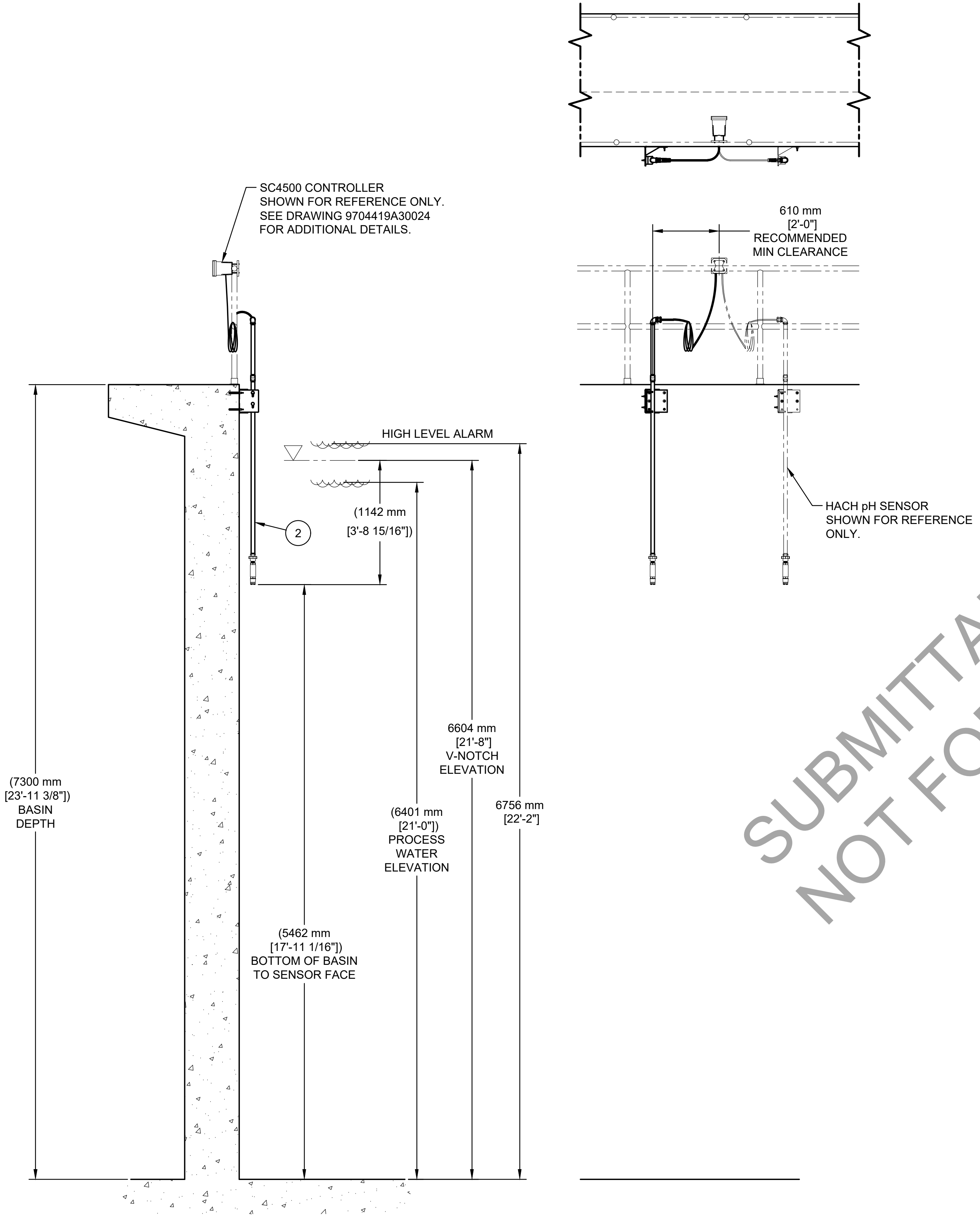
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO: M-SENSOR-13
TYPE:
DRAWN BY: CJC DATE: 2024-10-01
WEIGHT: SHEET: 1 OF 1

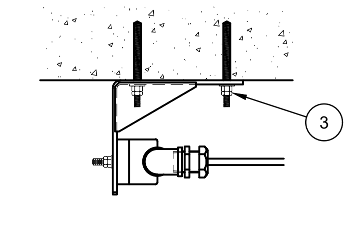
CONFIDENTIAL

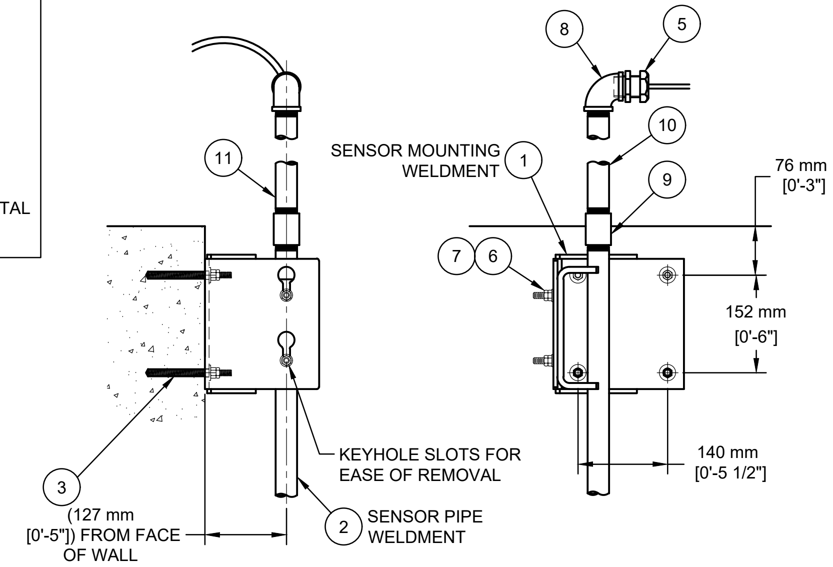
DRAWING NAME: LEVEL SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30016 SCALE: 1/24 SIZE: D

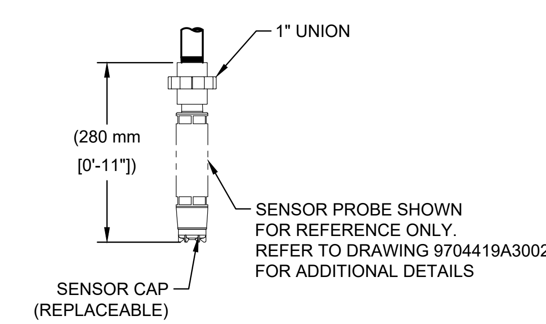


SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
3. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS OF THE SENSOR.
4. USE TY-WRAPS PROVIDED TO COIL EXCESS LENGTH OF SENSOR CABLE TOGETHER.
5. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.
7. DO NOT CRIMP OR DISTORT SENSOR CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES [50mm]. PROTECT EXPOSED CABLE FROM SOURCES OF POSSIBLE ACCIDENTAL DAMAGE.







CORD GRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #5). USE A 23/64" [9.12mm] BIT TO DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH O THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.

SENSOR COMPONENT WEIGHTS:

SENSOR PIPE WELDMENT	13 LBS [6 kg]
SENSOR ASSEMBLY (DO)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
10	1	2521313-SX0	PIPE, 1", S40, TBE, 20' LG	304 SS	-
9	1	2607353	COUPLING, 1"NPT, 150#	304 SS	-
8	1	2605207	ELBOW, 90DEG, THD, 1", 150#	304 SS	-
7	2	2614404	NUT, HEX, SERRATED FLANGE, 3/8-16	316 SS	-
6	2	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
5	1	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
4	2	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
3	4	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
2	1	2915092-6-SX0	SENSOR PIPE WELDMENT, 6 FT	304 SS	Y
1	1	2915093-SX0	SENSOR MOUNTING WELDMENT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

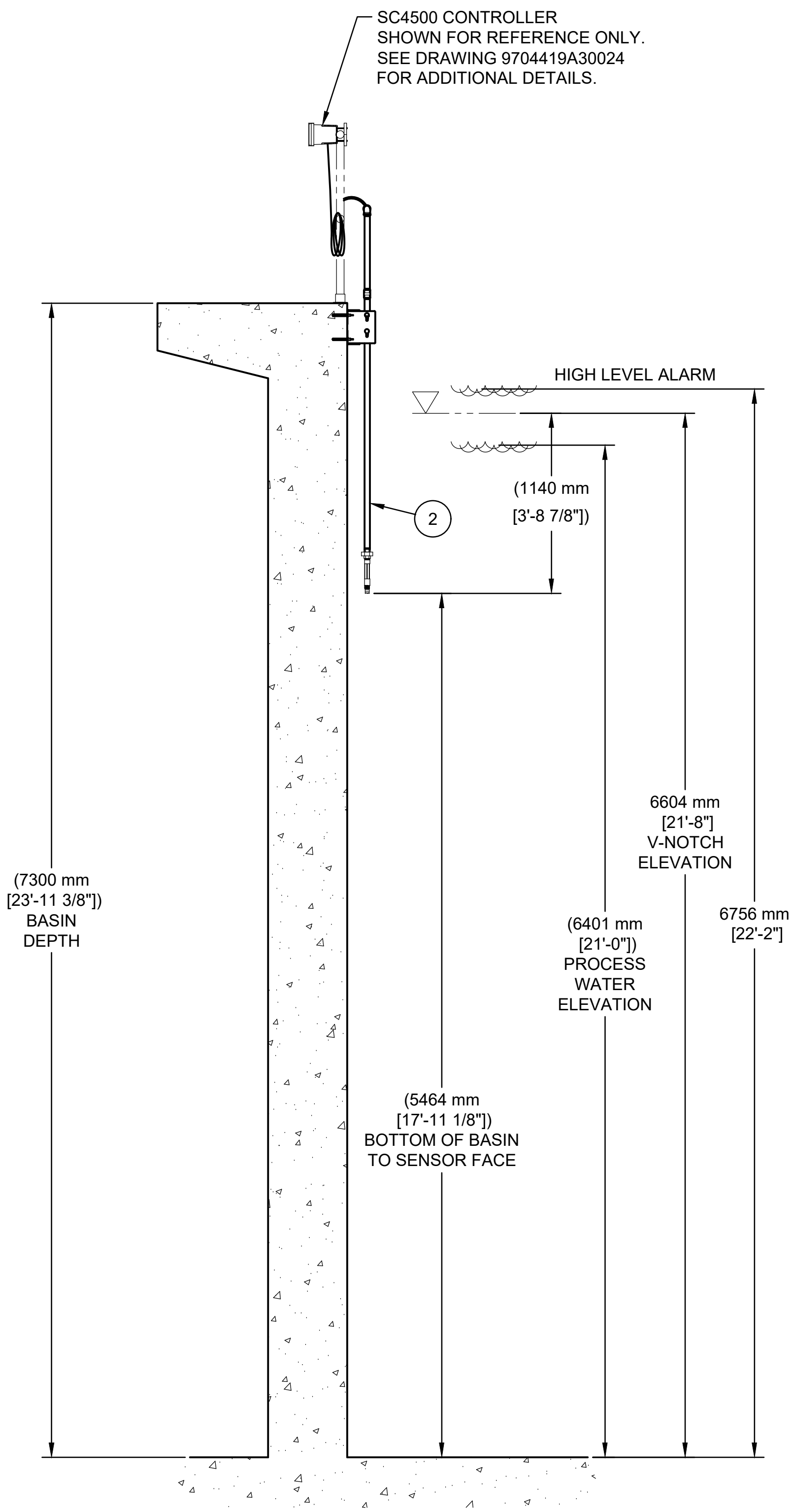
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

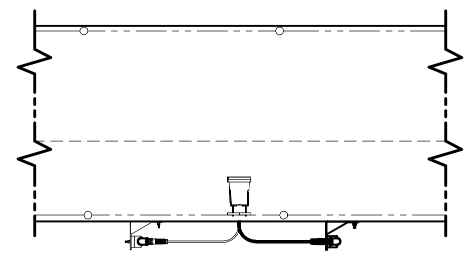
ANSI

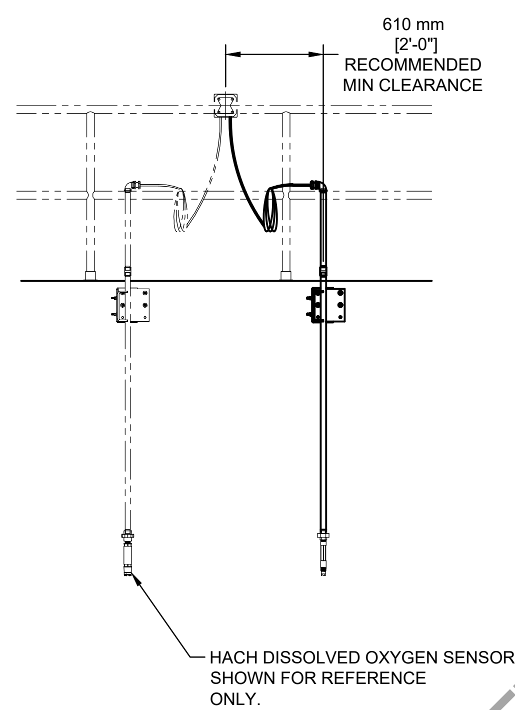
MATERIAL:
SIMILAR TO: M-SENSOR-13
TYPE:
DRAWN BY: CJC
DATE: 2024-10-01
WEIGHT:
SHEET: 1 OF 1

DRAWING NAME: DISSOLVED OXYGEN SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30018
SCALE: 1/24
SIZE: D

CONFIDENTIAL

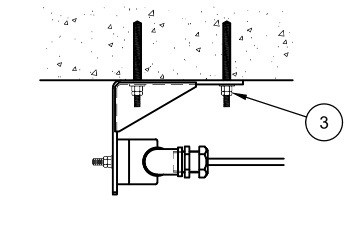


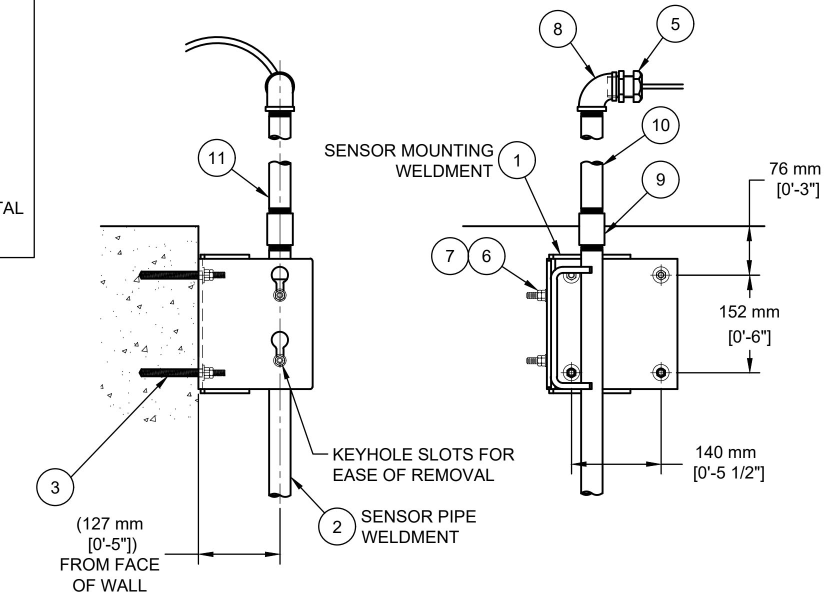


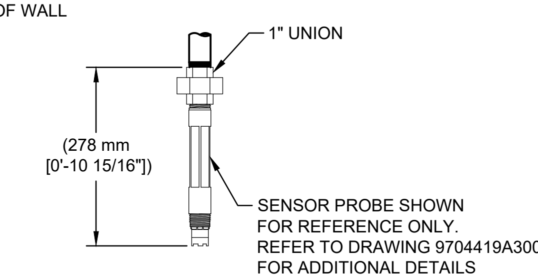


SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
3. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS OF THE SENSOR.
4. USE TY-WRAPS PROVIDED TO COIL EXCESS LENGTH OF SENSOR CABLE TOGETHER.
5. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.
7. DO NOT CRIMP OR DISTORT SENSOR CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES [50mm]. PROTECT EXPOSED CABLE FROM SOURCES OF POSSIBLE ACCIDENTAL DAMAGE.







CORD GRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #5). USE A 23/64" [9.12mm] BIT TO DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH O THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.

SENSOR COMPONENT WEIGHTS:

SENSOR PIPE WELDMENT	13 LBS [6 kg]
SENSOR ASSEMBLY (PH)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
10	1	2521313-SX0	PIPE, 1", S40, TBE, 20' LG	304 SS	-
9	1	2607353	COUPLING, 1"NPT, 150#	304 SS	-
8	1	2605207	ELBOW, 90DEG, THD, 1", 150#	304 SS	-
7	2	2614404	NUT, HEX, SERRATED FLANGE, 3/8-16	316 SS	-
6	2	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
5	1	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
4	2	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
3	4	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
2	1	2915092-6-SX0	SENSOR PIPE WELDMENT, 6 FT	304 SS	Y
1	1	2915093-SX0	SENSOR MOUNTING WELDMENT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

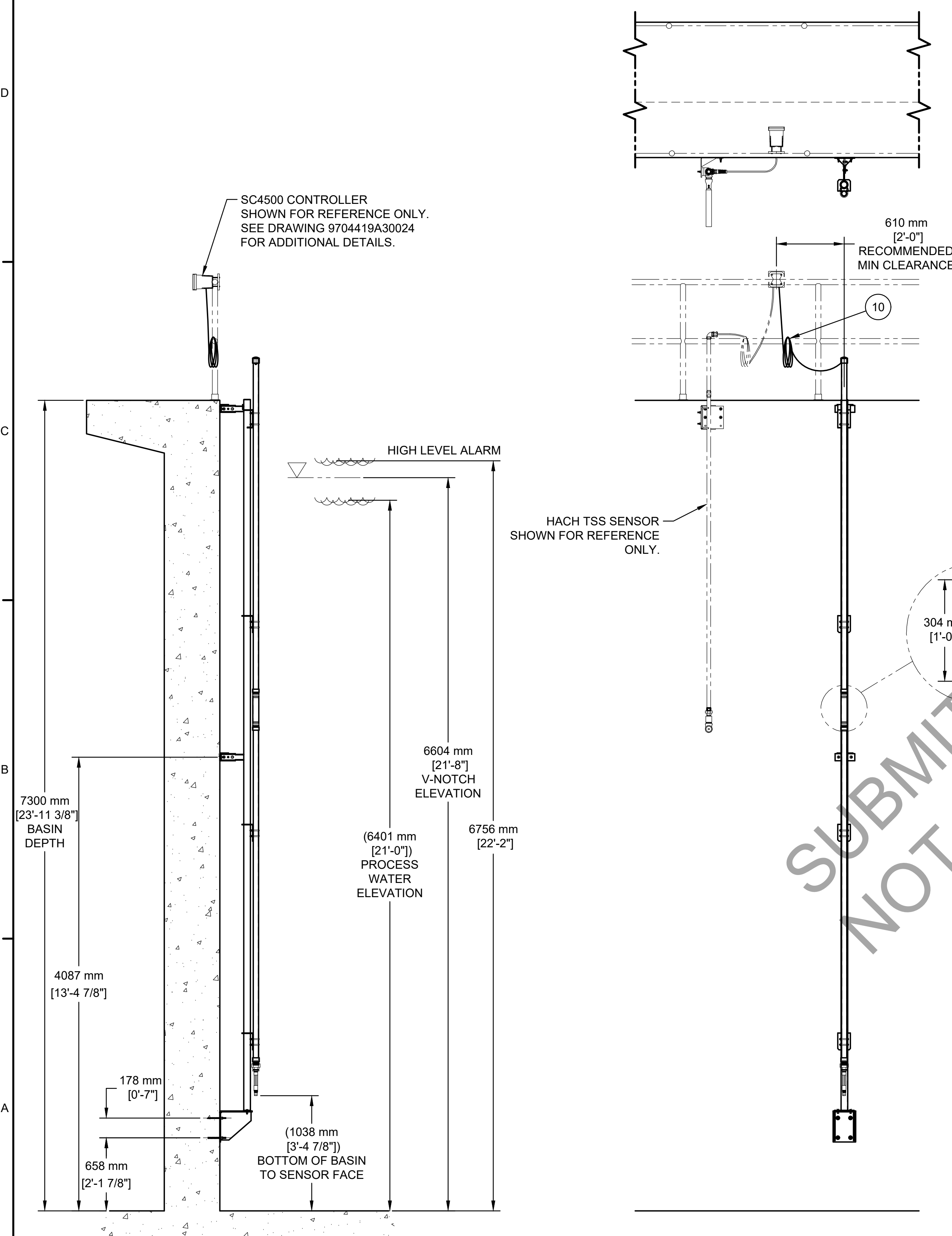
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: M-SENSOR-13
TYPE:
DRAWN BY: CJC
DATE: 2024-10-01
WEIGHT:
SHEET: 1 OF 1

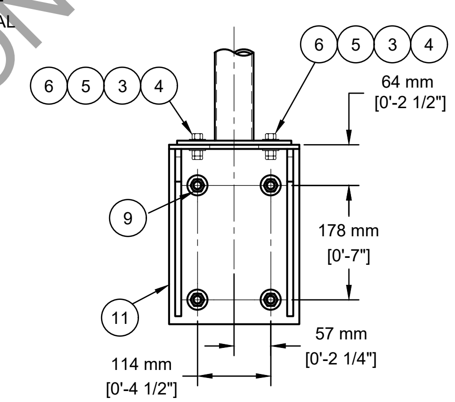
CONFIDENTIAL

DRAWING NAME: PH SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30019
SCALE: 1/24
SIZE: D

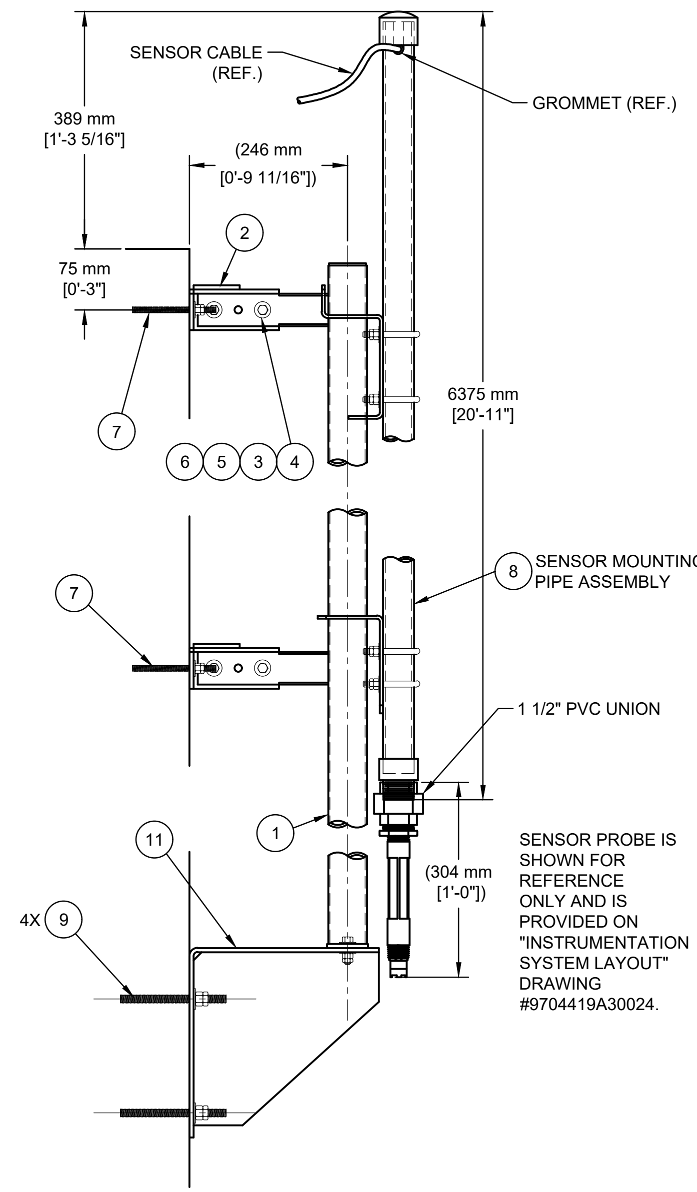


SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO RETURN SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. MOUNT GUIDE RAIL ASSEMBLY TO BASIN BEFORE INSTALLING SENSOR TO THE MOUNTING PIPE ASSEMBLY. MOUNT THE GUIDE RAIL ASSEMBLY LEVEL AND PLUMB . REFER TO THE SYSTEM PLAN VIEW DRAWING FOR LOCATION OF THE SENSORS IN THE BASIN.
3. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
4. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS. UNLESS OTHERWISE NOTED.
5. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING WITH THE TY-WRAPS PROVIDED.
6. ASSEMBLE SENSOR TO THE MOUNTING PIPE ASSEMBLY. SOME SENSOR CABLES CONTAIN A VENT TUBE TO REFERENCE ATMOSPHERIC PRESSURE. DO NOT CRIMP OR DISTORT CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.
7. WITH SENSOR ASSEMBLED TO MOUNTING PIPE, SLIDE THE ASSEMBLY OVER THE GUIDE RAIL. ATTACH SENSOR CABLE TO JUNCTION BOX OR CONTROLLER AS NECESSARY.



WALL SUPPORT WELDMENT
MOUNTING DETAIL



SENSOR MOUNTING DETAIL

SENSOR COMPONENT WEIGHTS:

SENSOR GUIDE RAIL	61 LBS [28 kg]
SENSOR PIPE (PVC)	22 LBS [10 kg]
WALL SUPPORT BASE	24 LBS [11 kg]
SENSOR ASSEMBLY (ORP)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
11	1	9704419A30209	ORP BASE WELDMENT	304 SS	Y
10	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
9	4	2967161-4	KIT, ADHESIVE ANCHOR, 1/2"	316 SS	Y
8	1	2965755-249-SX0	SENSOR MOUNTING PIPE ASSEMBLY, RETRIEVAL 249" LG	304 SS	Y
7	4	2967161-2	KIT, ADHESIVE ANCHOR, 3/8"	316 SS	Y
6	12	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
5	6	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
4	6	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
3	6	2602257	HHCS, 3/8-16 X 1.25"	316 SS	-
2	2	2915104-SX0	SHORT MOUNTING ARM WELDMENT	304 SS	Y
1	1	2915030-252-SX0	GUIDE RAIL WELDMENT, 21 FT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

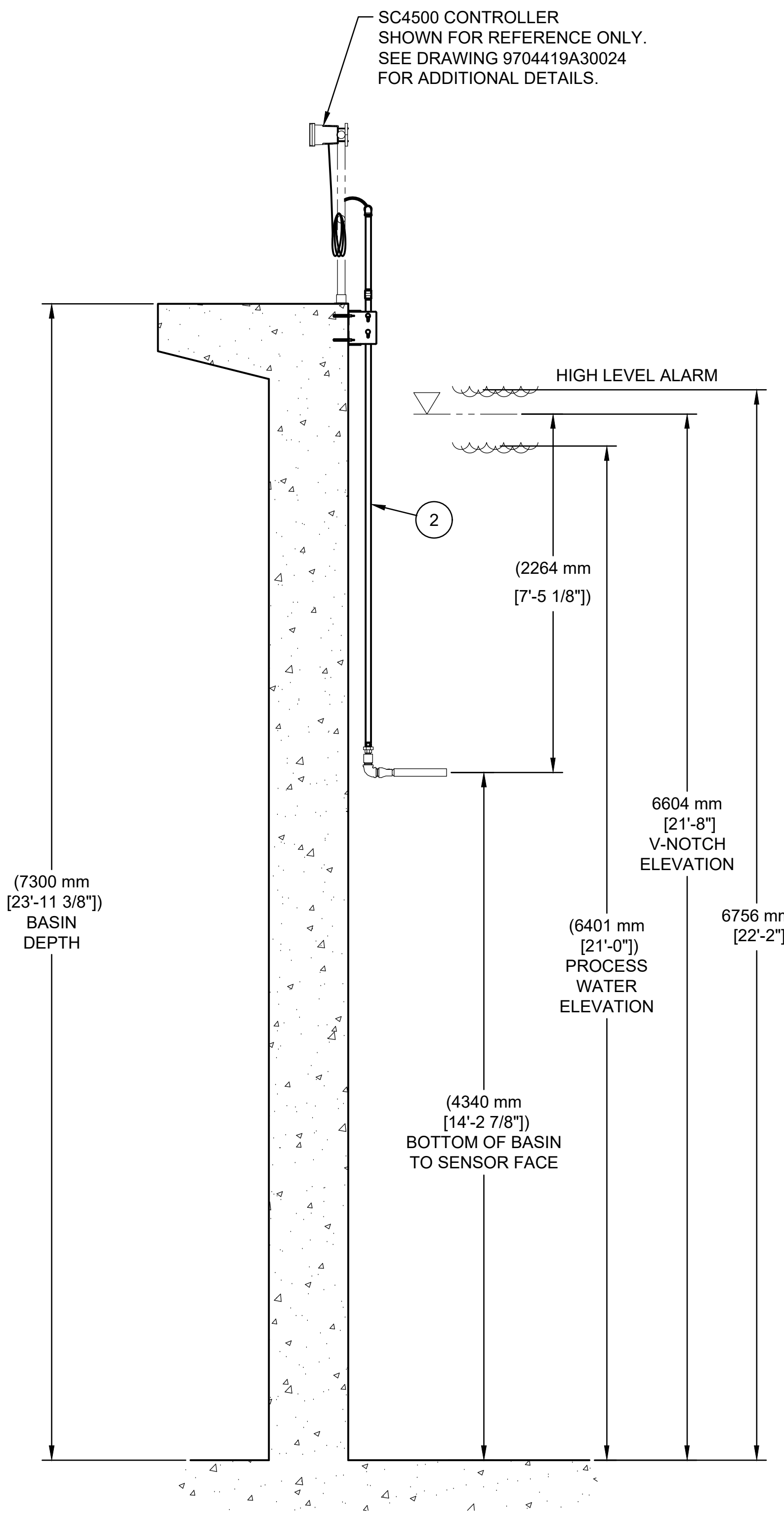
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

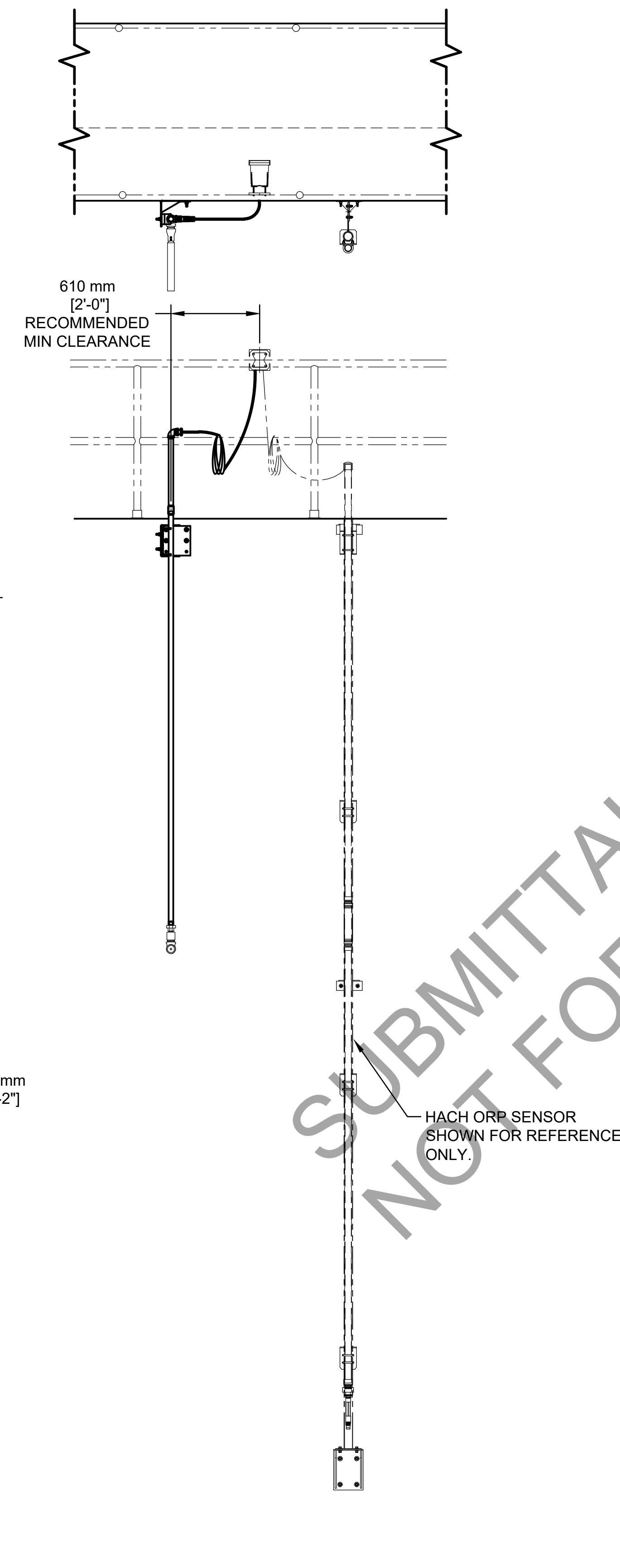
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-SENSOR-14
TYPE:
DRAWN BY: CJC DATE: 2024-10-01
WEIGHT: SHEET: 1 OF 1
DRAWING NAME: ORP SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30020 SCALE: 1/24 SIZE: D

CONFIDENTIAL

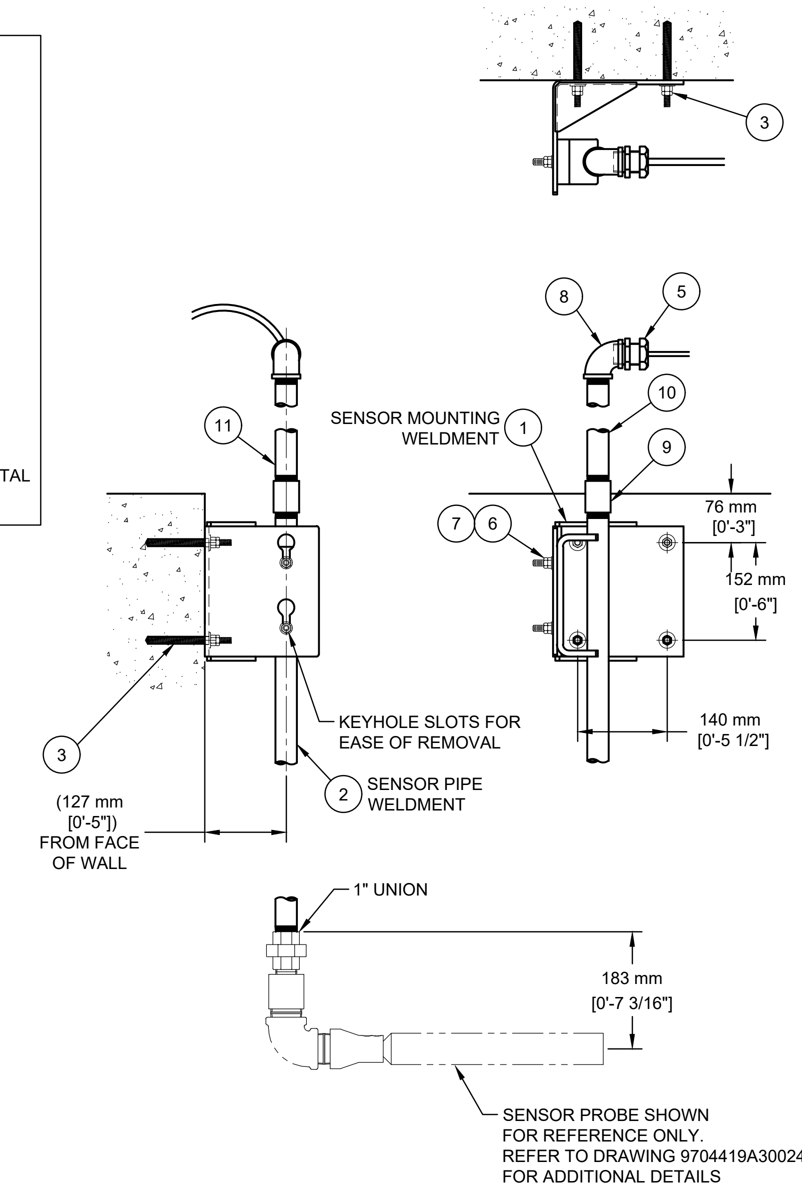




SUBMITTAL
NOT FOR CONSTRUCTION

SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
3. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS OF THE SENSOR.
4. USE TY-WRAPS PROVIDED TO COIL EXCESS LENGTH OF SENSOR CABLE TOGETHER.
5. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.
7. DO NOT CRIMP OR DISTORT SENSOR CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES [50mm]. PROTECT EXPOSED CABLE FROM SOURCES OF POSSIBLE ACCIDENTAL DAMAGE.



CORD GRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #5). USE A 23/64" [9.12mm] BIT TO DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH O THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.

SENSOR COMPONENT WEIGHTS:

SENSOR PIPE WELDMENT	19 LBS [9 kg]
SENSOR ASSEMBLY (TSS)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
10	1	2521313-SX0	PIPE, 1", S40, TBE, 20' LG	304 SS	-
9	1	2607353	COUPLING, 1"NPT, 150#	304 SS	-
8	1	2605207	ELBOW, 90DEG, THD, 1", 150#	304 SS	-
7	2	2614404	NUT, HEX, SERRATED FLANGE, 3/8-16	316 SS	-
6	2	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
5	1	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
4	2	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
3	4	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
2	1	2915092-10-SX0	SENSOR PIPE WELDMENT, 10 FT	304 SS	Y
1	1	2915093-SX0	SENSOR MOUNTING WELDMENT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

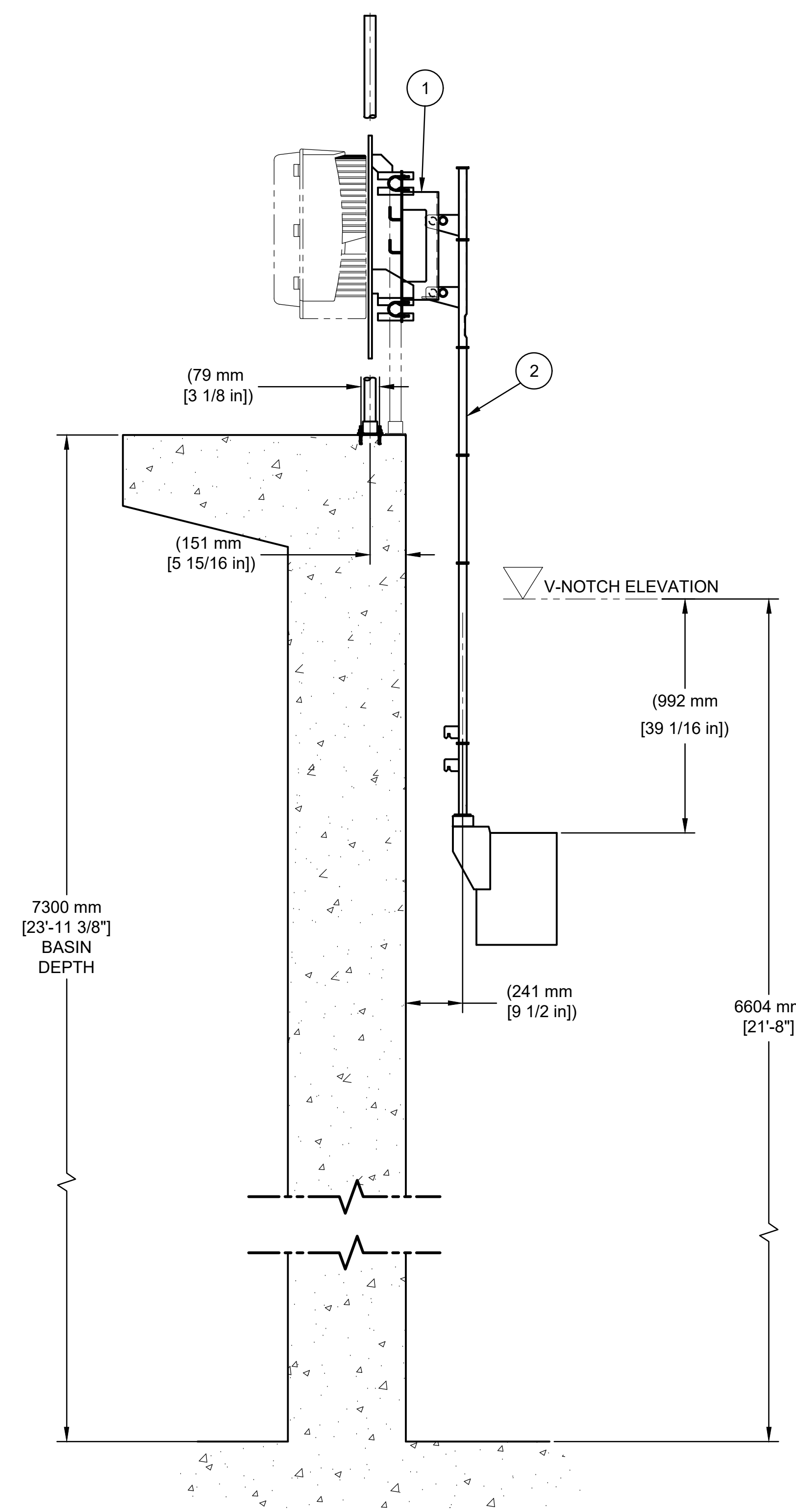
ANSI

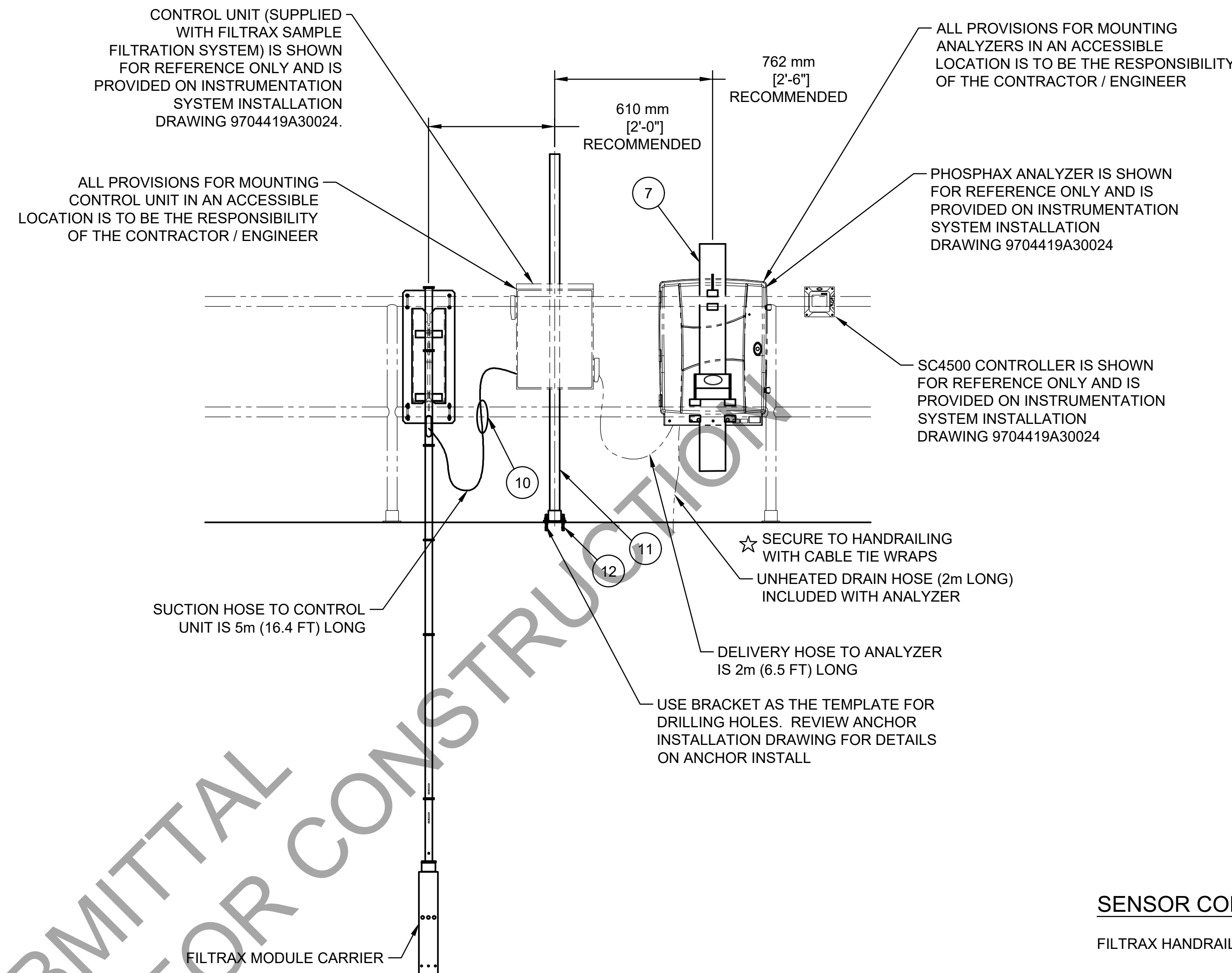
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO: M-SENSOR-13
TYPE:
DRAWN BY: CJC
DATE: 2024-10-01
WEIGHT:
SHEET: 1 OF 1

CONFIDENTIAL

DRAWING NAME: TSS SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30021
SCALE: 1/24
SIZE: D





NOTES:

1. PLEASE REVIEW ALL INSTALLATION DRAWINGS AND INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
3. HOSE ASSEMBLY MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS OF THE UNIT.
4. USE TY-WRAPS PROVIDED TO COIL EXCESS LENGTH OF SENSOR CABLE TOGETHER.
5. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.
7. DO NOT CRIMP OR DISTORT HOSE ASSEMBLY. LIMIT THE MINIMUM BEND RADIUS TO 2" [50 mm].
8. AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE SENSORS TO STORAGE PER GUIDELINES IN SECTION 1 OF OPERATION AND MAINTENANCE MANUAL MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
9. ANY ADDITIONAL PROVISIONS FOR LIFTING THE FILTER MODULE CARRIER (I.E. PORTABLE HOIST) ARE TO BE SUPPLIED BY OTHERS. WARNING: DO NOT LIFT UNIT BY THE HOSE ASSEMBLY.
10. ALL ANALYZERS MUST BE INSTALLED AT THE SAME ELEVATION TO ALLOW FOR PROPER DRAINING.

SENSOR COMPONENT WEIGHTS:

FILTRAX HANDRAIL ASSY	30 LBS [14 kg]
FILTRAX LIFTING POLE	21 LBS [9.5 kg]
MODULE CARRIER AND HOSE	20 LBS [9 kg]
CONTROL UNIT MOUNTING KIT	11 LBS [5 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
12	4	2962764	KIT, WEDGE ANCHOR, 3/8", RED HEAD SWW	316 SS	Y
11	1	2621239	MOUNTING KIT, HACH FILTRAX CONTROL UNIT	-	-
10	10	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
9	6	2614231	WASHER, LOCK, M5 X 9.2MM X 1.1MM	316 SS	-
8	6	2617390	SHCS, M5 X 0.80 X 20mm	316 SS	-
7	1	2620367	ANALYZER MOUNTING KIT, HANDRAIL, HACH LZY316	-	-
6	8	2600224	WASHER, FLAT, 1/4" X 5/8" X .044"	316 SS	-
5	8	2603011	NUT, HEX, JAM, 1/4-20	316 SS	-
4	8	2600476	NUT, HEX, FULL, 1/4-20	316 SS	-
3	4	2616177	U-BOLT, 1-1/2" PIPE, THD 1/4-20	304 SS	-
2	1	2917026-09-SX0	FILTRAX LIFTING PIPE WELDMENT, 9 FT	304 SS	Y
1	1	2917025-SX0	FILTRAX HANDRAIL SUPPORT WELDMENT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

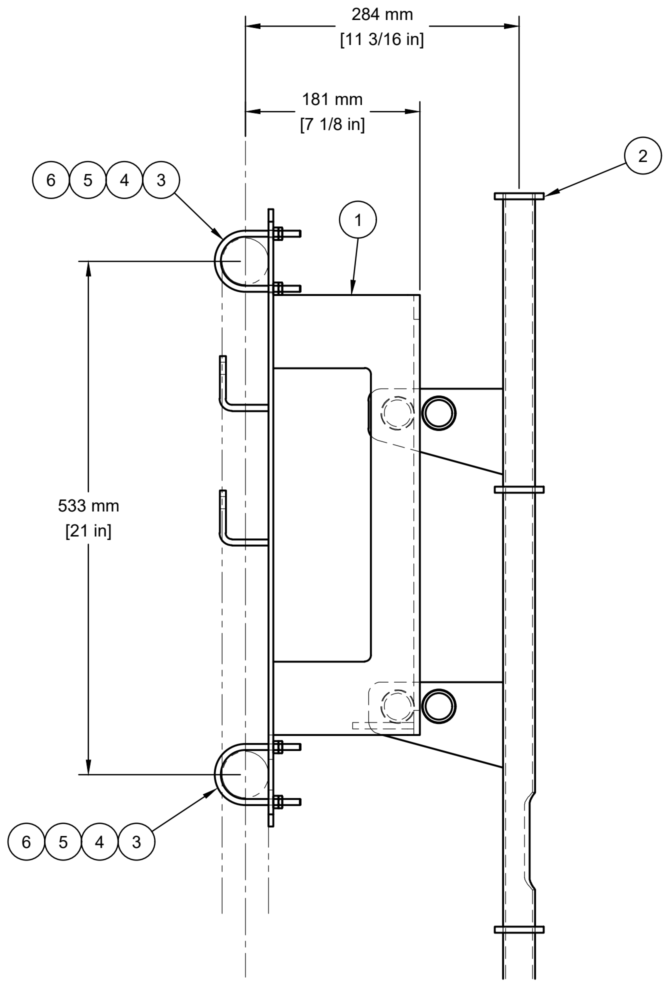
DO NOT SCALE DRAWING

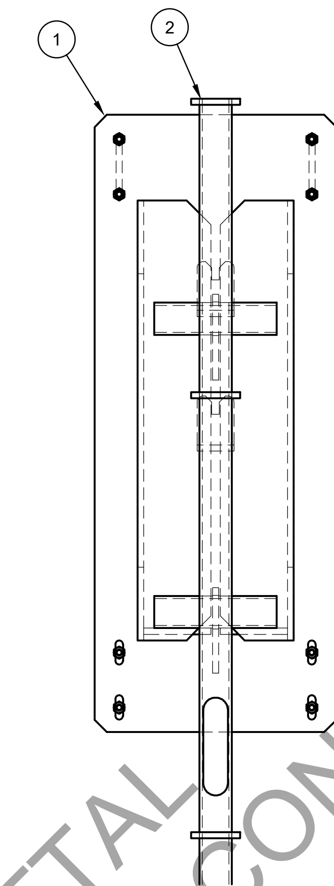
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

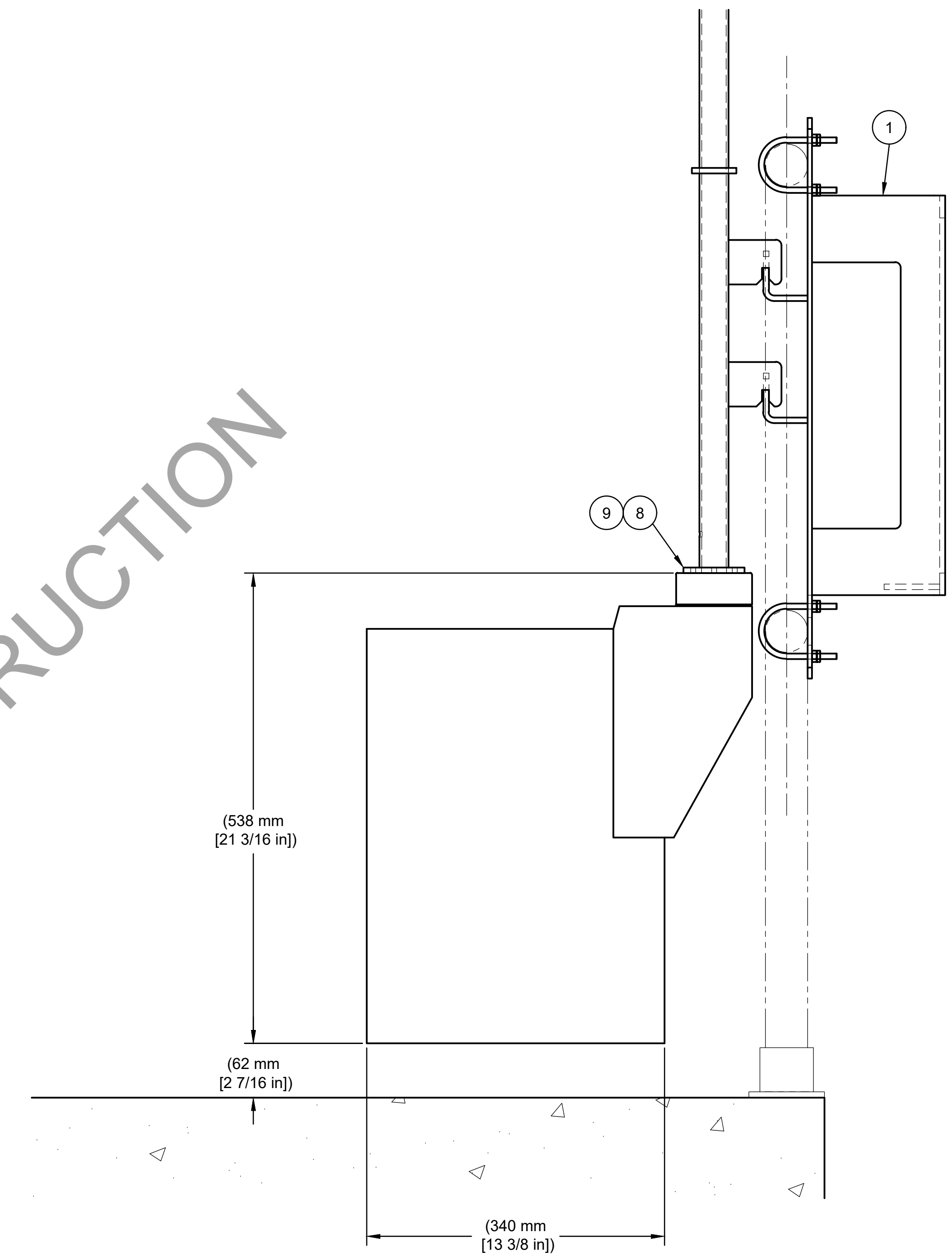
MATERIAL:
SIMILAR TO:
TYPE: AGS
DRAWN BY: CJC DATE: 2024-10-02
WEIGHT: SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: FILTRAX SAMPLING SYSTEM INSTL, AGS
DRAWING NUMBER: 9704419A30022 SCALE: 1/16 SIZE: D







MAINTENANCE POSITION

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

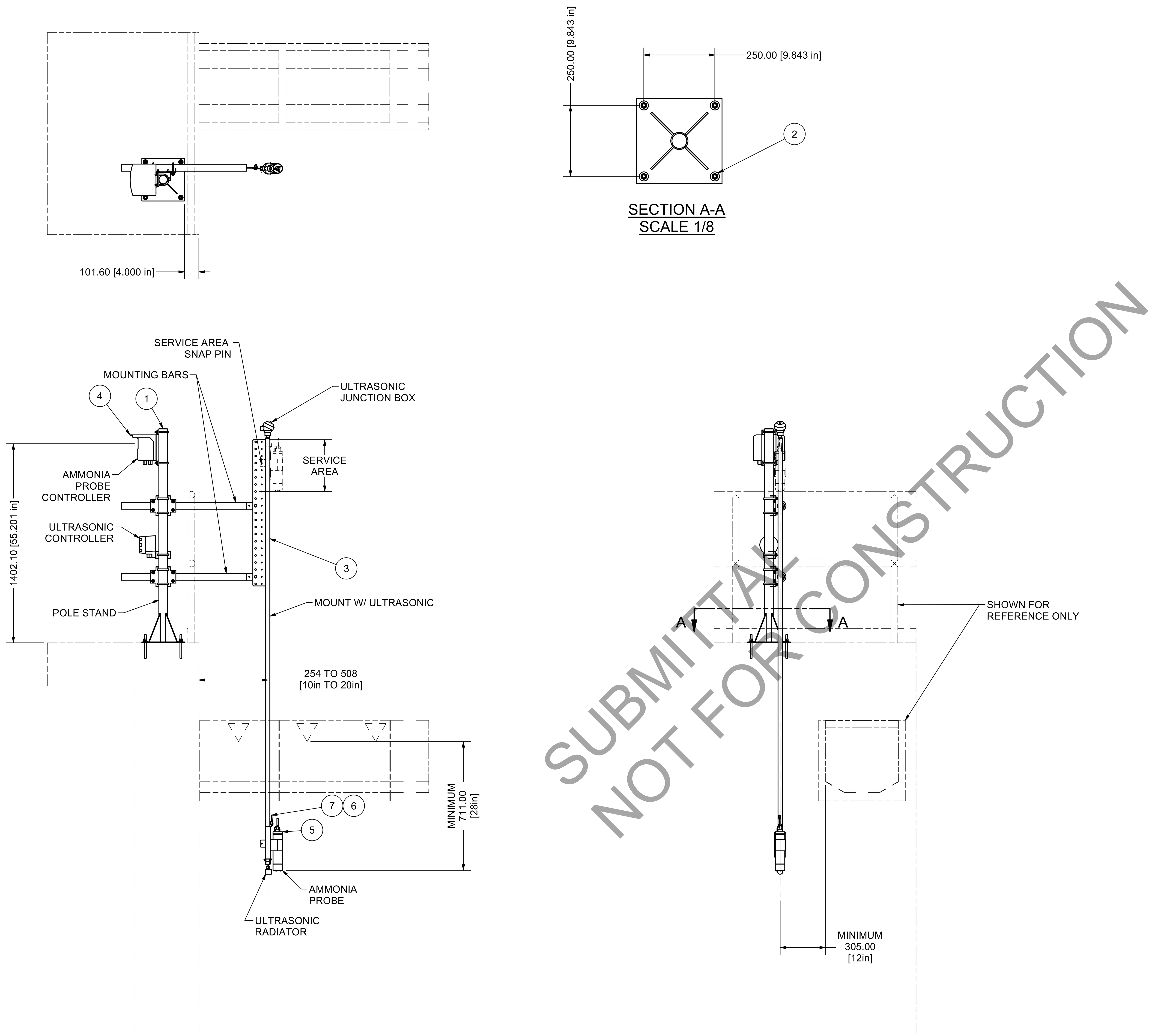
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: AGS
DRAWN BY: CJC
DATE: 2024-10-02
WEIGHT:
SHEET: 2 OF 2

DRAWING NAME: FILTRAX SAMPLING SYSTEM INSTL, AGS
DRAWING NUMBER: 9704419A30022
SCALE: 1/4
SIZE: D



NOTES:

1. PLEASE REVIEW ALL INSTALLATION DRAWINGS AND INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.

2. DO NOT CUT CABLES, COIL THEM FOR FUTURE ADJUSTMENTS AND MAINTENANCE. USE PROVIDE TY-WRAPS TO SECURE THEM.

3. AFTER COMPLETION OF INSTALLATION AND WIRING, PROBES ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO REMOVE PROBES TO STORAGE PER GUIDELINES IN SECTION 1 OF OPERATION AND MAINTENANCE MANUAL MAY RESULT IN PROBE DAMAGE AND VOID WARRANTY.

4. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

5. TORQUE FASTENERS PER ES-1057, UNLESS OTHERWISE SPECIFIED.

6. USE POLE STAND AS TEMPLATE FOR LOCATING ANCHORS. REFERENCE ANCHOR DRAWING FOR ADHESIVE ANCHOR INSTALLATION INSTRUCTIONS.

7. COMPONENT WEIGHTS:
- POLE STAND: 35 LB [16 kg]
- (2) BARS: 10 LB/EA [4.5 kg]
- MOUNT W/ ULTRASONIC: 30 LB [14 kg]
- CONTROLLER AND BRACKET: 12 LB [5 kg]
- SENSOR AND SLIDER ASSEMBLY: 10 LB [4.5 kg]

8. REFERENCE DOCUMENTATION IN SECTION 6 OF AASI O&M:
EP-50601-001 - CONTROLLER AND PROBE
EP-50601-002 - ULTRASONIC CLEANER

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
8	10	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
7	1	2611498-3	CHAIN, 1/8", 304 SS X 25'	304 SS	-
6	2	2621108	CONNECTING LINK, OVAL, 1/8" CHAIN	316 SS	-
5	1	2621103-1	AMMONIA PROBE, HORIBA AM-2000, 10M	-	-
4	1	2621102-1	CONTROLLER, HORIBA HC-200NH	-	-
3	1	2968940-30-SX0	MOUNT, HORIBA, W/ ULTRASONIC, 3M	304 SS	-
2	4	2967161-3	KIT, ADHESIVE ANCHOR, 1/2"	304 SS	Y
1	1	2621107-SX0	POLE STAND, HORIBA	304 SS	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

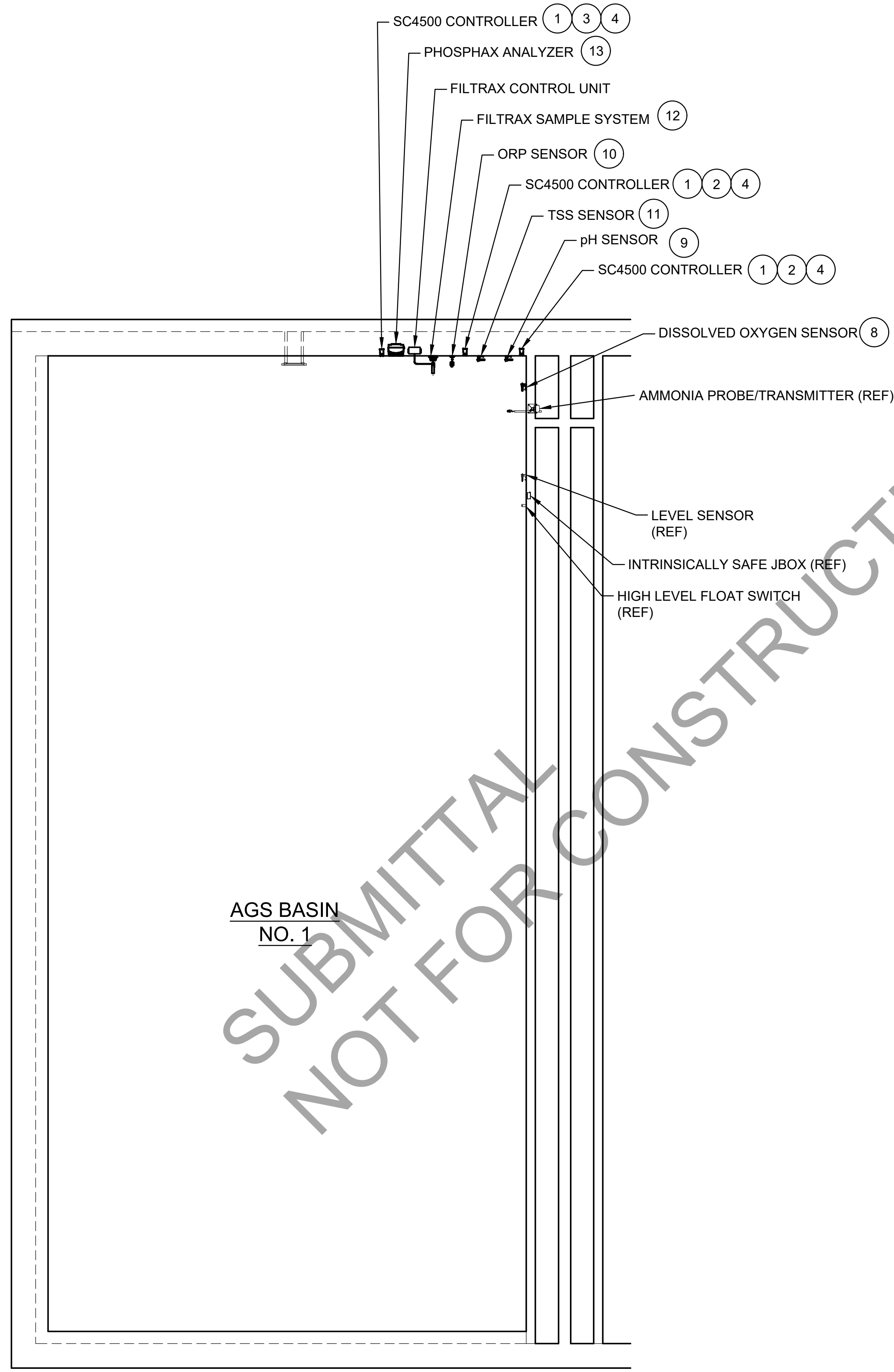
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-NEREDA-5
TYPE: NEREDA
DRAWN BY: CJC DATE: 2024-10-01
WEIGHT: NOTES SHEET: 1 OF 1

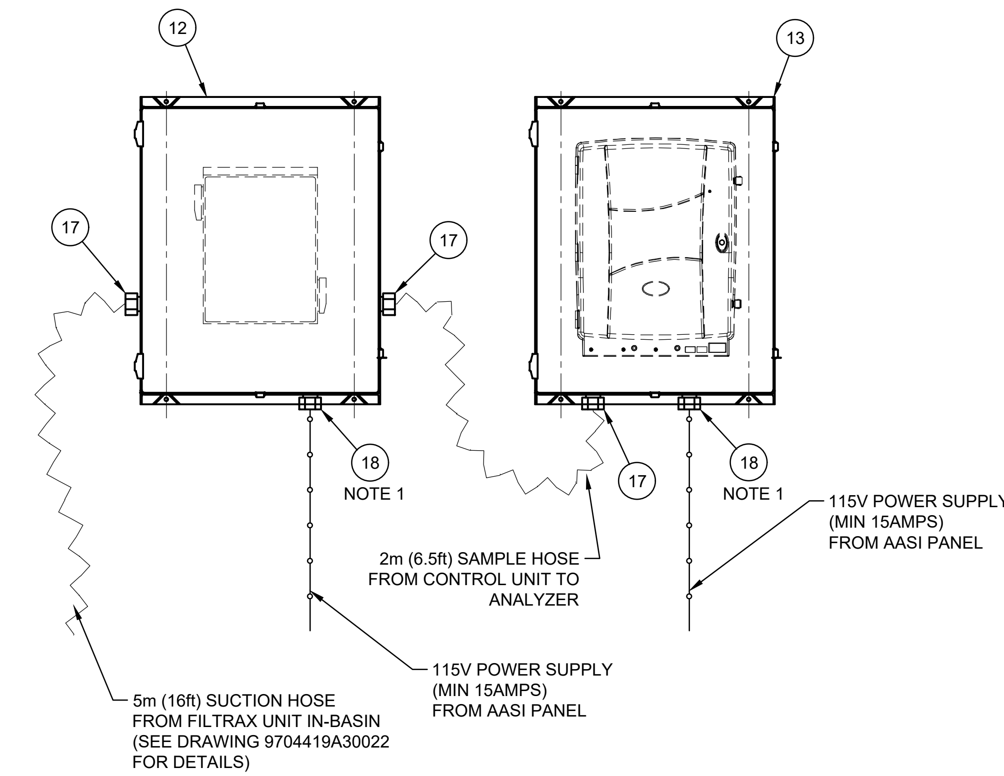
DRAWING NAME: AMMONIA SENSOR INSTL, AGS
DRAWING NUMBER: 9704419A30023
SCALE: 1/16
SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.

CORDGRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #19). DETERMINE THE DIAMETER OF THE POWER CABLE BEING USED AND DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET.
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH TO THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.



PROJECT INCLUDES INSTRUMENT SERVICE AGREEMENT PER 9704416A30403

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
18	2	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
17	3	2616659	CORDGRIP, .87 - 1.26, 1- 1/2"NPT, STRAIGHT	PA	-
16	2	2615291	CONNECTOR, SAFETY LOCK HACH	-	-
15	20	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
14	1	2620913	POWER BOX W/ POWER CONNECTION CABLE	-	-
13	1	9704419A30703	PHOSPHAX HOUSING CONTROL PANEL ASSEMBLY		Y
12	1	9704419A30702	FILTRAX HOUSING CONTROL PANEL ASSEMBLY		Y
11	1	2968942-SX0	TSS SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
10	1	2967135-SX0	ORP SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
9	1	2967134-SX0	PH SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
8	1	2966772	DISSOLVED OXYGEN SENSOR ASSY, FIXED MTG, C1D2	PVC	Y
7	2	2617800	DIGITAL GATEWAY, HACH # 6120500	-	-
6	2	2615744	EXTENSION CABLE, 1m	-	-
5	2	2621128	CABLE, ETHERNET, C1D2, M12 X M12, 5m	-	-
4	3	2620816	SUN SHADE, HACH SC4200C, UNIVERSAL	PLASTIC	-
3	1	2621688	UPGRADE KIT, HACH SC4500, MODBUS TCP/IP	-	-
2	2	2620815	UPGRADE KIT, HACH SC4500, LAN ETHERNET	-	-
1	3	2620812-A1C	CONTROLLER, HACH SC4500, ANALOG, 100-240VAC, C1D2	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

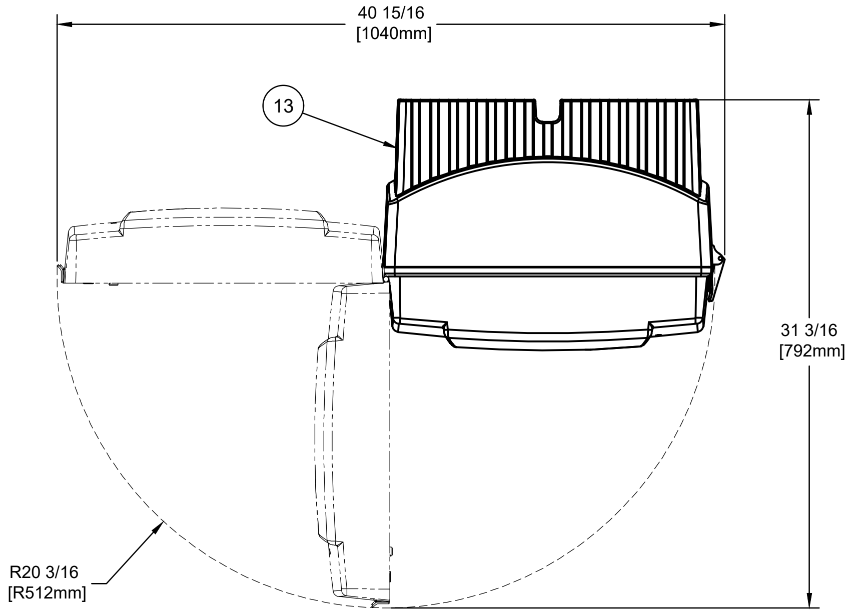
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-07
WEIGHT: SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 1
DRAWING NUMBER: 9704419A30024-1 SCALE: 1/100 SIZE: D



ANALYZER NOTES:

1. AMTAX AND PHOSPHAX ANALYZERS MUST BE MOUNTED WITHIN 6.5 FT (2m) DISTANCE OF THE SC4500 CONTROLLER BY THE INSTALLING CONTRACTOR.

2. THE DISTANCE LIMITATION OF THE HACH INTERNAL NETWORK IS 4000 FT [1219m]. THIS INCLUDES THE COMBINED DISTANCE ON SENSOR CABLES TO THE CONTROLLERS, THE CONTROLLER CONNECTIONS, AND THE DISPLAY MODULE TO THE CONTROLLER.

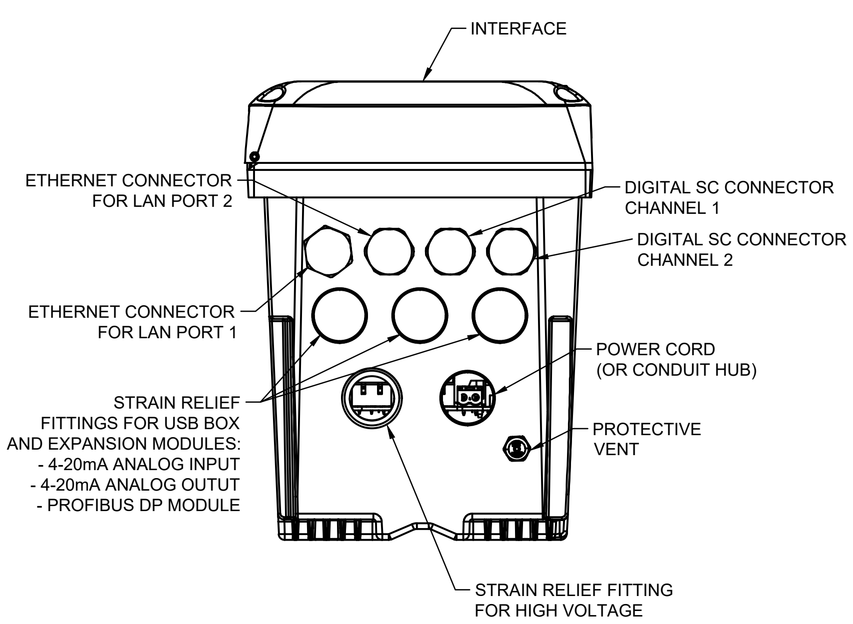
CONTROLLER CONNECTIONS:

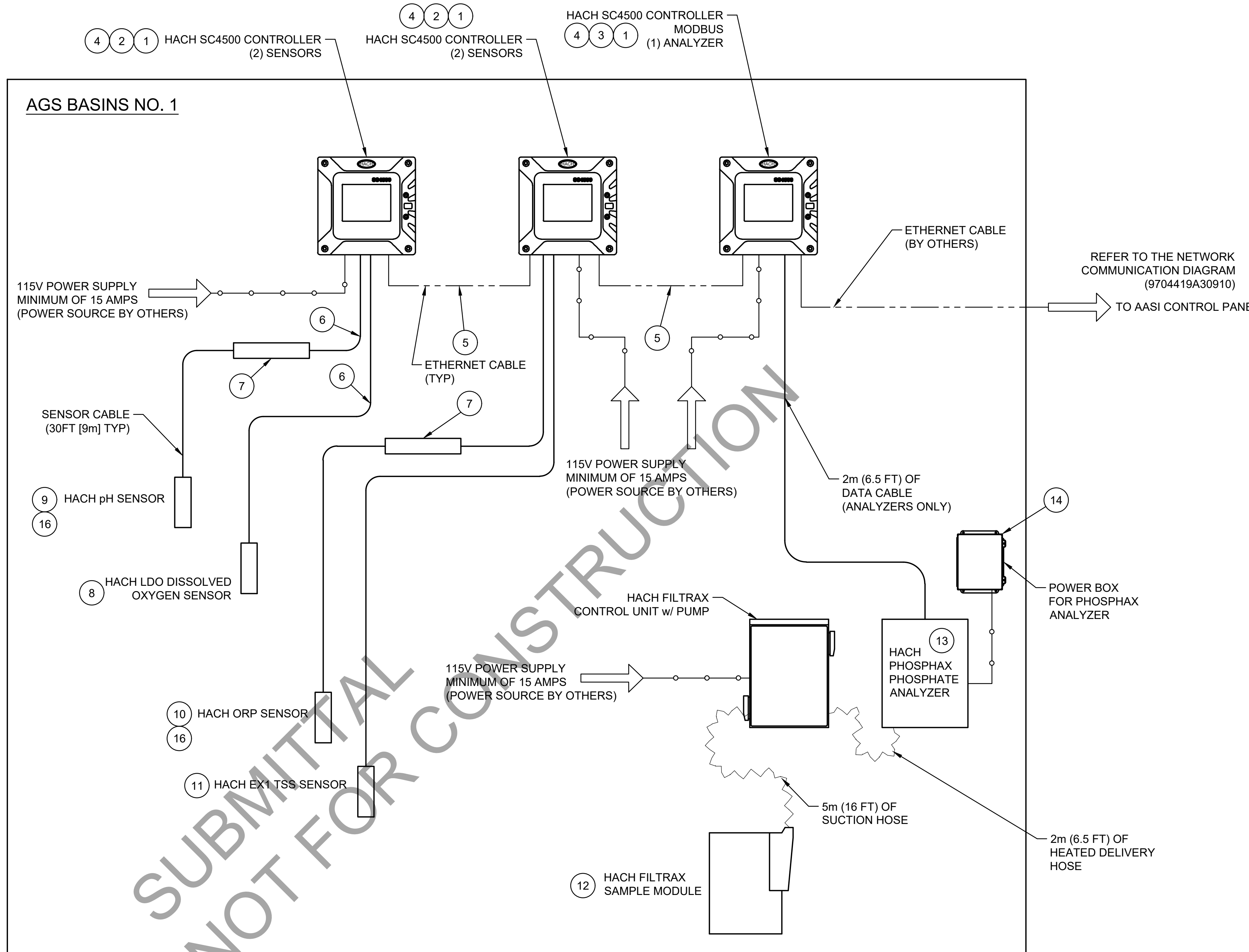
1. ONE STRAIN RELIEF USED WITH MODBUS PROBE MODULE.

2. LOCATION FOR INTERNAL NETWORK CONNECTOR TO BE FIELD INSTALLED BY OTHERS.

CONTROLLER INSTALLATION NOTE:

THE SENSOR CABLES ATTACH DIRECTLY TO THE CONTROLLER. THESE CABLES SHOULD NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO CONTROLLER OR HANDRAILING. A 115 VOLT, SINGLE PHASE POWER SOURCE IS REQUIRED AT THE CONTROLLER.





LEGEND	
— · · — · · —	HACH INTERNAL RS485 NETWORK
— — — — —	MODBUS SERIES RS485
— - — - —	ETHERNET
—o—o—o—	POWER SUPPLY WIRES
∧∧∧∧∧∧	FILTER SAMPLE LINE

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

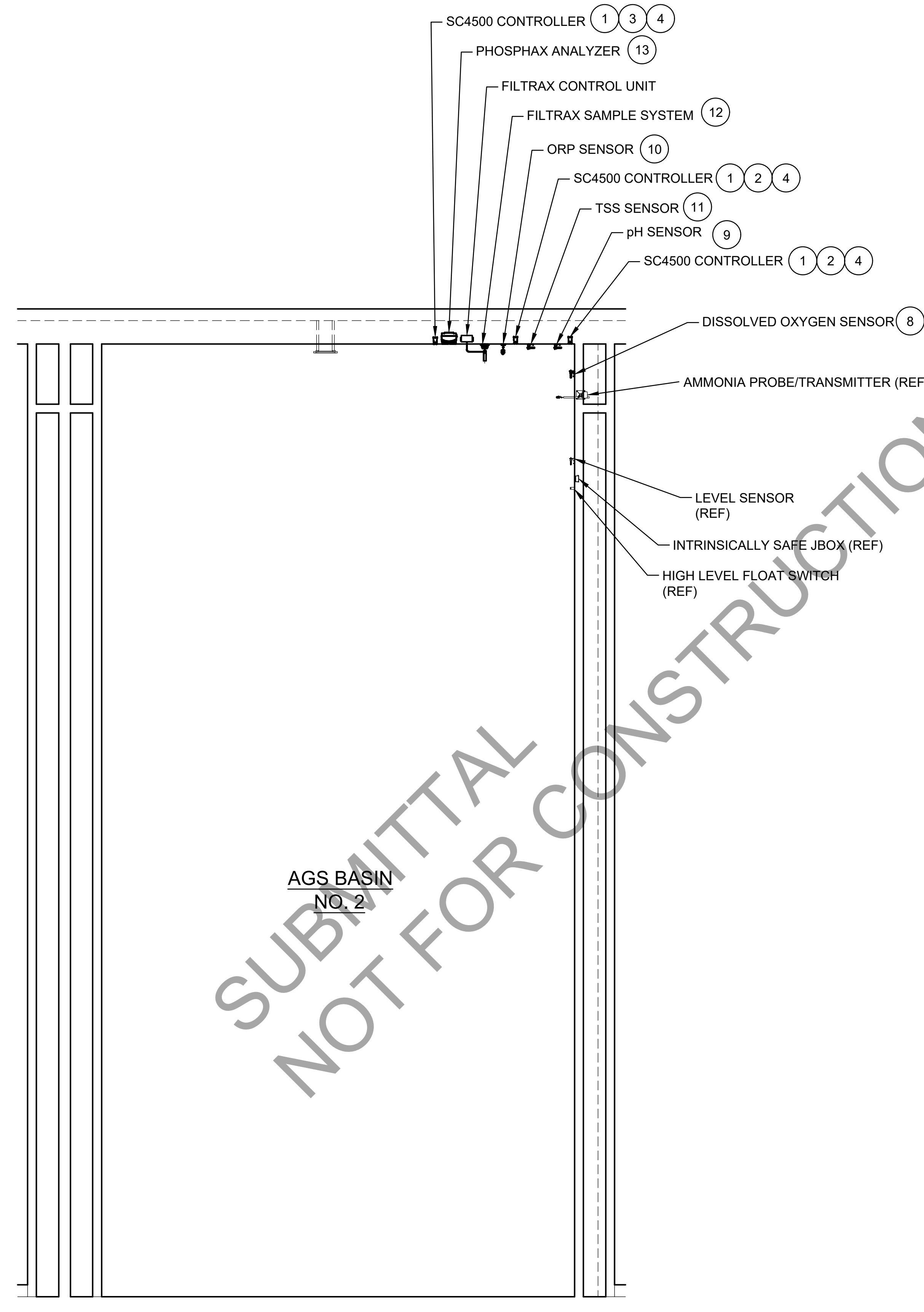
DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 1

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

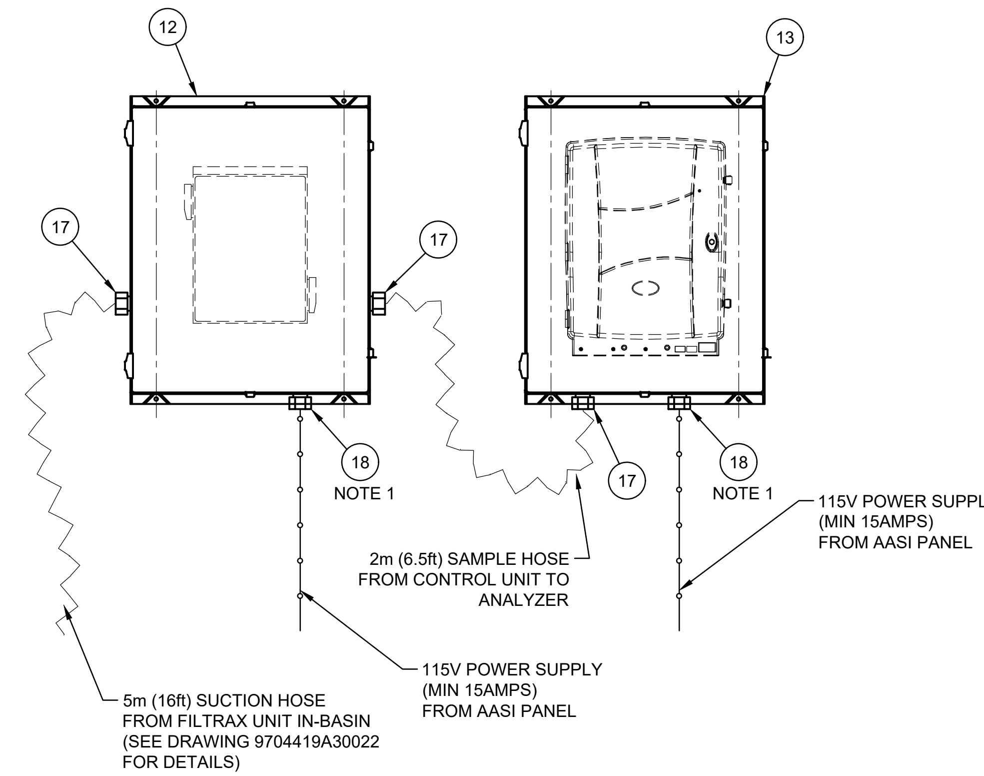
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-07
WEIGHT: SHEET: 2 OF 2
DRAWING NUMBER: 9704419A30024-1 SCALE: NTS SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.

CORDGRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #19). DETERMINE THE DIAMETER OF THE POWER CABLE BEING USED AND DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET.
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH TO THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.



PROJECT INCLUDES INSTRUMENT SERVICE AGREEMENT PER 9704416A30403

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
18	2	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
17	3	2616659	CORDGRIP, .87 - 1.26, 1- 1/2"NPT, STRAIGHT	PA	-
16	2	2615291	CONNECTOR, SAFETY LOCK HACH	-	-
15	20	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
14	1	2620913	POWER BOX W/ POWER CONNECTION CABLE	-	-
13	1	9704419A30703	PHOSPHAX HOUSING CONTROL PANEL ASSEMBLY		Y
12	1	9704419A30702	FILTRAX HOUSING CONTROL PANEL ASSEMBLY		Y
11	1	2968942-SX0	TSS SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
10	1	2967135-SX0	ORP SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
9	1	2967134-SX0	PH SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
8	1	2966772	DISSOLVED OXYGEN SENSOR ASSY, FIXED MTG, C1D2	PVC	Y
7	2	2617800	DIGITAL GATEWAY, HACH # 6120500	-	-
6	2	2615744	EXTENSION CABLE, 1m	-	-
5	2	2621128	CABLE, ETHERNET, C1D2, M12 X M12, 5m	-	-
4	3	2620816	SUN SHADE, HACH SC4200C, UNIVERSAL	PLASTIC	-
3	1	2621688	UPGRADE KIT, HACH SC4500, MODBUS TCP/IP	-	-
2	2	2620815	UPGRADE KIT, HACH SC4500, LAN ETHERNET	-	-
1	3	2620812-A1C	CONTROLLER, HACH SC4500, ANALOG, 100-240VAC, C1D2	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

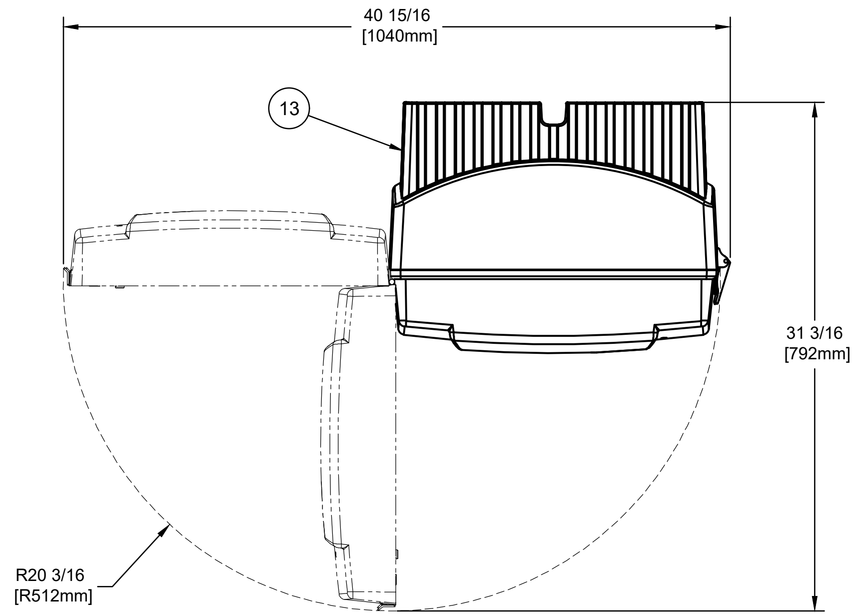
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-07
WEIGHT: SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 2
DRAWING NUMBER: 9704419A30024-2
SCALE: 1/100
SIZE: D



ANALYZER NOTES:

1. AMTAX AND PHOSPHAX ANALYZERS MUST BE MOUNTED WITHIN 6.5 FT (2m) DISTANCE OF THE SC4500 CONTROLLER BY THE INSTALLING CONTRACTOR.

2. THE DISTANCE LIMITATION OF THE HACH INTERNAL NETWORK IS 4000 FT [1219m]. THIS INCLUDES THE COMBINED DISTANCE ON SENSOR CABLES TO THE CONTROLLERS, THE CONTROLLER CONNECTIONS, AND THE DISPLAY MODULE TO THE CONTROLLER.

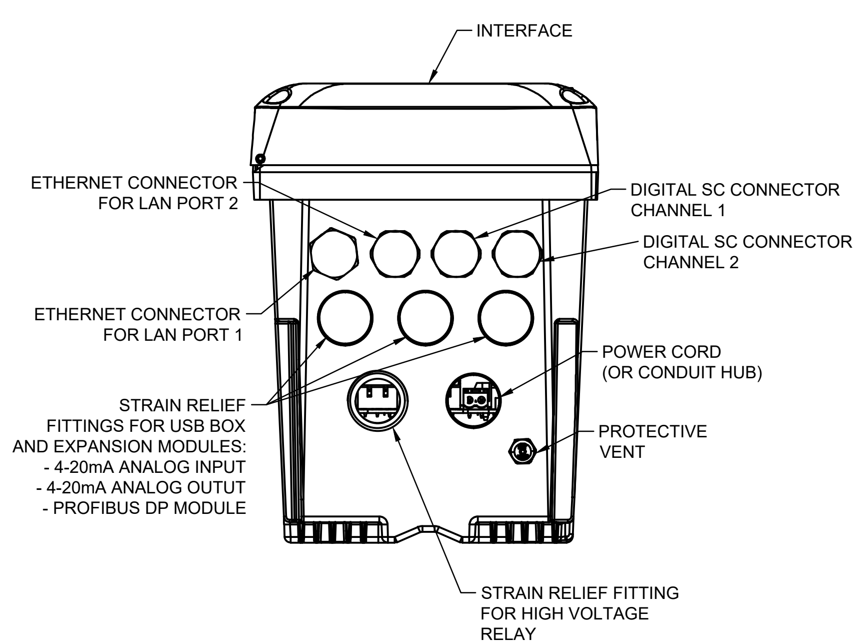
CONTROLLER CONNECTIONS:

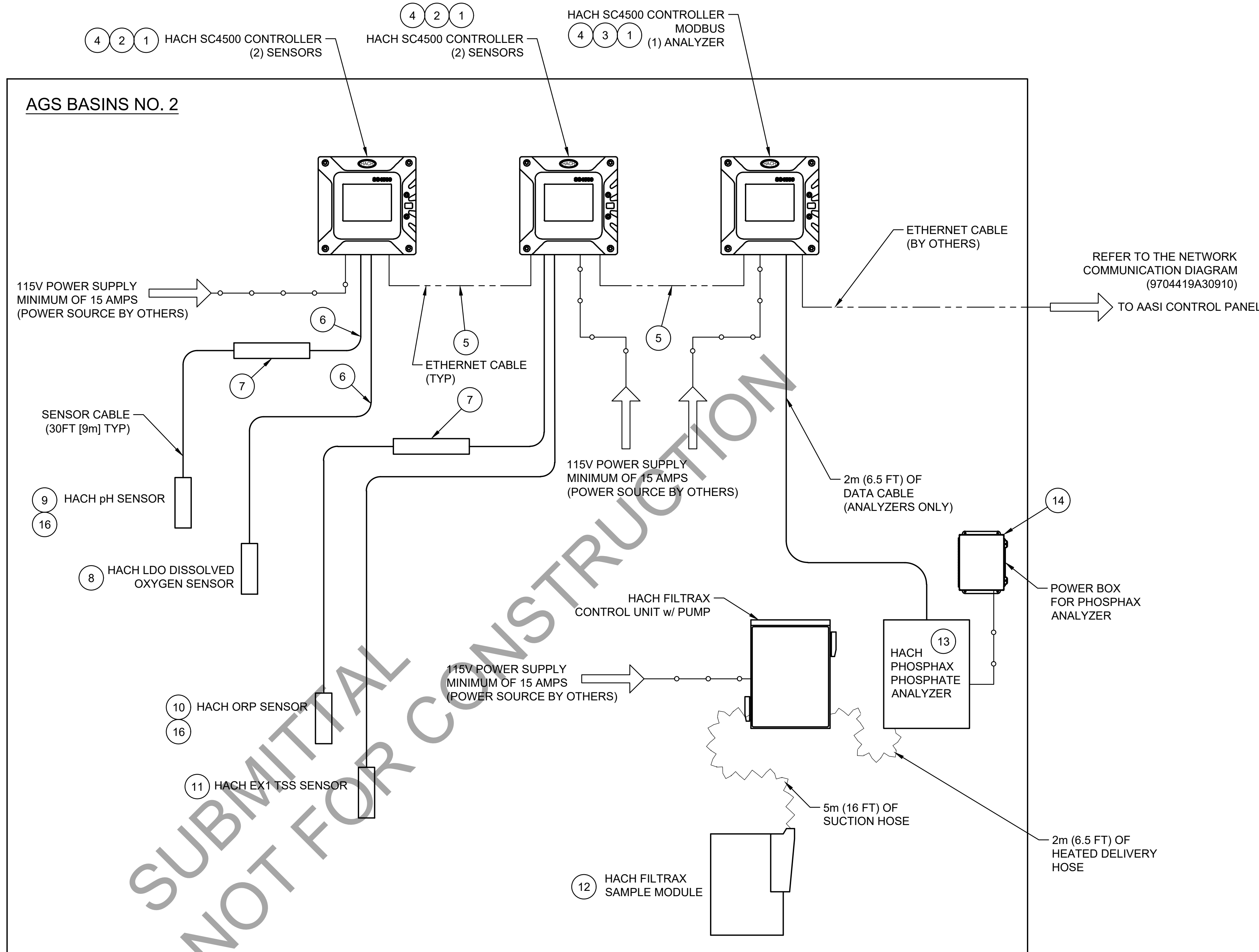
1. ONE STRAIN RELIEF USED WITH MODBUS PROBE MODULE.

2. LOCATION FOR INTERNAL NETWORK CONNECTOR TO BE FIELD INSTALLED BY OTHERS.

CONTROLLER INSTALLATION NOTE:

THE SENSOR CABLES ATTACH DIRECTLY TO THE CONTROLLER. THESE CABLES SHOULD NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO CONTROLLER OR HANDRAILING. A 115 VOLT, SINGLE PHASE POWER SOURCE IS REQUIRED AT THE CONTROLLER.





HACH INTERNAL RS485 NETWORK

MODBUS SERIES RS485

ETHERNET

POWER SUPPLY WIRES

FILTER SAMPLE LINE

LEGEND

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

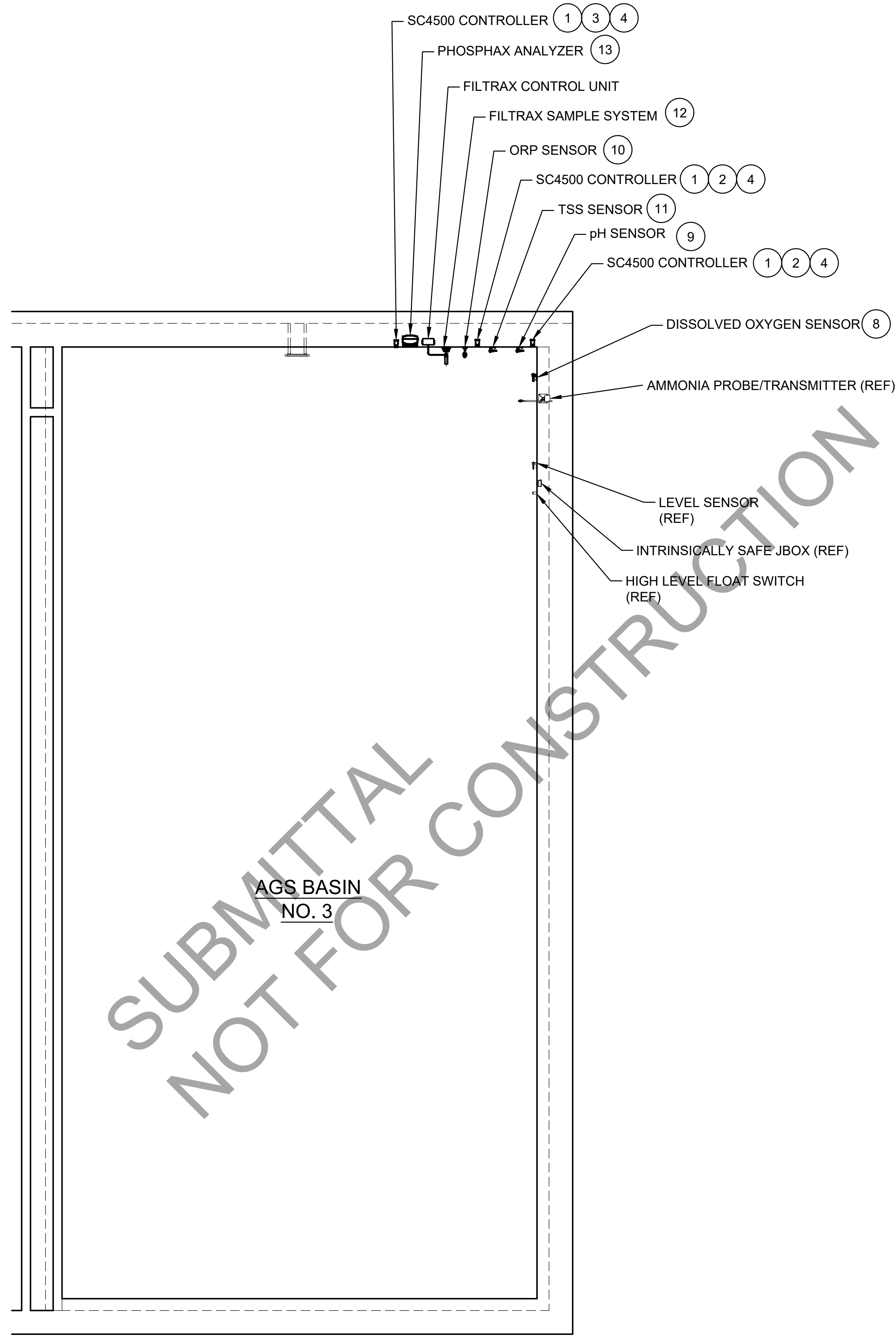
DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 2

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

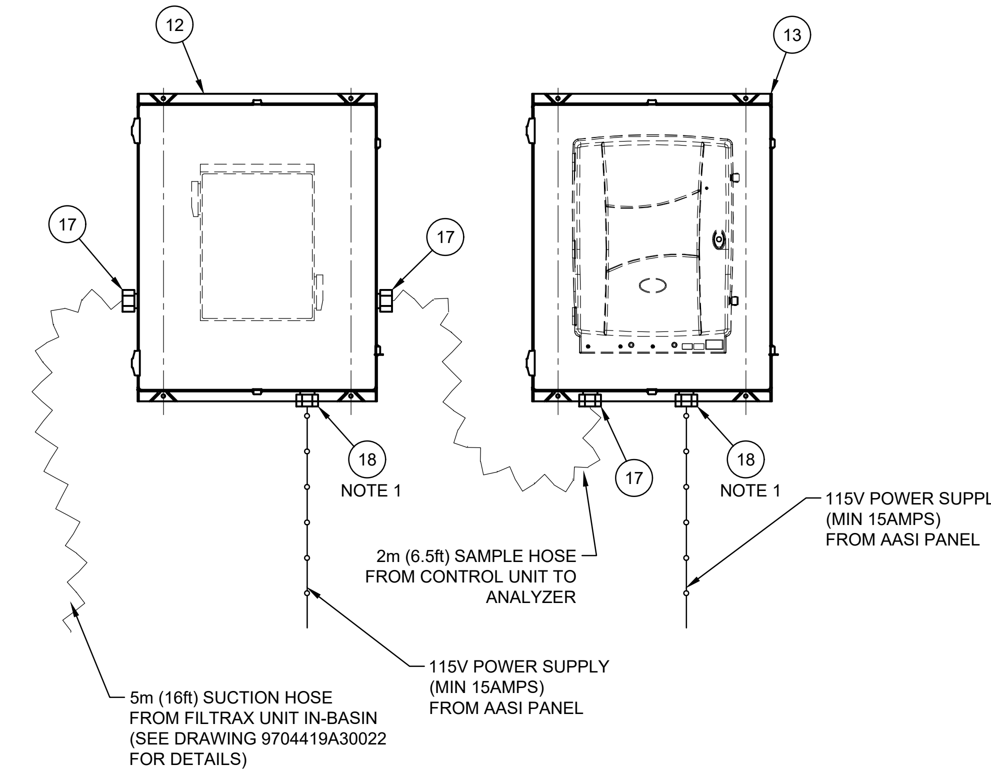
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-07
WEIGHT: SHEET: 2 OF 2
DRAWING NUMBER: 9704419A30024-2 SCALE: NTS SIZE: D



NOTE: ENGINEER/CONTRACTOR WILL BE RESPONSIBLE FOR THE FINAL LOCATIONS OF ALL INSTRUMENTATION. ENSURE THAT ALL CABLES/HOSE ARE WITHIN RANGE OF THE PROVIDED EQUIPMENT.

CORDGRIP PREPARATION NOTES:

1. LOCATE 1" NYLON CORD GRIP (ITEM #19). DETERMINE THE DIAMETER OF THE POWER CABLE BEING USED AND DRILL HOLE IN THE CENTER OF THE SOLID INSERT GROMMET.
2. AFTER DRILLING THE HOLE, SLIT THE SIDE OF THE INSERT GROMMET FROM THE GROMMET LIP TO THE CENTER OF THE HOLE AND DOWN THE SIDE THROUGH TO THE DRILLED HOLE.
3. SLIDE THE BOTTOM THREADED PART OF CORD GRIP OVER THE SENSOR CABLE WITH THREADS FACING THE MOUNTING PIPE. SPREAD GROMMET APART AT SLIT AND SLIDE OVER SENSOR CABLE.
4. INSERT THE GROMMET, LIP END FIRST, INTO THE FINGER GRIPS OF THE CORD GRIP. ROTATE GROMMET WITH THE ANGLE OF THE FINGER GRIPS, AS YOU PUSH THE GROMMET INTO THE CORD GRIP UNTIL IT SNAPS INTO PLACE.



PROJECT INCLUDES INSTRUMENT SERVICE AGREEMENT PER 9704416A30403

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
18	2	2616448	CORDGRIP, 1" NPT, STR, SEALCON CD29NP-BK	NYLON	-
17	3	2616659	CORDGRIP, .87 - 1.26, 1- 1/2"NPT, STRAIGHT	PA	-
16	2	2615291	CONNECTOR, SAFETY LOCK HACH	-	-
15	20	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
14	1	2620913	POWER BOX W/ POWER CONNECTION CABLE	-	-
13	1	9704419A30703	PHOSPHAX HOUSING CONTROL PANEL ASSEMBLY	-	Y
12	1	9704419A30702	FILTRAX HOUSING CONTROL PANEL ASSEMBLY	-	Y
11	1	2968942-SX0	TSS SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
10	1	2967135-SX0	ORP SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
9	1	2967134-SX0	PH SENSOR ASSY, FIXED MTG, C1D2	304 SS	Y
8	1	2966772	DISSOLVED OXYGEN SENSOR ASSY, FIXED MTG, C1D2	PVC	Y
7	2	2617800	DIGITAL GATEWAY, HACH # 6120500	-	-
6	2	2615744	EXTENSION CABLE, 1m	-	-
5	2	2621128	CABLE, ETHERNET, C1D2, M12 X M12, 5m	-	-
4	3	2620816	SUN SHADE, HACH SC4200C, UNIVERSAL	PLASTIC	-
3	1	2621688	UPGRADE KIT, HACH SC4500, MODBUS TCP/IP	-	-
2	2	2620815	UPGRADE KIT, HACH SC4500, LAN ETHERNET	-	-
1	3	2620812-A1C	CONTROLLER, HACH SC4500, ANALOG, 100-240VAC, C1D2	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL

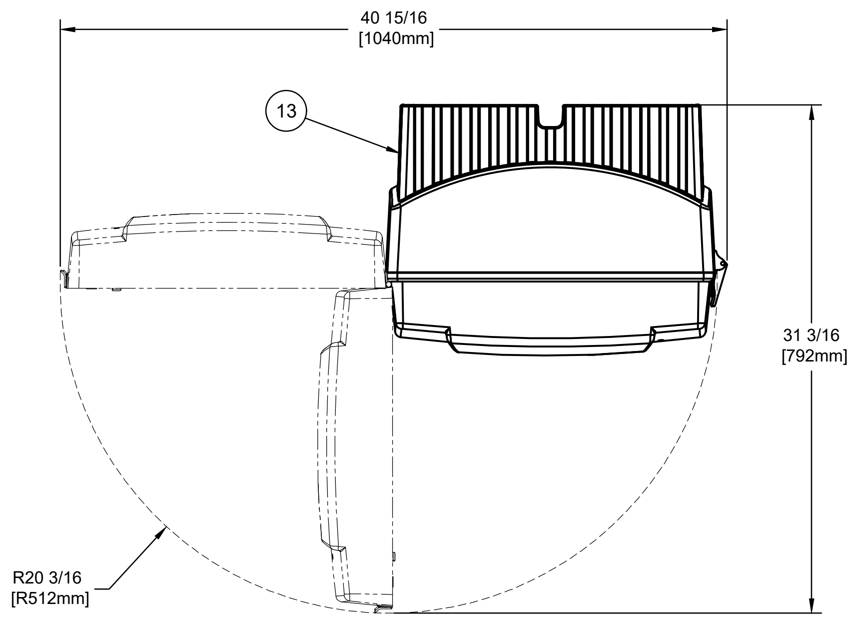
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-07
WEIGHT: SHEET: 1 OF 2

CONFIDENTIAL

DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 3
DRAWING NUMBER: 9704419A30024-3
SCALE: 1/100
SIZE: D



ANALYZER NOTES:

1. AMTAX AND PHOSPHAX ANALYZERS MUST BE MOUNTED WITHIN 6.5 FT (2m) DISTANCE OF THE SC4500 CONTROLLER BY THE INSTALLING CONTRACTOR.

2. THE DISTANCE LIMITATION OF THE HACH INTERNAL NETWORK IS 4000 FT [1219m]. THIS INCLUDES THE COMBINED DISTANCE ON SENSOR CABLES TO THE CONTROLLERS, THE CONTROLLER CONNECTIONS, AND THE DISPLAY MODULE TO THE CONTROLLER.

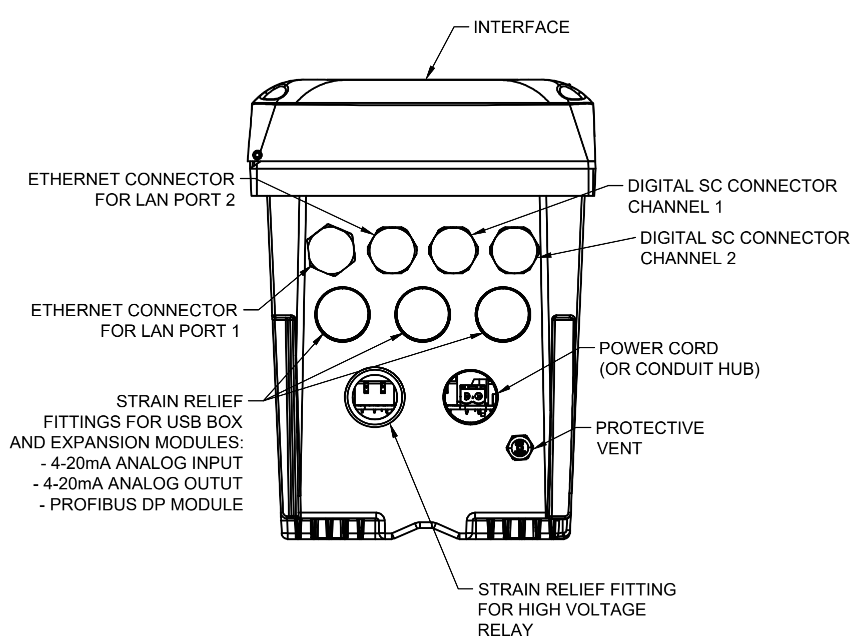
CONTROLLER CONNECTIONS:

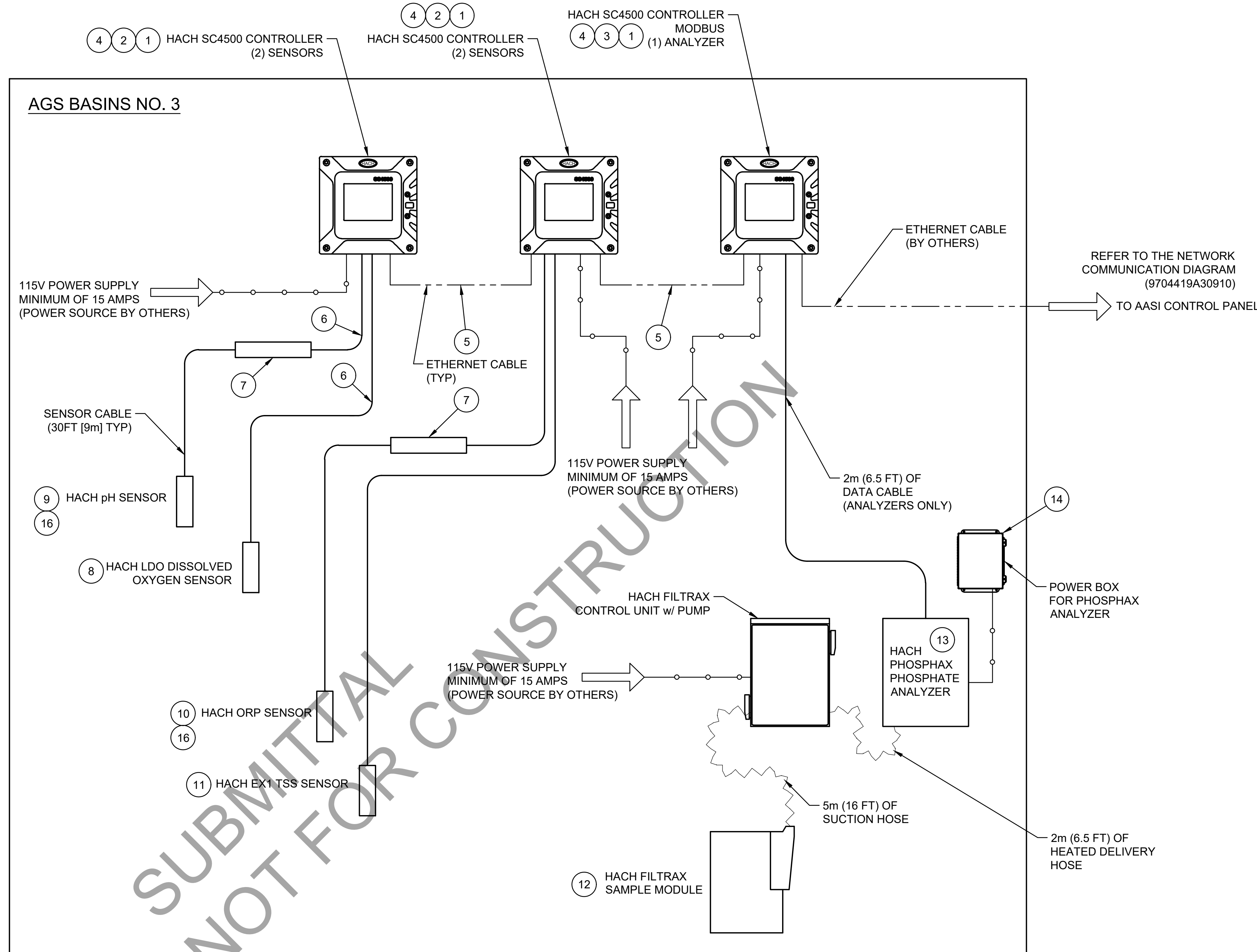
1. ONE STRAIN RELIEF USED WITH MODBUS PROBE MODULE.

2. LOCATION FOR INTERNAL NETWORK CONNECTOR TO BE FIELD INSTALLED BY OTHERS.

CONTROLLER INSTALLATION NOTE:

THE SENSOR CABLES ATTACH DIRECTLY TO THE CONTROLLER. THESE CABLES SHOULD NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO CONTROLLER OR HANDRAILING. A 115 VOLT, SINGLE PHASE POWER SOURCE IS REQUIRED AT THE CONTROLLER.





SUBMITTAL
NOT FOR CONSTRUCTION

LEGEND

- HACH INTERNAL RS485 NETWORK
- MODBUS SERIES RS485
- ETHERNET
- POWER SUPPLY WIRES
- FILTER SAMPLE LINE

CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES				
JOB LOCATION: NAPANEE, ONTARIO, CANADA				
A		2024-10-07	CJC	SUBMITTAL
B		2025-02-15	CJC	FULL SUBMITTAL
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: HACH INSTRUMENTATION LAYOUT, AGS BASIN 3				

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

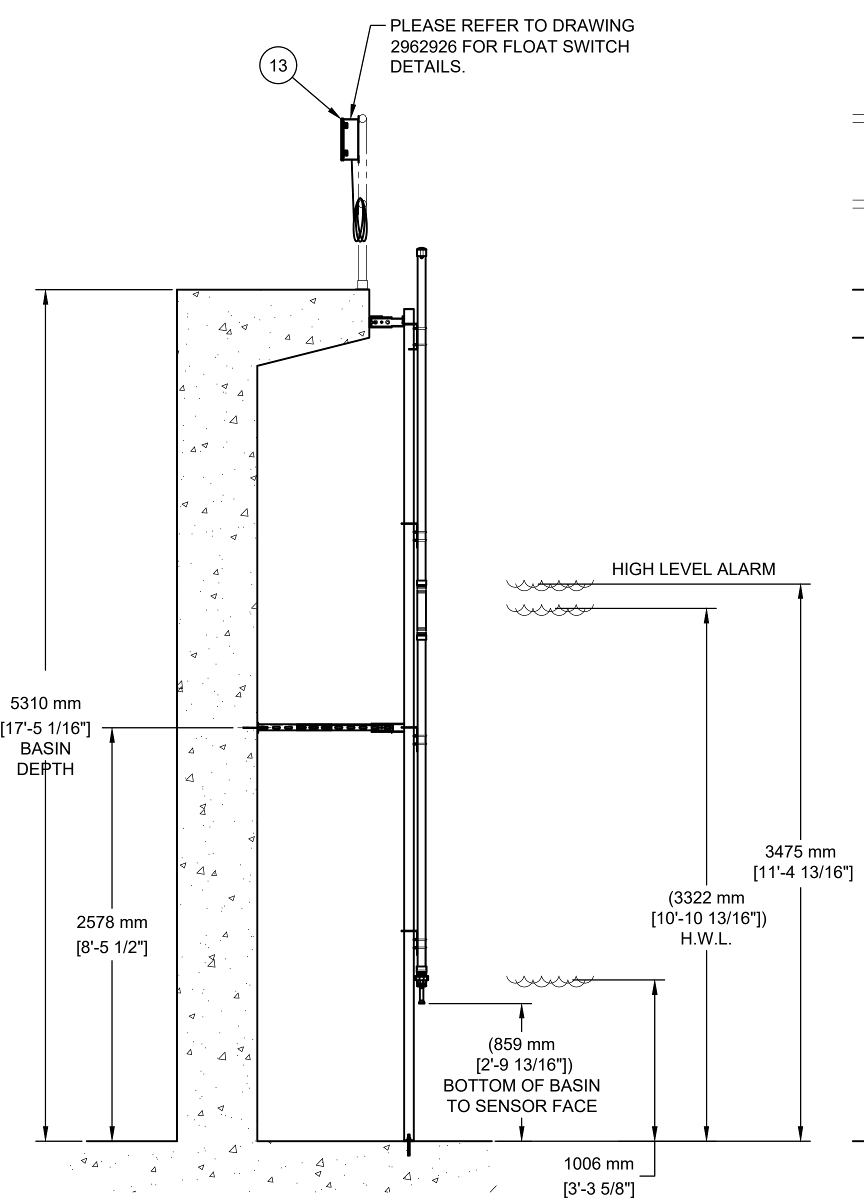
DO NOT SCALE DRAWING

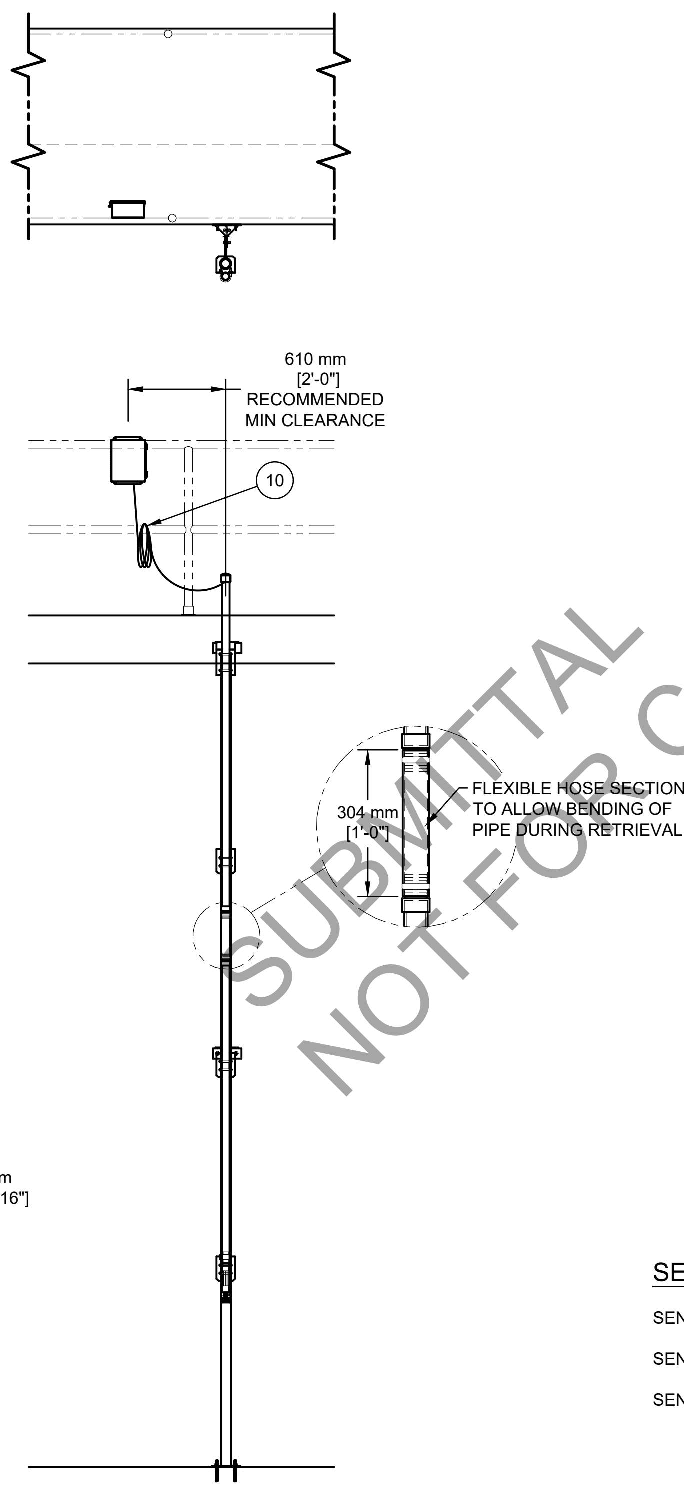
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

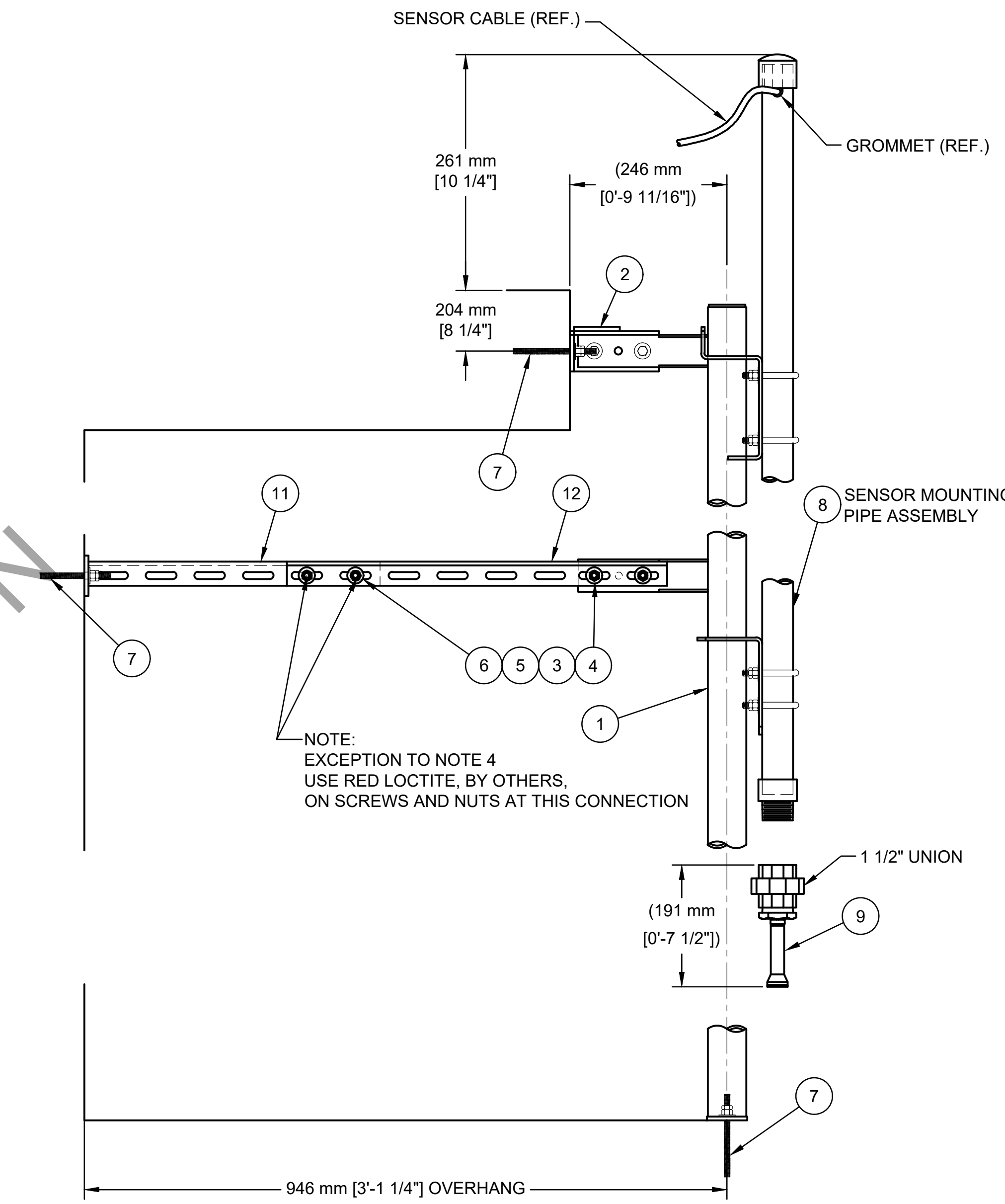
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC — DATE: 2024-10-07
WEIGHT: — SHEET: 2 OF 2
DRAWING NUMBER: 9704419A30024-3 — SCALE: NTS — SIZE: D

SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO RETURN SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. MOUNT GUIDE RAIL ASSEMBLY TO BASIN BEFORE INSTALLING SENSOR TO THE MOUNTING PIPE ASSEMBLY. MOUNT THE GUIDE RAIL ASSEMBLY LEVEL AND PLUMB . REFER TO THE SYSTEM PLAN VIEW DRAWING FOR LOCATION OF THE SENSORS IN THE BASIN.
3. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
4. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS. UNLESS OTHERWISE NOTED.
5. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING WITH THE TY-WRAPS PROVIDED.
6. ASSEMBLE SENSOR TO THE MOUNTING PIPE ASSEMBLY. SOME SENSOR CABLES CONTAIN A VENT TUBE TO REFERENCE ATMOSPHERIC PRESSURE. DO NOT CRIMP OR DISTORT CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.
7. WITH SENSOR ASSEMBLED TO MOUNTING PIPE, SLIDE THE ASSEMBLY OVER THE GUIDE RAIL. ATTACH SENSOR CABLE TO JUNCTION BOX OR CONTROLLER AS NECESSARY.







SENSOR MOUNTING DETAIL

SUBMITTAL
NOT FOR CONSTRUCTION

SENSOR COMPONENT WEIGHTS:

SENSOR GUIDE RAIL	50 LBS [23 kg]
SENSOR PIPE (PVC)	19 LBS [9 kg]
SENSOR ASSEMBLY (LEVEL)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
13	1	2969295	INTRINSICALLY SAFE JUNCTION BOX	304 SS	Y
12	1	2519549-SX0	ANGLE, 1 1/2" X 1 1/2" X 1/4" X 23 1/2"	304 SS	Y
11	1	2915407-SX0	BRACKET, WALL, SENSOR GUIDE	304 SS	Y
10	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
9	1	2968886-10-050	PRESSURE TRANS. SUB ASSY, 1.5", LEVELRAT, 10 PSI, 50	PVC	Y
8	1	2965755-177-SX0	SENSOR MOUNTING PIPE ASSEMBLY, RETRIEVAL 177" LG	304 SS	Y
7	6	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
6	12	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
5	6	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
4	6	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
3	6	2602257	HHCS, 3/8-16 X 1.25"	316 SS	-
2	1	2915104-SX0	SHORT MOUNTING ARM WELDMENT	304 SS	Y
1	1	2915030-204-SX0	GUIDE RAIL WELDMENT, 17 FT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

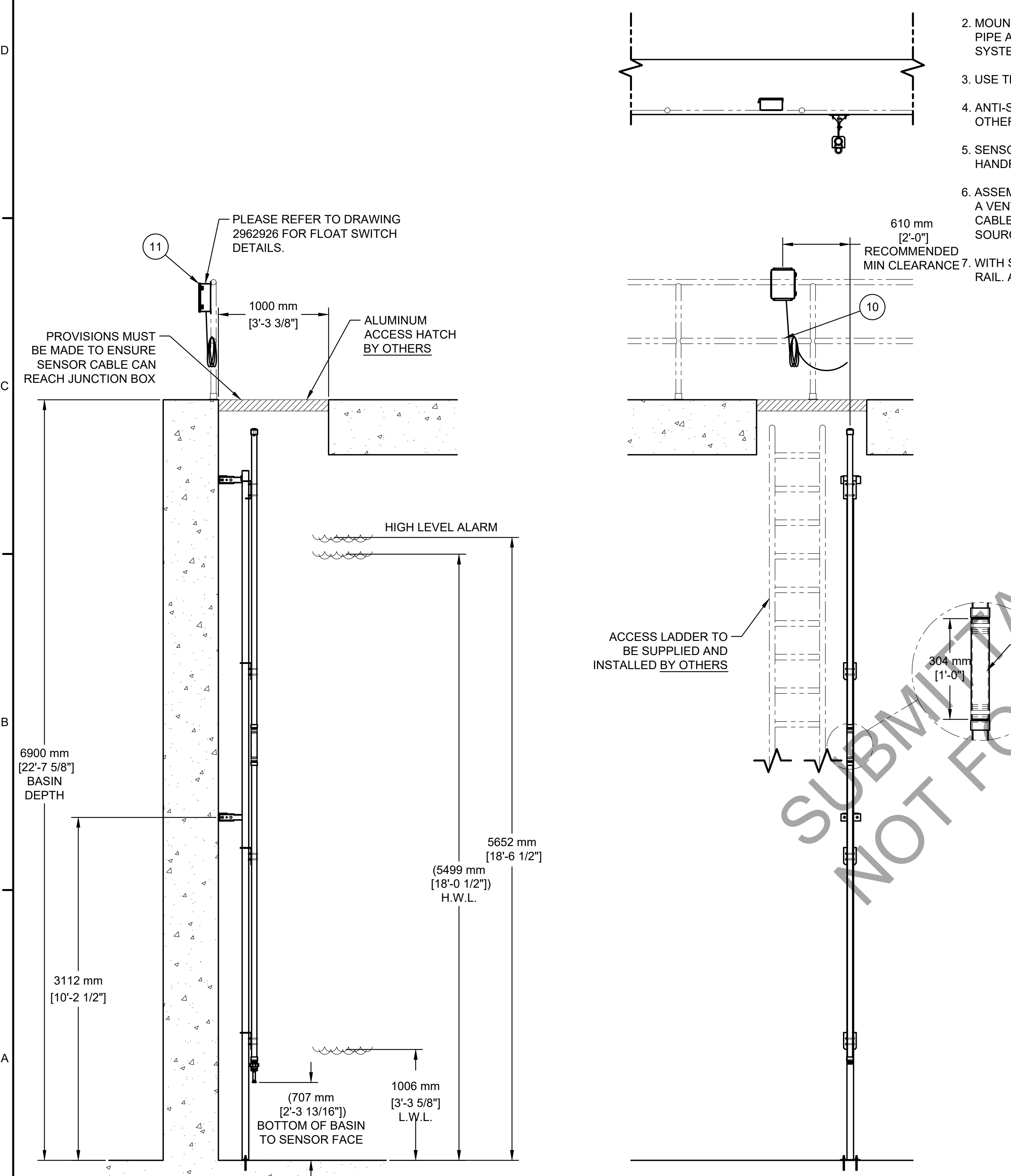
MATERIAL:
SIMILAR TO: M-SENSOR-14
TYPE:
DRAWN BY: CJC DATE: 2024-10-02
WEIGHT: SHEET: 1 OF 1

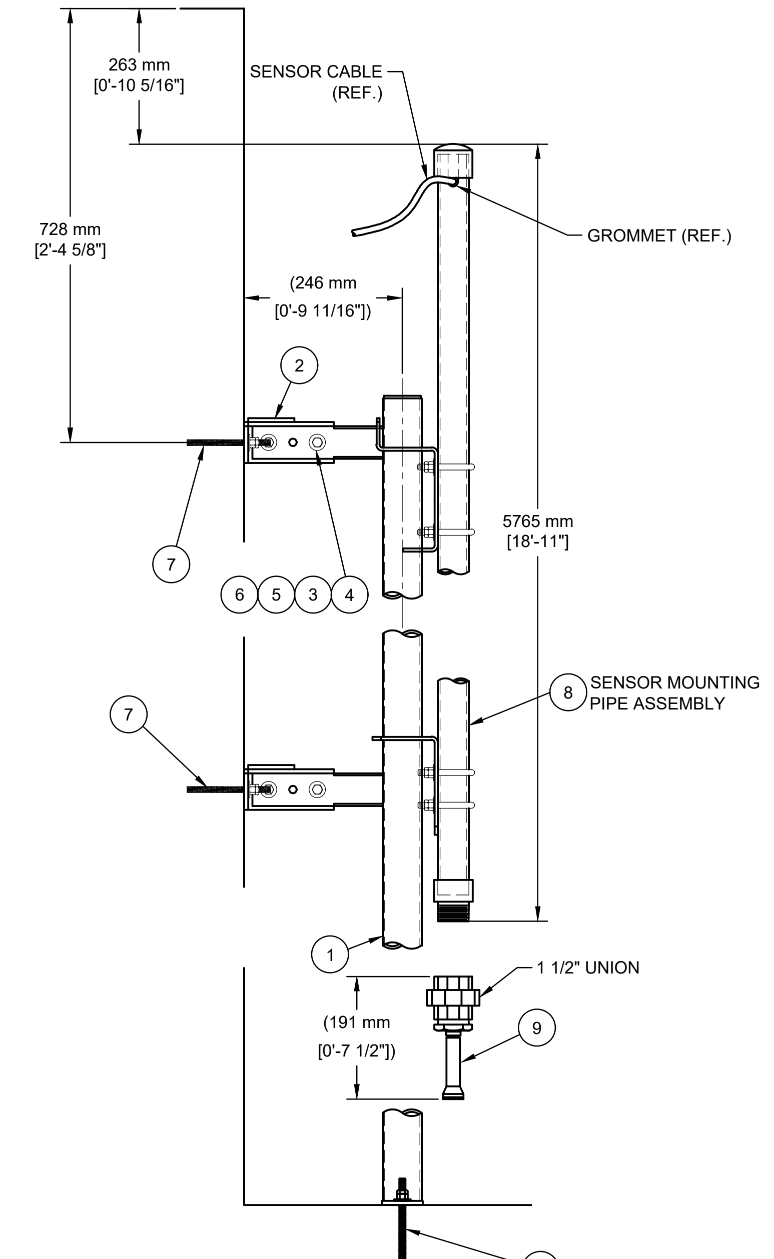
CONFIDENTIAL

DRAWING NAME: LEVEL SENSOR INSTL, POST-EQ
DRAWING NUMBER: 9704419A30025 SCALE: 1/24 SIZE: D

SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO RETURN SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. MOUNT GUIDE RAIL ASSEMBLY TO BASIN BEFORE INSTALLING SENSOR TO THE MOUNTING PIPE ASSEMBLY. MOUNT THE GUIDE RAIL ASSEMBLY LEVEL AND PLUMB . REFER TO THE SYSTEM PLAN VIEW DRAWING FOR LOCATION OF THE SENSORS IN THE BASIN.
3. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
4. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS. UNLESS OTHERWISE NOTED.
5. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING WITH THE TY-WRAPS PROVIDED.
6. ASSEMBLE SENSOR TO THE MOUNTING PIPE ASSEMBLY. SOME SENSOR CABLES CONTAIN A VENT TUBE TO REFERENCE ATMOSPHERIC PRESSURE. DO NOT CRIMP OR DISTORT CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.
7. WITH SENSOR ASSEMBLED TO MOUNTING PIPE, SLIDE THE ASSEMBLY OVER THE GUIDE RAIL. ATTACH SENSOR CABLE TO JUNCTION BOX OR CONTROLLER AS NECESSARY.





SENSOR MOUNTING DETAIL

SENSOR COMPONENT WEIGHTS:

SENSOR GUIDE RAIL	59 LBS [27 kg]
SENSOR PIPE (PVC)	21 LBS [9.5 kg]
SENSOR ASSEMBLY (LEVEL)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
11	1	2969295	INTRINSICALLY SAFE JUNCTION BOX	304 SS	Y
10	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
9	1	2968886-10-050	PRESSURE TRANS. SUB ASSY, 1.5", LEVELRAT, 10 PSI, 50	PVC	Y
8	1	2965755-225-SX0	SENSOR MOUNTING PIPE ASSEMBLY, RETRIEVAL 225" LG	304 SS	Y
7	6	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
6	8	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
5	4	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
4	4	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
3	4	2602257	HHCS, 3/8-16 X 1.25"	316 SS	-
2	2	2915104-SX0	SHORT MOUNTING ARM WELDMENT	304 SS	Y
1	1	2915030-246-SX0	GUIDE RAIL WELDMENT, 20.5 FT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

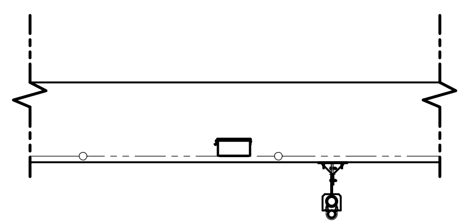
MATERIAL:
SIMILAR TO: M-SENSOR-14
TYPE:
DRAWN BY: CJC | DATE: 2024-10-03
WEIGHT: | SHEET: 1 OF 1

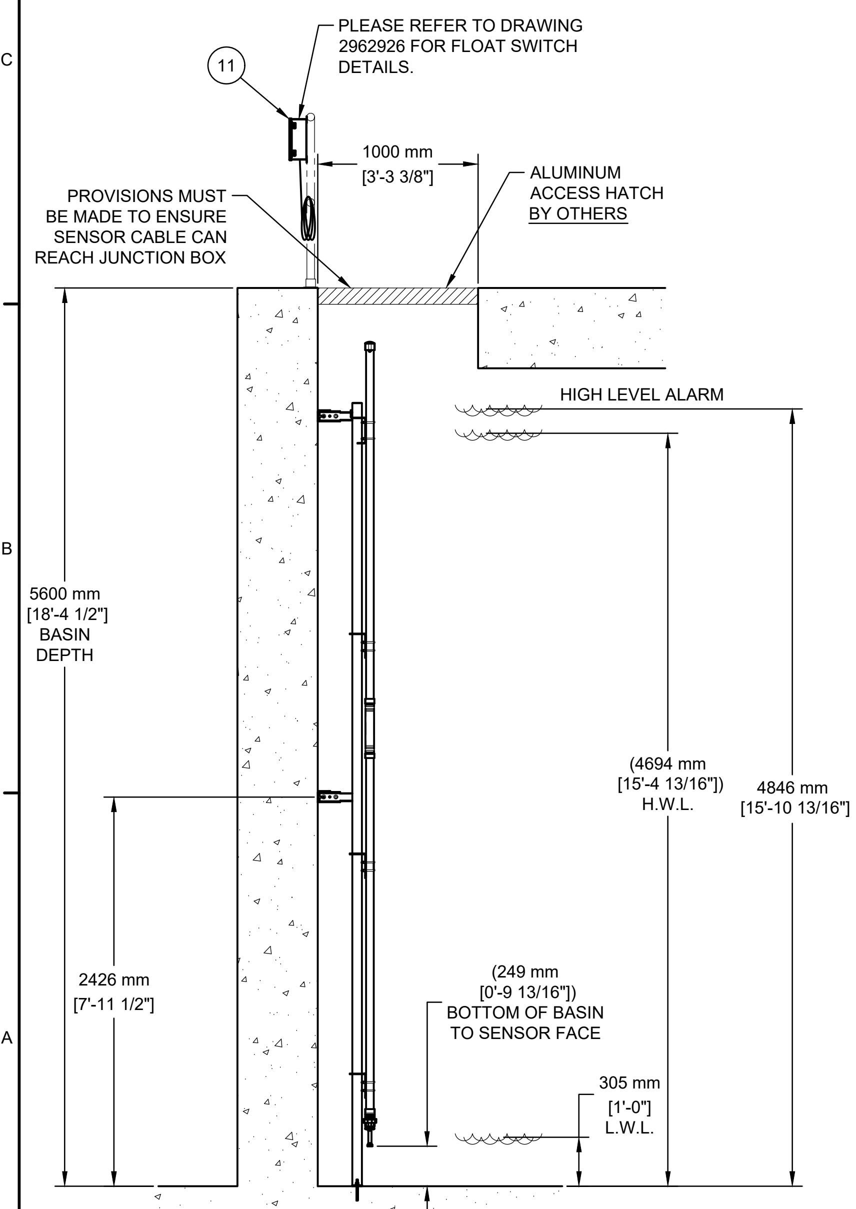
CONFIDENTIAL

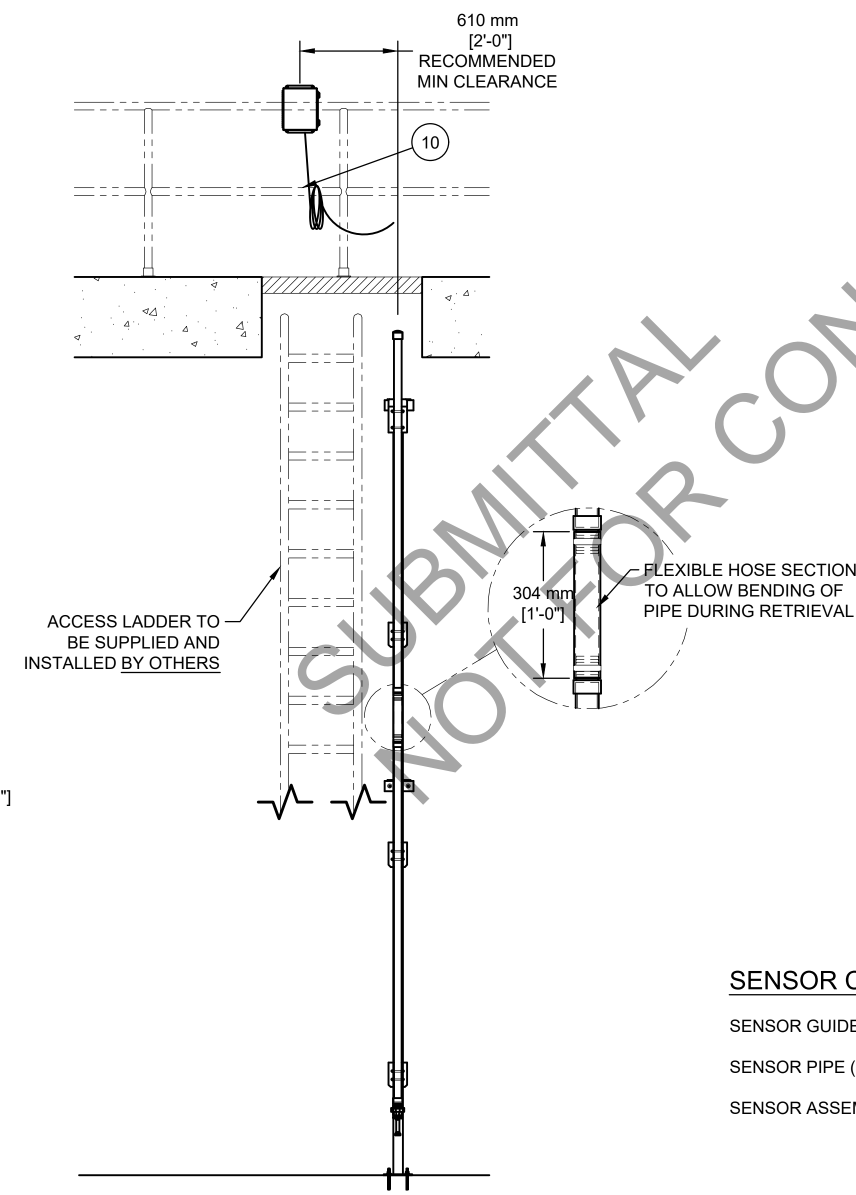
DRAWING NAME: LEVEL SENSOR INSTL, INFLUENT BUFFER
DRAWING NUMBER: 9704419A30027 | SCALE: 1/24 | SIZE: D

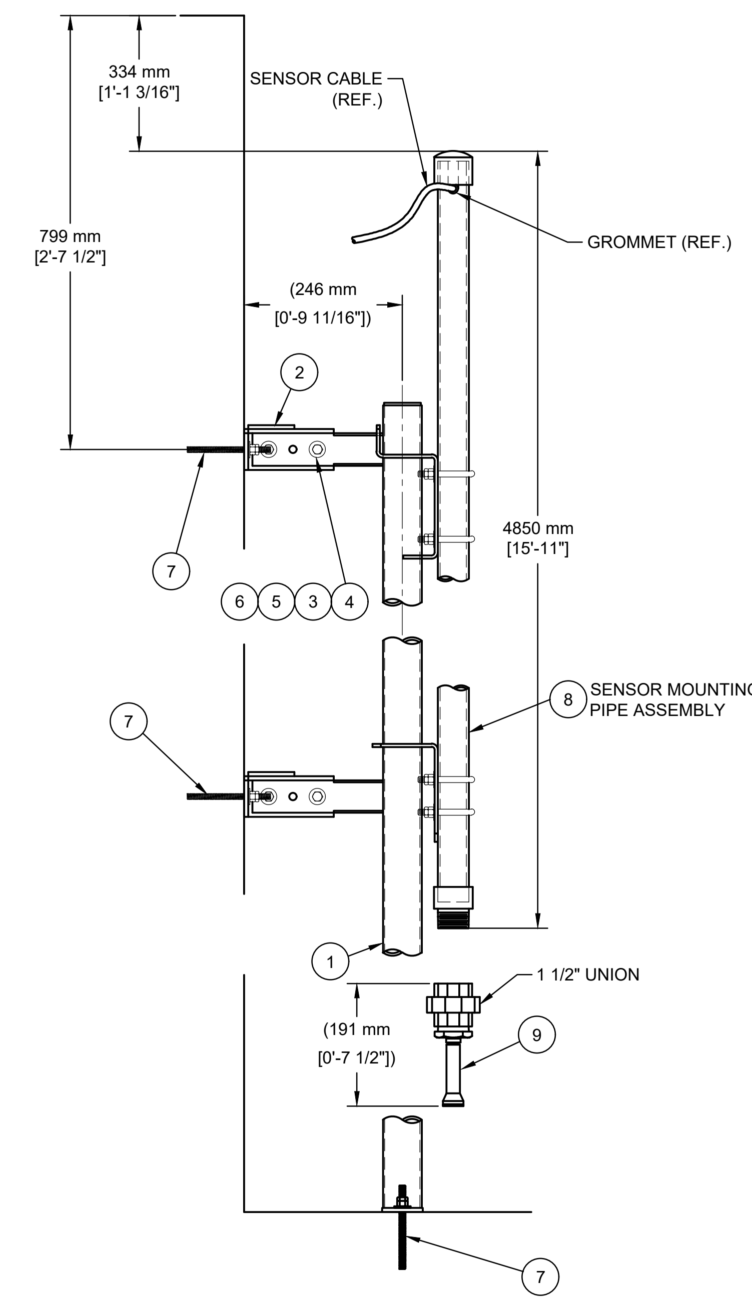
SENSOR INSTALLATION NOTES:

1. UNLESS NOTED OTHERWISE, AFTER COMPLETION OF INSTALLATION AND WIRING, SENSORS ARE TO BE REMOVED AND RETURNED TO STORAGE UNTIL COMMISSIONING. FAILURE TO RETURN SENSORS TO STORAGE PER GUIDELINES IN OPERATION AND MAINTENANCE SECTION 1 MAY RESULT IN SENSOR DAMAGE AND VOID WARRANTY.
2. MOUNT GUIDE RAIL ASSEMBLY TO BASIN BEFORE INSTALLING SENSOR TO THE MOUNTING PIPE ASSEMBLY. MOUNT THE GUIDE RAIL ASSEMBLY LEVEL AND PLUMB . REFER TO THE SYSTEM PLAN VIEW DRAWING FOR LOCATION OF THE SENSORS IN THE BASIN.
3. USE THREAD SEALANT OR TAPE ON ALL PIPE THREADS.
4. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS. UNLESS OTHERWISE NOTED.
5. SENSOR CABLE MUST NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING WITH THE TY-WRAPS PROVIDED.
6. ASSEMBLE SENSOR TO THE MOUNTING PIPE ASSEMBLY. SOME SENSOR CABLES CONTAIN A VENT TUBE TO REFERENCE ATMOSPHERIC PRESSURE. DO NOT CRIMP OR DISTORT CABLE. LIMIT THE MINIMUM BEND RADIUS TO (2) INCHES. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.
7. WITH SENSOR ASSEMBLED TO MOUNTING PIPE, SLIDE THE ASSEMBLY OVER THE GUIDE RAIL. ATTACH SENSOR CABLE TO JUNCTION BOX OR CONTROLLER AS NECESSARY.









SENSOR MOUNTING DETAIL

SENSOR COMPONENT WEIGHTS:

SENSOR GUIDE RAIL	59 LBS [21 kg]
SENSOR PIPE (PVC)	20 LBS [9 kg]
SENSOR ASSEMBLY (LEVEL)	3.6 LBS [2 kg]

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
11	1	2969295	INTRINSICALLY SAFE JUNCTION BOX	304 SS	Y
10	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
9	1	2968886-10-050	PRESSURE TRANS. SUB ASSY, 1.5", LEVELRAT, 10 PSI, 50	PVC	Y
8	1	2965755-189-SX0	SENSOR MOUNTING PIPE ASSEMBLY, RETRIEVAL 189" LG	304 SS	Y
7	6	2967161-1	KIT, ADHESIVE ANCHOR, 3/8"	304 SS	Y
6	8	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
5	4	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
4	4	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
3	4	2602257	HHCS, 3/8-16 X 1.25"	316 SS	-
2	2	2914254	SHORT MOUNTING ARM WELDMENT	304 SS	Y
1	1	2915030-192-SX0	GUIDE RAIL WELDMENT, 16 FT	304 SS	Y

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-27	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-SENSOR-14
TYPE:
DRAWN BY: CJC DATE: 2024-10-03
WEIGHT: SHEET: 1 OF 1

CONFIDENTIAL

DRAWING NAME: LEVEL SENSOR INSTL, SLUDGE BUFFER
DRAWING NUMBER: 9704419A30032
SCALE: 1/24
SIZE: D

CONFIDENTIAL

JOB NAME:	NAPANEE WPCP UPGRADES
JOB LOCATION:	NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

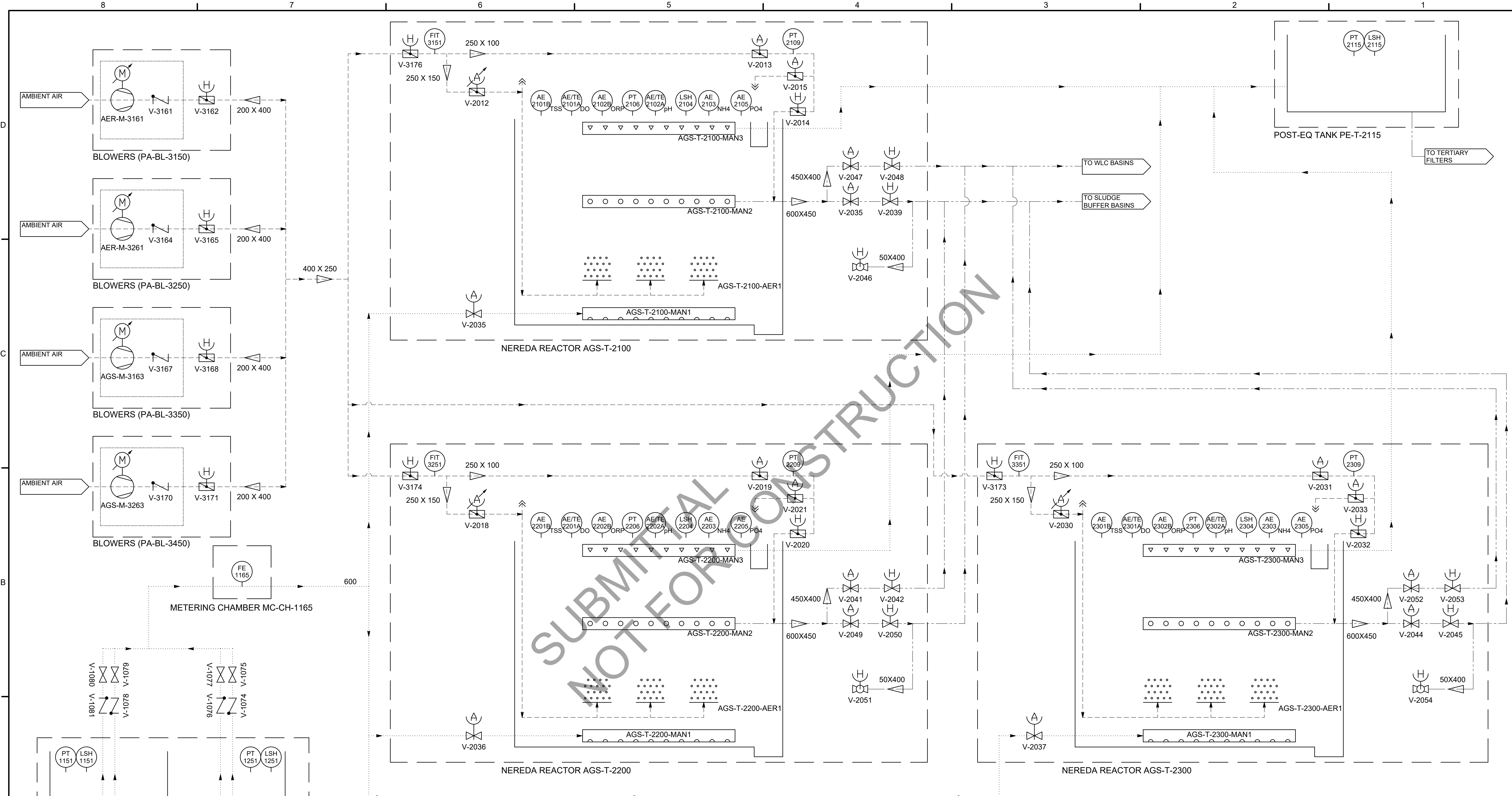
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC | DATE: 2025-01-21
WEIGHT: | SHEET: 1 OF 3

DRAWING NAME: PROCESS FLOW DIAGRAM
DRAWING NUMBER: 9704419A30034
SCALE: NTS
SIZE: D



JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	SUBMITTAL

DRAWN BY: CJC DATE: 2025-01-21
WEIGHT: SHEET: 2 OF 3

CONFIDENTIAL

DRAWING NAME: PROCESS FLOW DIAGRAM
DRAWING NUMBER: 9704419A30034
SCALE: NTS SIZE: D

Item	Size	Tag	Scope
Influent Wet Well Basin 1		RSP-T-1151	BY OTHERS
Influent Wet Well Basin 2		RSP-T-1251	BY OTHERS
Influent Wet Well Pump 1		HSW-ISP-1160	BY OTHERS
Influent Wet Well Pump 1 Check Valve		V-1080	BY OTHERS
Influent Wet Well Pump 1 Isolation Valve		V-1081	BY OTHERS
Influent Wet Well Pump 2		HSW-ISP-1260	BY OTHERS
Influent Wet Well Pump 2 Check Valve		V-1078	BY OTHERS
Influent Wet Well Pump 2 Isolation Valve		V-1079	BY OTHERS
Influent Wet Well Pump 3		HSW-ISP-1360	BY OTHERS
Influent Wet Well Pump 3 Check Valve		V-1076	BY OTHERS
Influent Wet Well Pump 3 Isolation Valve		V-1077	BY OTHERS
Influent Wet Well Pump 4		HSW-ISP-1460	BY OTHERS
Influent Wet Well Pump 4 Check Valve		V-1074	BY OTHERS
Influent Wet Well Pump 4 Isolation Valve		V-1075	BY OTHERS
Influent Wet Well Basin 1 Level Transducer		PT-1151	AASI
Influent Wet Well Basin 1 High Level Float Switch		LSH-1151	AASI
Influent Wet Well Basin 2 Level Transducer		PT-1251	AASI
Influent Wet Well Basin 2 High Level Float Switch		LSH-1251	AASI
Metering Chamber Basin		MC-CH-1165	BY OTHERS
Metering Chamber Flowmeter		FE-1165	BY OTHERS
Blower Package Motor		AER-M-3161	AASI
Blower Package Check Valve		V-3161	AASI
Blower Isolation Valve	8"	V-3162	AASI
Blower Package Motor		AER-M-3261	AASI
Blower Package Check Valve		V-3164	AASI
Blower Isolation Valve	8"	V-3165	AASI
Blower Package Motor		AGS-M-3163	AASI
Blower Package Check Valve		V-3167	AASI
Blower Isolation Valve	8"	V-3168	AASI
Blower Package Motor		AGS-M-3263	AASI
Blower Package Check Valve		V-3170	AASI
Blower Isolation Valve	8"	V-3171	AASI
Reactor 1 Influent Valve	24"	V-2035	AASI
Reactor 1 Influent Manifold	36"	AGS-T-2100-MAN1	AASI
Reactor 1 Sludge Decanter	20"	AGS-T-2100-MAN2	AASI
Reactor 1 Sludge Waste Valve	18"	V-2035	AASI
Reactor 1 Sludge Waste Throttling Valve	18"	V-2039	AASI
Reactor 1 Sludge Waste Sample Valve	2"	V-2046	BY OTHERS
Reactor 1 Water Level Correction Valve	16"	V-2047	AASI
Reactor 1 Water Level Correction Isolation Valve	16"	V-2048	AASI
Reactor 1 Effluent Decanter		AGS-T-2100-MAN3	AASI
Reactor 1 Aeration Grid		AGS-T-2100-AER1	AASI
Reactor 1 Aeration Valve	6"	V-2012	AASI
Reactor 1 Aeration Isolation Valve	10"	V-3176	AASI
Reactor 1 Aeration Flow Meter		FIT-3151	AASI
Reactor 1 Sludge Decanter Fill Valve	4"	V-2013	AASI
Reactor 1 Sludge Decanter Vent Valve	4"	V-2015	AASI
Reactor 1 Sludge Decanter Throttling Valve	4"	V-2014	AASI
Reactor 1 Basin		AGS-T-2100	BY OTHERS
Reactor 1 Sludge Decanter Pressure Transducer		PT-2109	AASI
Reactor 1 Level Transducer		PT-2106	AASI
Reactor 1 High Level Float Switch		LSH-2104	AASI
Reactor 1 TSS		AE-2101B	AASI
Reactor 1 pH		AE/TE-2102A	AASI
Reactor 1 DO		AE/TE-2101A	AASI
Reactor 1 ORP		AE-2102B	AASI
Reactor 1 Ammonia (NH4)		AE-2103	AASI
Reactor 1 Phosphate (PO4)		AE-2105	AASI

Item	Size	Tag	Scope
Reactor 2 Influent Valve	24"	V-2036	AASI
Reactor 2 Influent Manifold	36"	AGS-T-2200-MAN1	AASI
Reactor 2 Sludge Decanter	20"	AGS-T-2200-MAN2	AASI
Reactor 2 Sludge Waste Valve	18"	V-2049	AASI
Reactor 2 Sludge Waste Throttling Valve	18"	V-2050	AASI
Reactor 2 Sludge Waste Sample Valve	2"	V-2051	BY OTHERS
Reactor 2 Water Level Correction Valve	16"	V-2041	AASI
Reactor 2 Water Level Correction Isolation Valve	16"	V-2042	AASI
Reactor 2 Effluent Decanter		AGS-T-2200-MAN3	AASI
Reactor 2 Aeration Grid		AGS-T-2200-AER1	AASI
Reactor 2 Aeration Valve	6"	V-2018	AASI
Reactor 2 Aeration Isolation Valve	10"	V-3174	AASI
Reactor 2 Aeration Flow Meter		FIT-3251	AASI
Reactor 2 Sludge Decanter Fill Valve	4"	V-2019	AASI
Reactor 2 Sludge Decanter Vent Valve	4"	V-2021	AASI
Reactor 2 Sludge Decanter Throttling Valve	4"	V-2020	AASI
Reactor 2 Basin		AGS-T-2200	BY OTHERS
Reactor 2 Sludge Decanter Pressure Transducer		PT-2209	AASI
Reactor 2 Level Transducer		PT-2206	AASI
Reactor 2 High Level Float Switch		LSH-2204	AASI
Reactor 2 TSS		AE-2201B	AASI
Reactor 2 pH		AE/TE-2202A	AASI
Reactor 2 DO		AE/TE-2201A	AASI
Reactor 2 ORP		AE-2202B	AASI
Reactor 2 Ammonia (NH4)		AE-2203	AASI
Reactor 2 Phosphate (PO4)		AE-2205	AASI
Reactor 3 Influent Valve	24"	V-2037	AASI
Reactor 3 Influent Manifold	36"	AGS-T-2300-MAN1	AASI
Reactor 3 Sludge Decanter	20"	AGS-T-2300-MAN2	AASI
Reactor 3 Sludge Waste Valve	18"	V-2044	AASI
Reactor 3 Sludge Waste Throttling Valve	18"	V-2045	AASI
Reactor 3 Sludge Waste Sample Valve	2"	V-2054	BY OTHERS
Reactor 3 Water Level Correction Valve	16"	V-2052	AASI
Reactor 3 Water Level Correction Isolation Valve	16"	V-2053	AASI
Reactor 3 Effluent Decanter		AGS-T-2300-MAN3	AASI
Reactor 3 Aeration Grid		AGS-T-2300-AER1	AASI
Reactor 3 Aeration Valve	6"	V-2030	AASI
Reactor 3 Aeration Isolation Valve	10"	V-3173	AASI
Reactor 3 Aeration Flow Meter		FIT-3351	AASI
Reactor 3 Sludge Decanter Fill Valve	4"	V-2031	AASI
Reactor 3 Sludge Decanter Vent Valve	4"	V-2033	AASI
Reactor 3 Sludge Decanter Throttling Valve	4"	V-2032	AASI
Reactor 3 Basin		AGS-T-2300	BY OTHERS
Reactor 3 Sludge Decanter Pressure Transducer		PT-2309	AASI
Reactor 3 Level Transducer		PT-2306	AASI
Reactor 3 High Level Float Switch		LSH-2304	AASI
Reactor 3 TSS		AE-2301B	AASI
Reactor 3 pH		AE/TE-2302A	AASI
Reactor 3 DO		AE/TE-2301A	AASI
Reactor 3 ORP		AE-2302B	AASI
Reactor 3 Ammonia (NH4)		AE-2303	AASI
Reactor 3 Phosphate (PO4)		AE-2305	AASI
Post-EQ Basin		PE-T-2115	BY OTHERS
Post-EQ Level Transducer		PT-2115	AASI
Post-EQ High Level Float Switch		LSH-2115	AASI

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

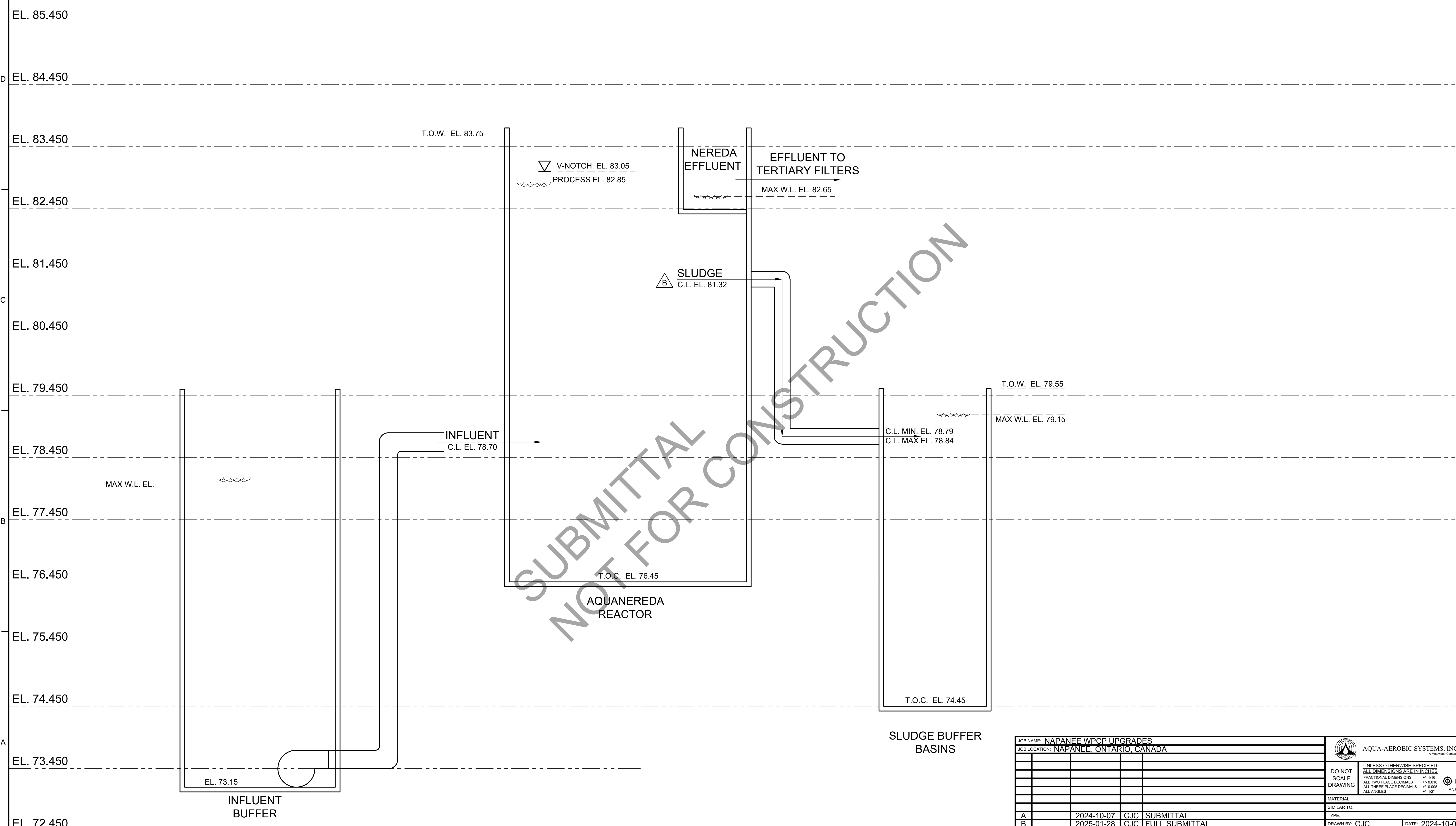
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	SUBMITTAL

DRAWN BY: CJC — DATE: 2025-01-21
WEIGHT: — SHEET: 3 OF 3
DRAWING NAME: PROCESS FLOW DIAGRAM
DRAWING NUMBER: 9704419A30034 — SCALE: NTS — SIZE: D



CONFIDENTIAL

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2024-10-07	CJC	SUBMITTAL
B		2025-01-28	CJC	FULL SUBMITTAL

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

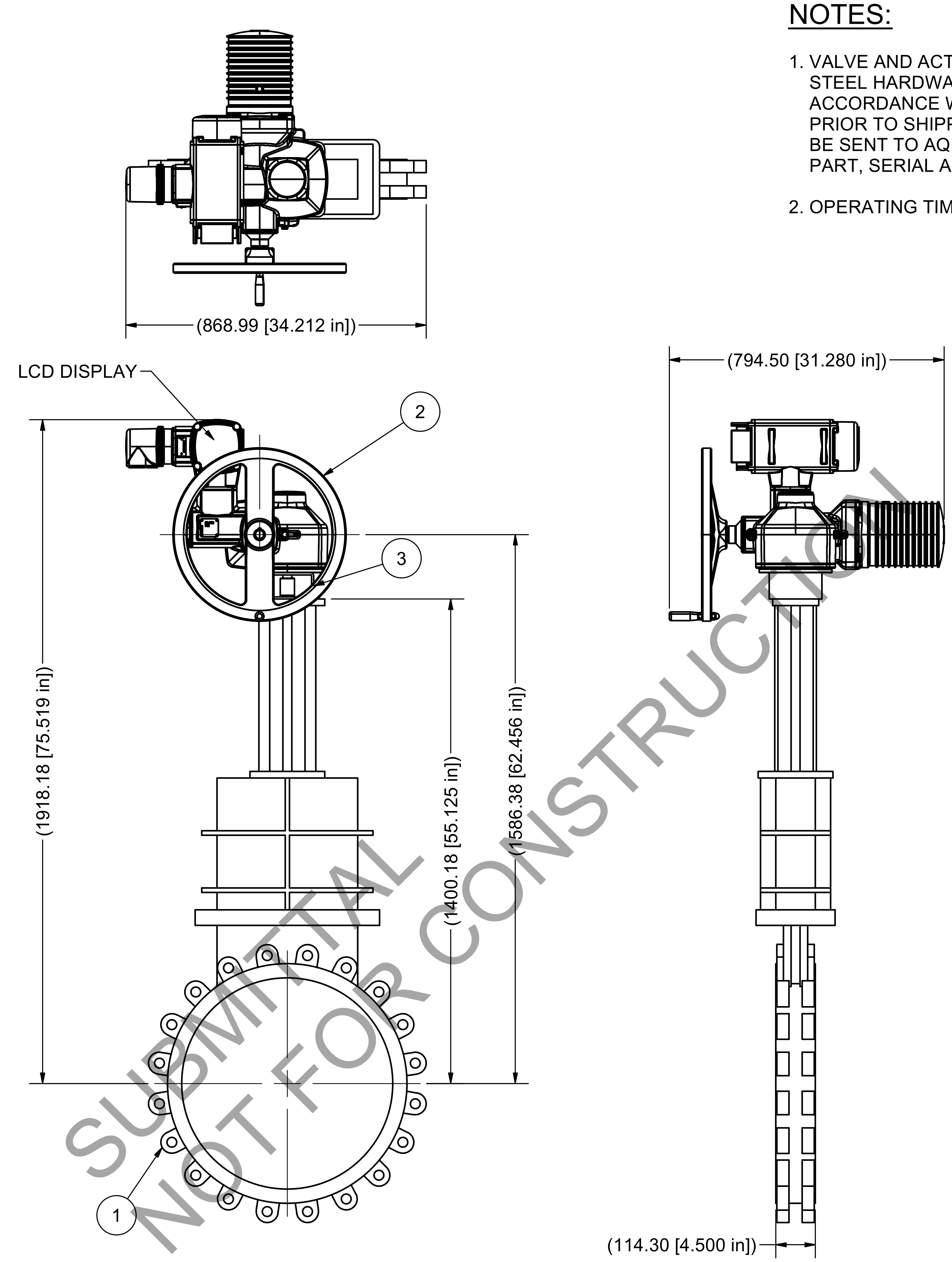
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC
DATE: 2024-10-08
WEIGHT:
SHEET: 1 OF 1

DRAWING NAME: HYDRAULIC PROFILE
DRAWING NUMBER: 9704419A30036
SCALE: 1/28
SIZE: D

NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED PER DIAGRAM #XXXXXXX, AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART, SERIAL AND PURCHASE ORDER NUMBERS.
2. OPERATING TIME: 107 SECONDS.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	9704419A30360	MTG KIT, 24” PRATT 77 TO AUMA SA16.2	304 SS	-
2	1	9704419A30132	ACTUATOR ASSY, AUMA, SAEX16.2, 575V, CSA	-	Y
1	1	9704419A30355	VALVE, 24”, KNIFE GATE, PRATT 77, LO	316 SS	Y

JOB NAME: NAPANEE WPCF UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

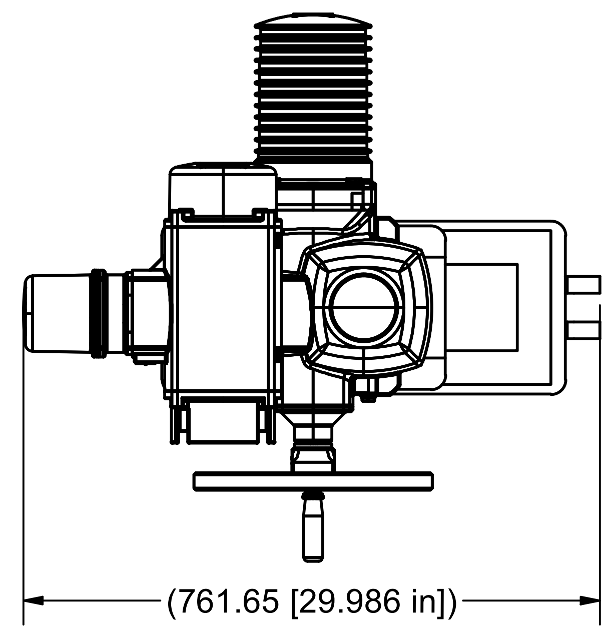
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

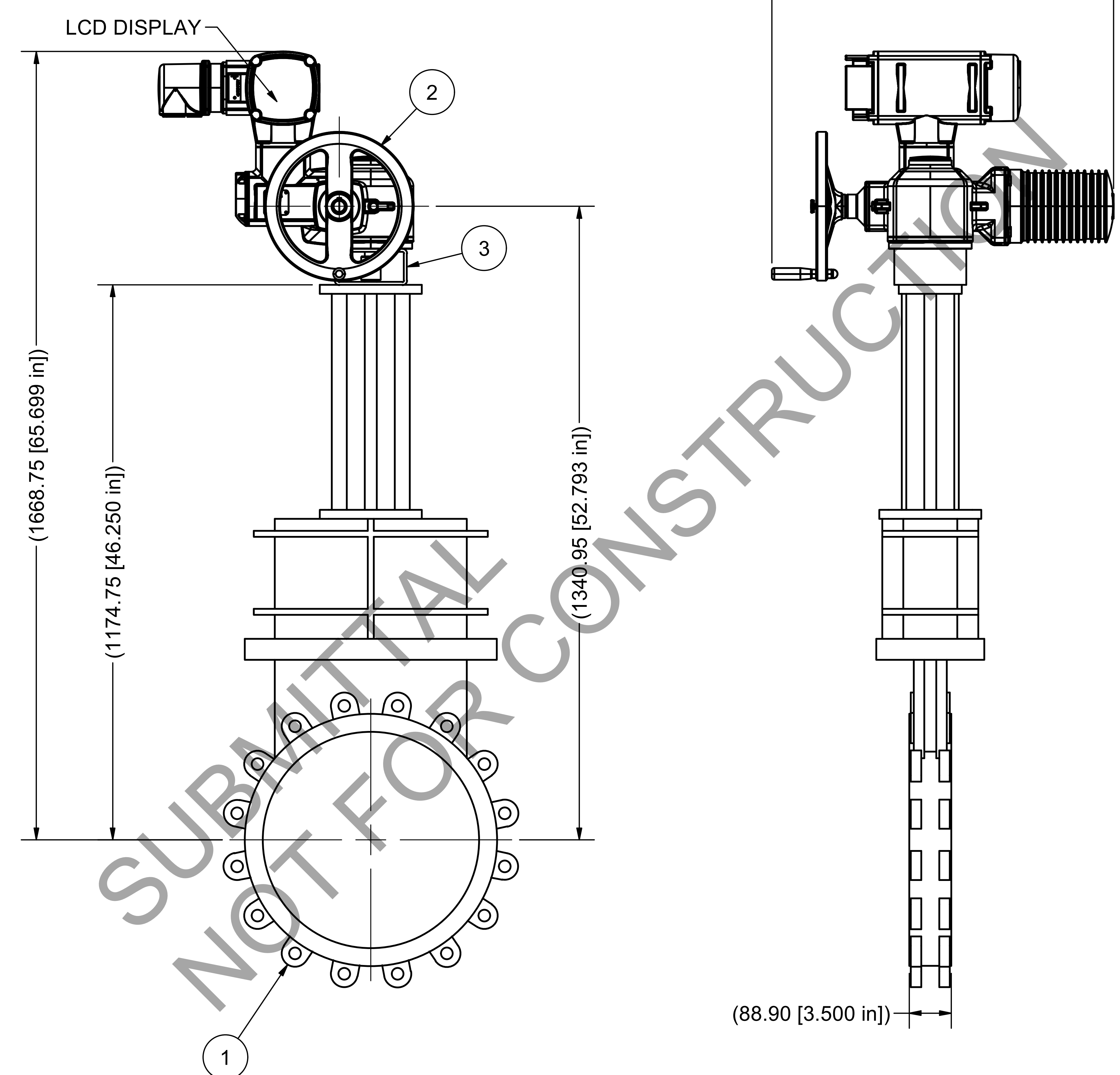
DRAWN BY: CJC | DATE: 2025-02-03
WEIGHT: 560 KG | SHEET: 1 OF 1

DRAWING NAME: VALVE ASSY, 24”, KNIFE GATE, AUMA
DRAWING NUMBER: 9704419A30124 | SCALE: 1/12 | SIZE: C



NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED PER DIAGRAM #XXXXXXX, AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART, SERIAL AND PURCHASE ORDER NUMBERS.
2. OPERATING TIME: 80 SECONDS.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	9704419A30361	MTG KIT, 18" PRATT 77 TO AUMA SA16.2	304 SS	-
2	1	9704419A30133	ACTUATOR ASSY, AUMA, SAEX14.6, 575V, CSA	-	Y
1	1	9704419A30356	VALVE, 18", KNIFE GATE, PRATT 77, LO	316 SS	Y

JOB NAME: NAPANEE WPCF UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:

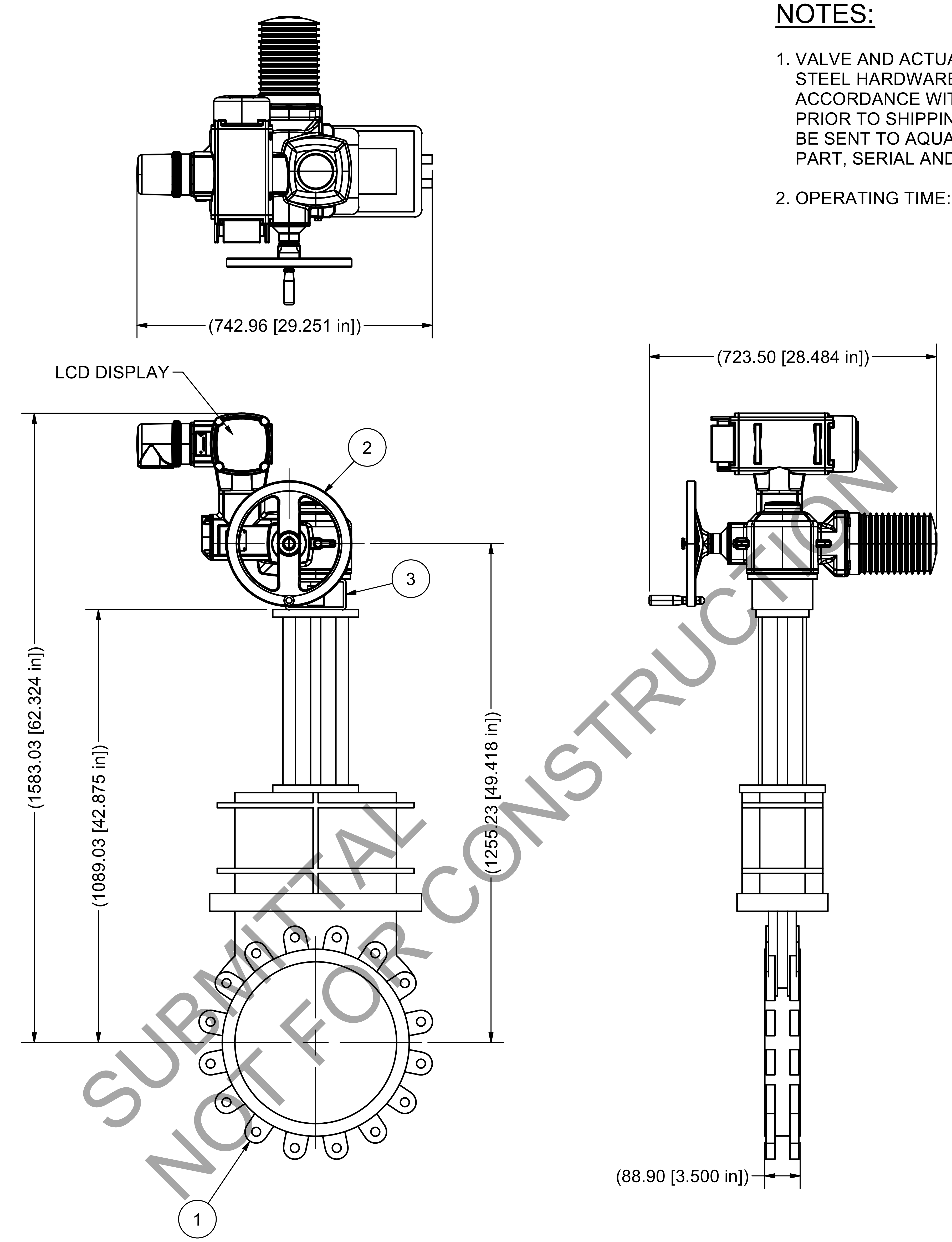
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DRAWN BY: CJC | DATE: 2025-02-03
WEIGHT: 271 KG | SHEET: 1 OF 1

DRAWING NAME: VALVE ASSY, 18", KNIFE GATE, AUMA
DRAWING NUMBER: 9704419A30125 | SCALE: 1/10 | SIZE: C

NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED PER DIAGRAM #XXXXXXX, AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART, SERIAL AND PURCHASE ORDER NUMBERS.
2. OPERATING TIME: 71 SECONDS.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	9704419A30362	MTG KIT, 16" PRATT 77 TO AUMA SA16.2	304 SS	-
2	1	9704419A30137	ACTUATOR ASSY, AUMA, SAEX14.6, 575V, CSA	-	Y
1	1	9704419A30357	VALVE, 16", KNIFE GATE, PRATT 77, LO	316 SS	Y

JOB NAME: NAPANEE WPCF UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

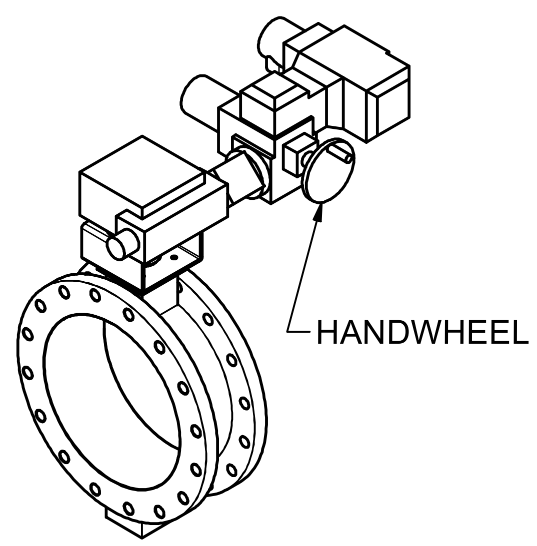
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

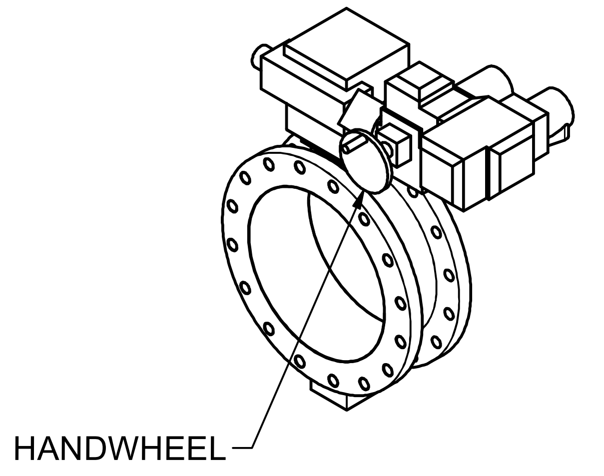
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC — DATE: 2025-02-03
WEIGHT: 243 KG — SHEET: 1 OF 1
DRAWING NAME: VALVE ASSY, 16", KNIFE GATE, AUMA
DRAWING NUMBER: 9704419A30126 — SCALE: 1/10 — SIZE: C

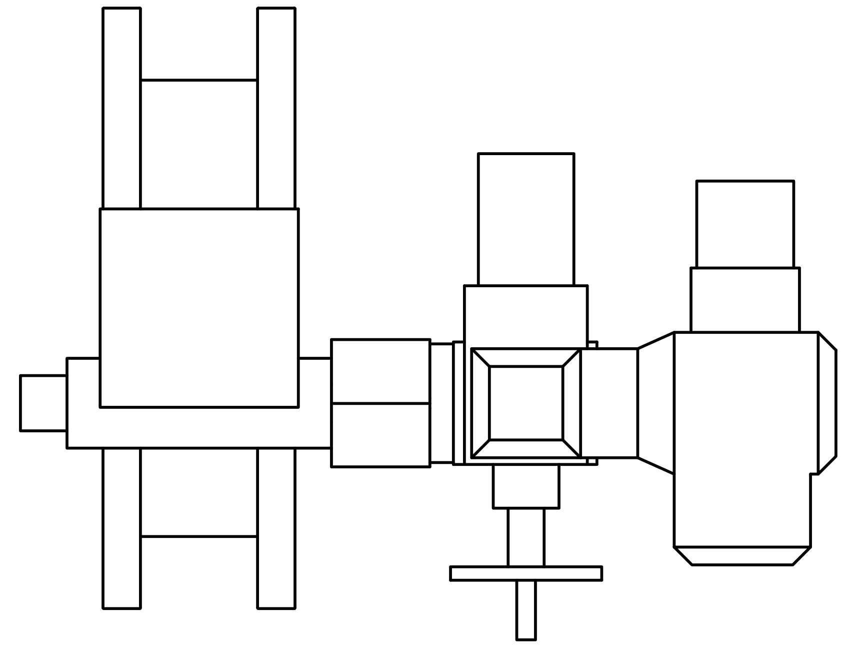
VIEW



POSITION 1

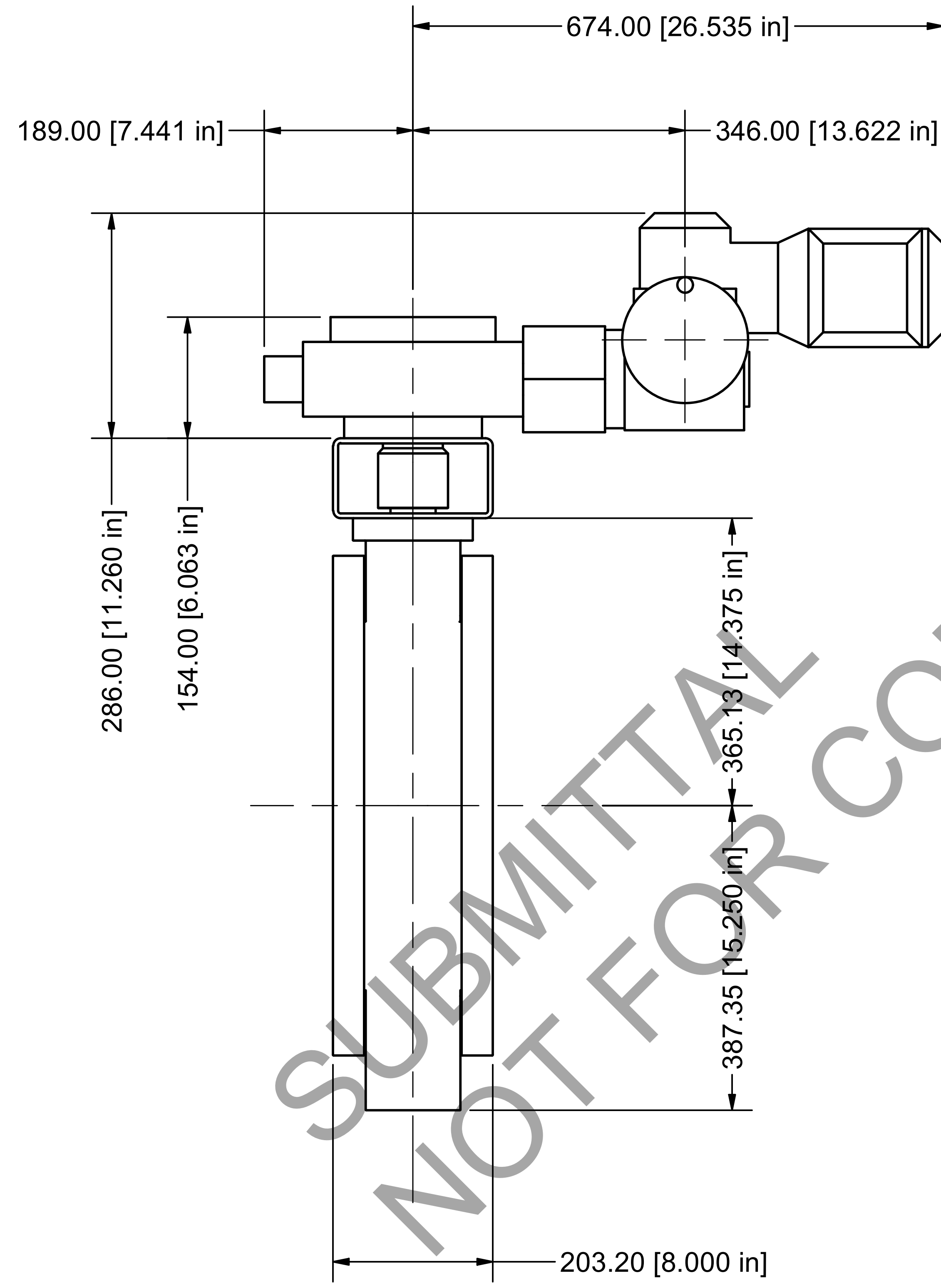


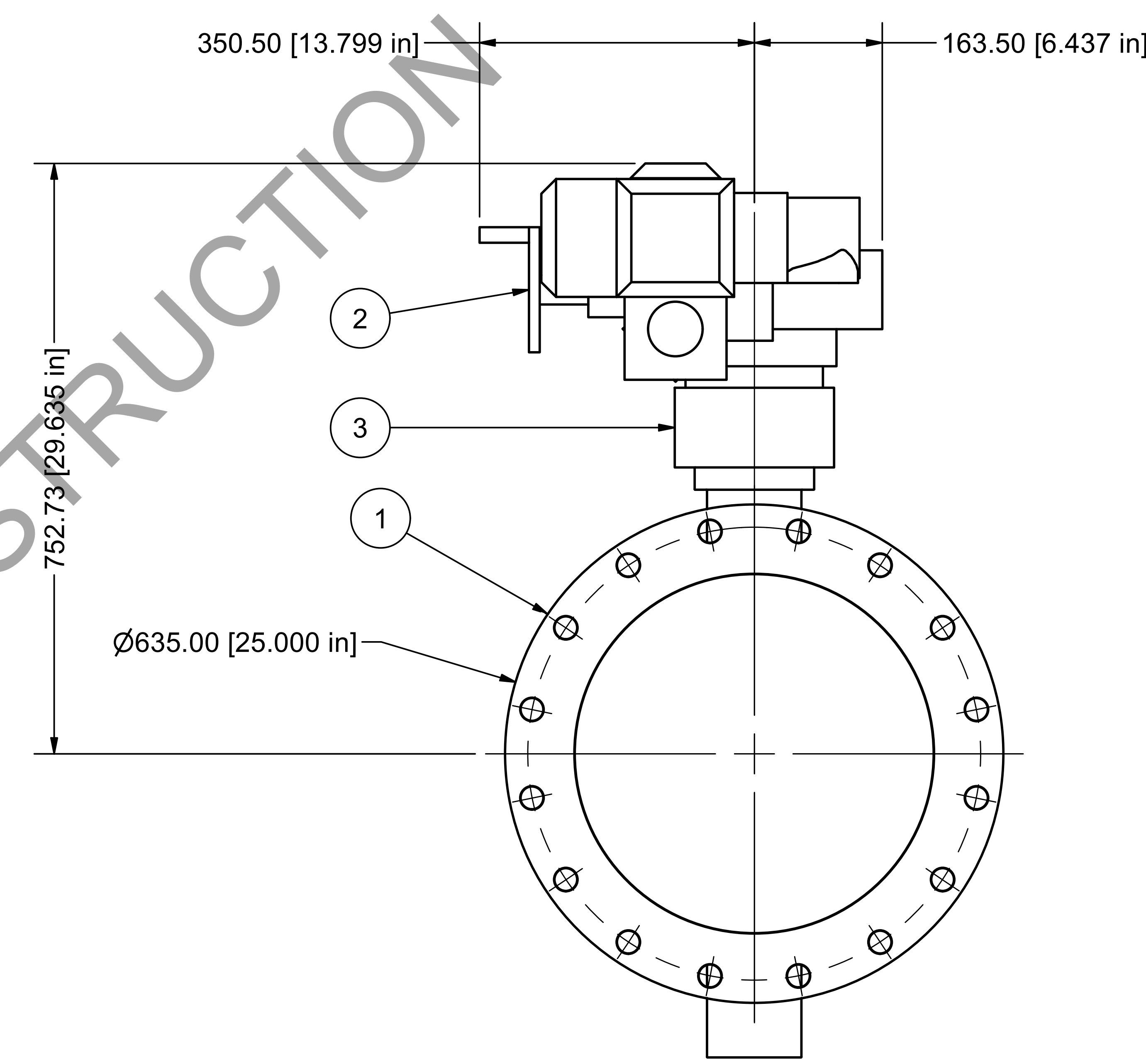
POSITION 2



ASSEMBLY NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS, INC. TEST REPORT MUST INCLUDE ALL PART NUMBERS, SERIAL NUMBERS AND PURCHASE ORDER NUMBERS.
2. OPERATING TIMES FOR 90 DEGREE OPERATION: 30 SECONDS.





ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2620626-SX0	MOUNTING KIT, 18" MIL 511A-TO-AUMA GS100.3	304 SS	-
2	1	9704419A30134	ACTUATOR ASSY, AUMA, SAEX07.6, 575V, CSA	-	Y
1	1	2615543	VALVE, 18" B/F MILLIKEN #511A	CAST IRON	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

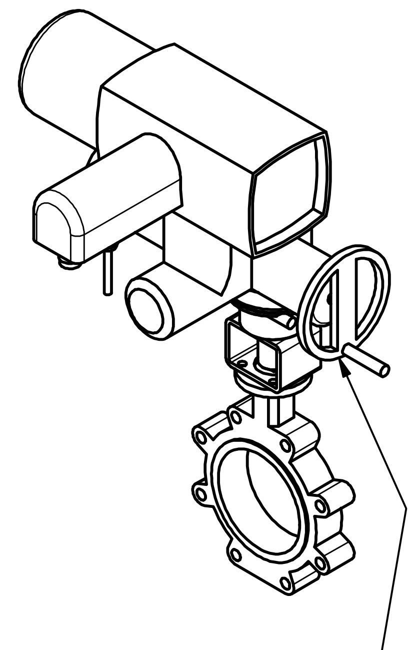
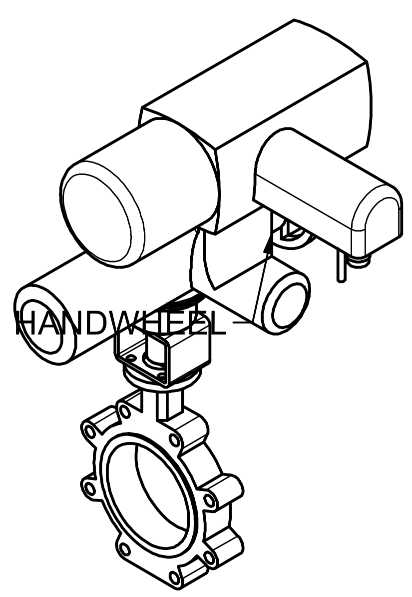
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

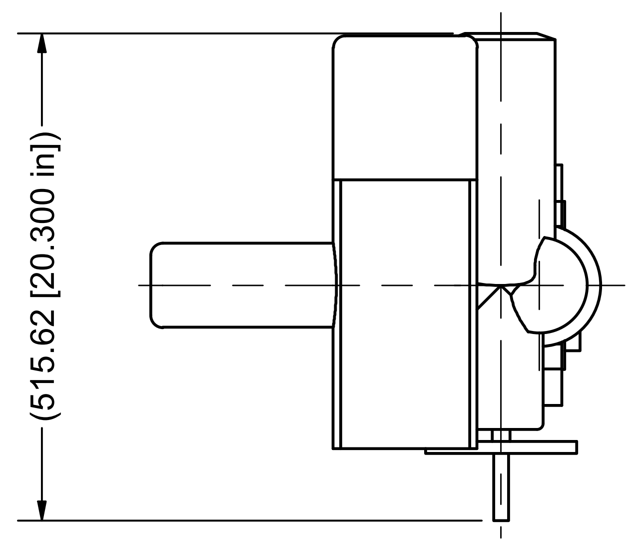
ANSI

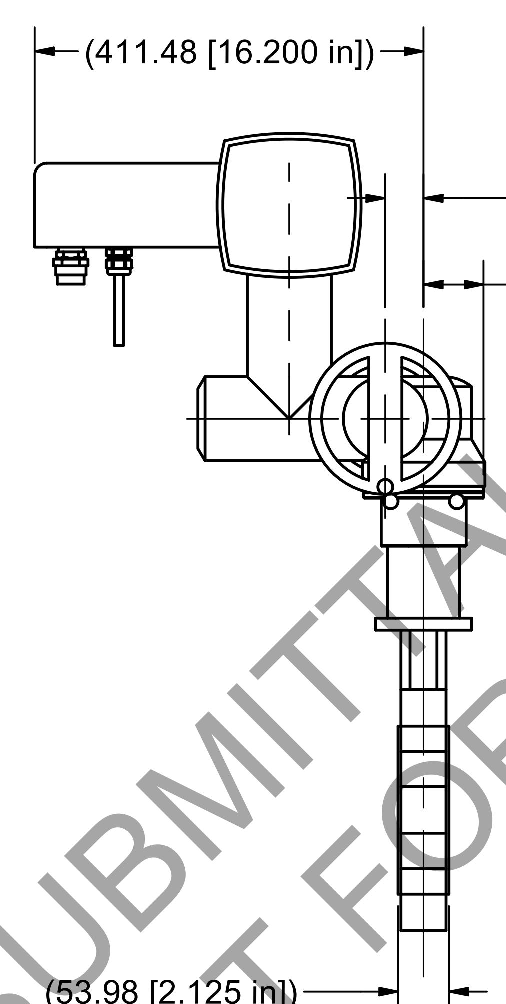
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL: -
SIMILAR TO: 2968638
TYPE: VALVE
DRAWN BY: CJC
DATE: 2025-01-29
WEIGHT: 214 KG
SHEET: 1 OF 1

DRAWING NAME: VALVE ASSY, 18", BFLY, AUMA SAEX07.6, 575V
DRAWING NUMBER: 9704419A30127
SCALE: 1/8
SIZE: C

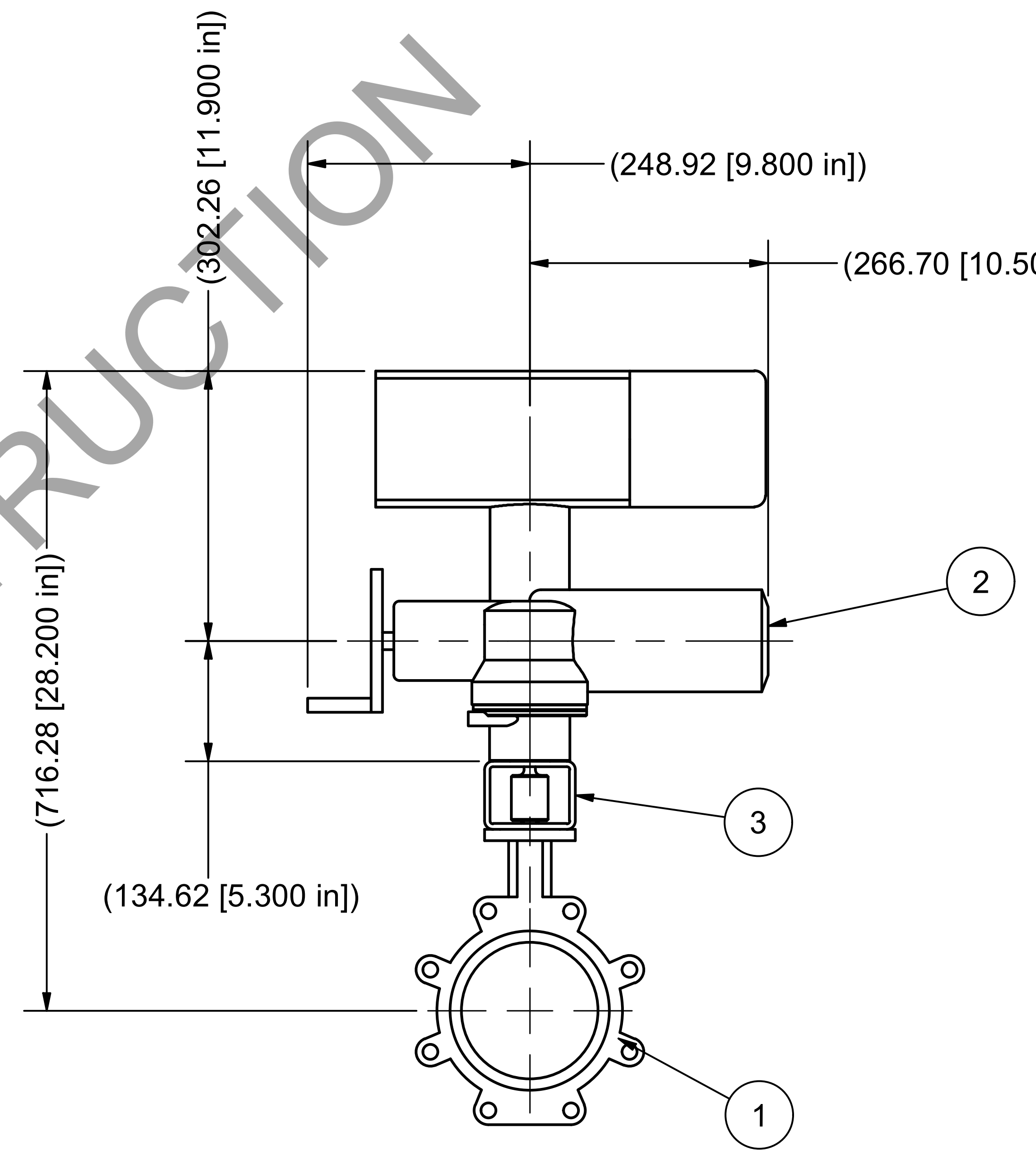
POS	VIEW
1	
2	





NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED PER DIAGRAM #2702953, AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART, SERIAL AND PURCHASE ORDER NUMBERS.
2. 90° OPERATING TIME: 12 SECONDS.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2620468-SX0	MTG KIT, 6", ABZ 396 TO AUMA SQ7.2	304 SS	-
2	1	9704419A30135	ACTUATOR ASSY, AUMA SQR07.2, 575V, CSA	-	Y
1	1	2617009	VALVE, BFLY, 6" ABZ FIGURE 397, LO	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

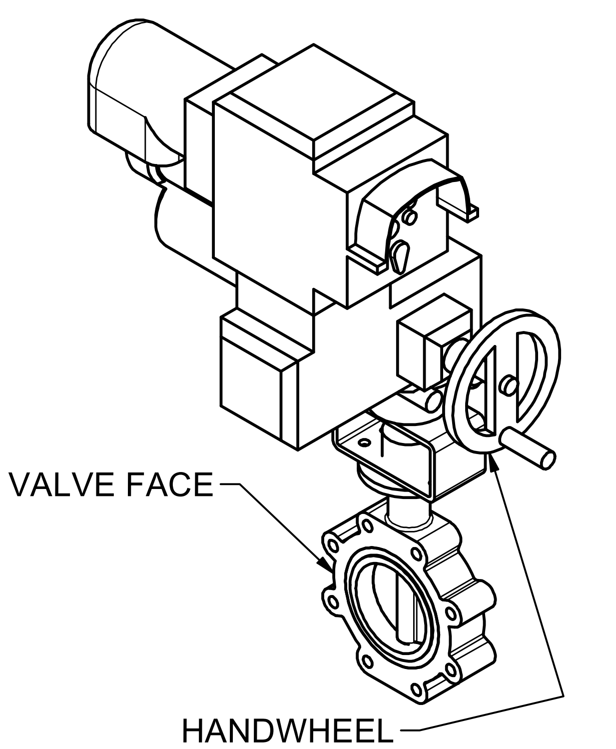
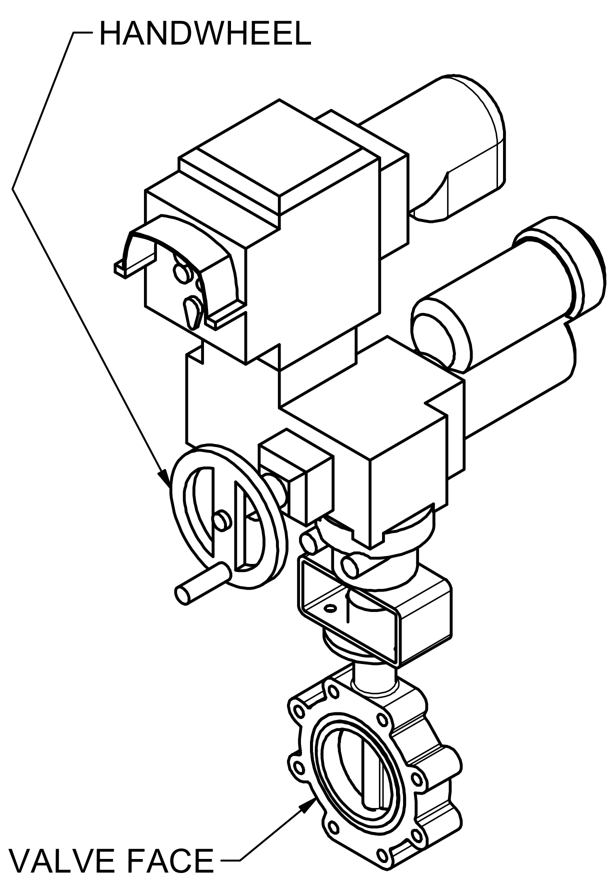
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

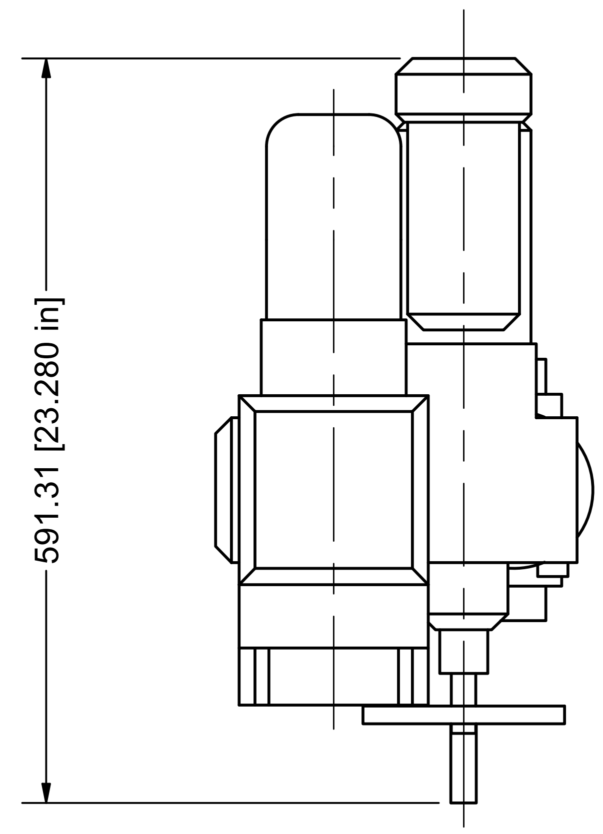
ANSI

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL: -
SIMILAR TO: 2968852
TYPE: VALVE
DRAWN BY: CJC
DATE: 2025-01-28
WEIGHT: 42 KG
SHEET: 1 OF 1

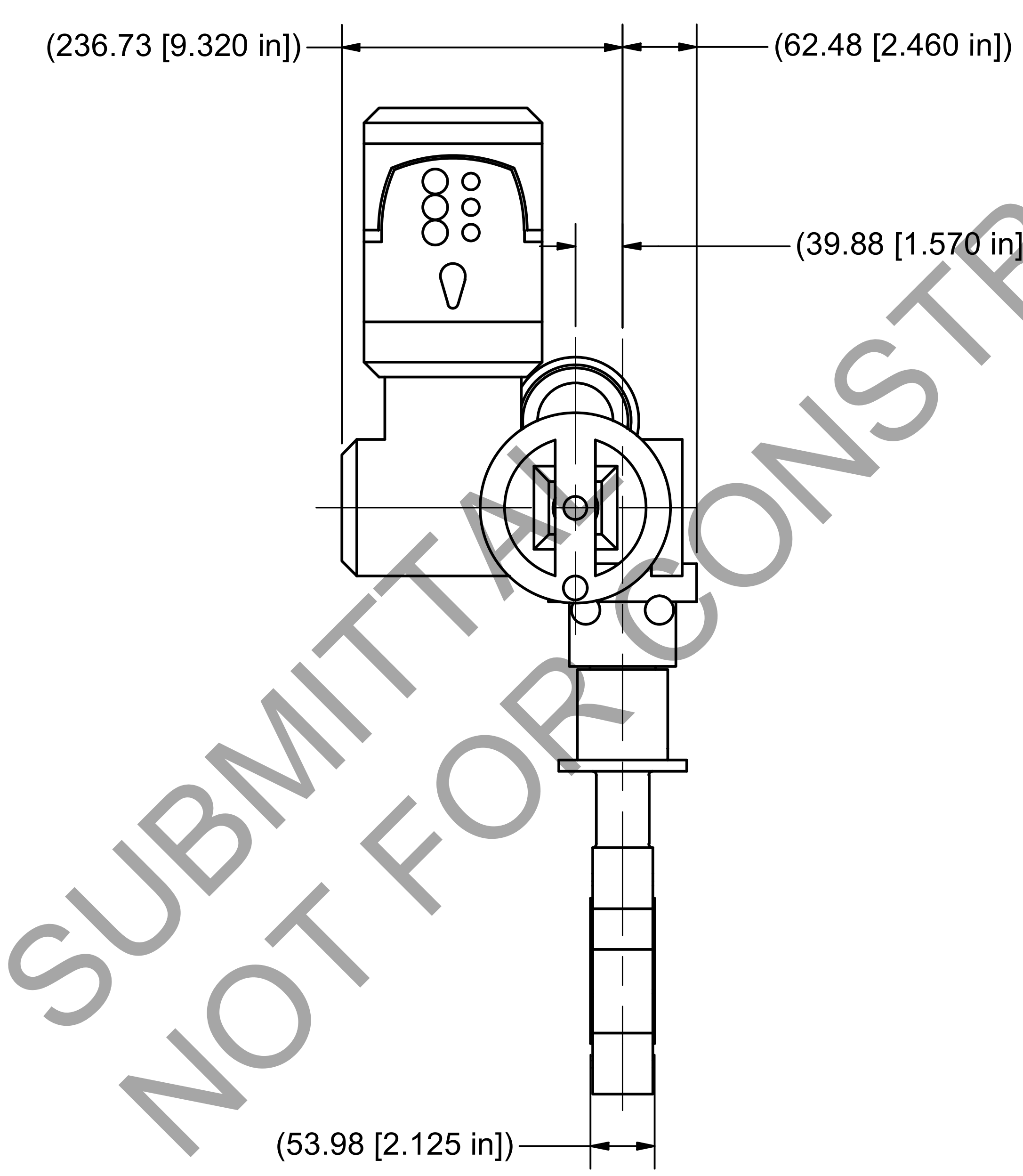
DRAWING NAME: VALVE ASSY, 6", BFLY, AUMA SQR07.2, 575V
DRAWING NUMBER: 9704419A30128
SCALE: 1/6
SIZE: C

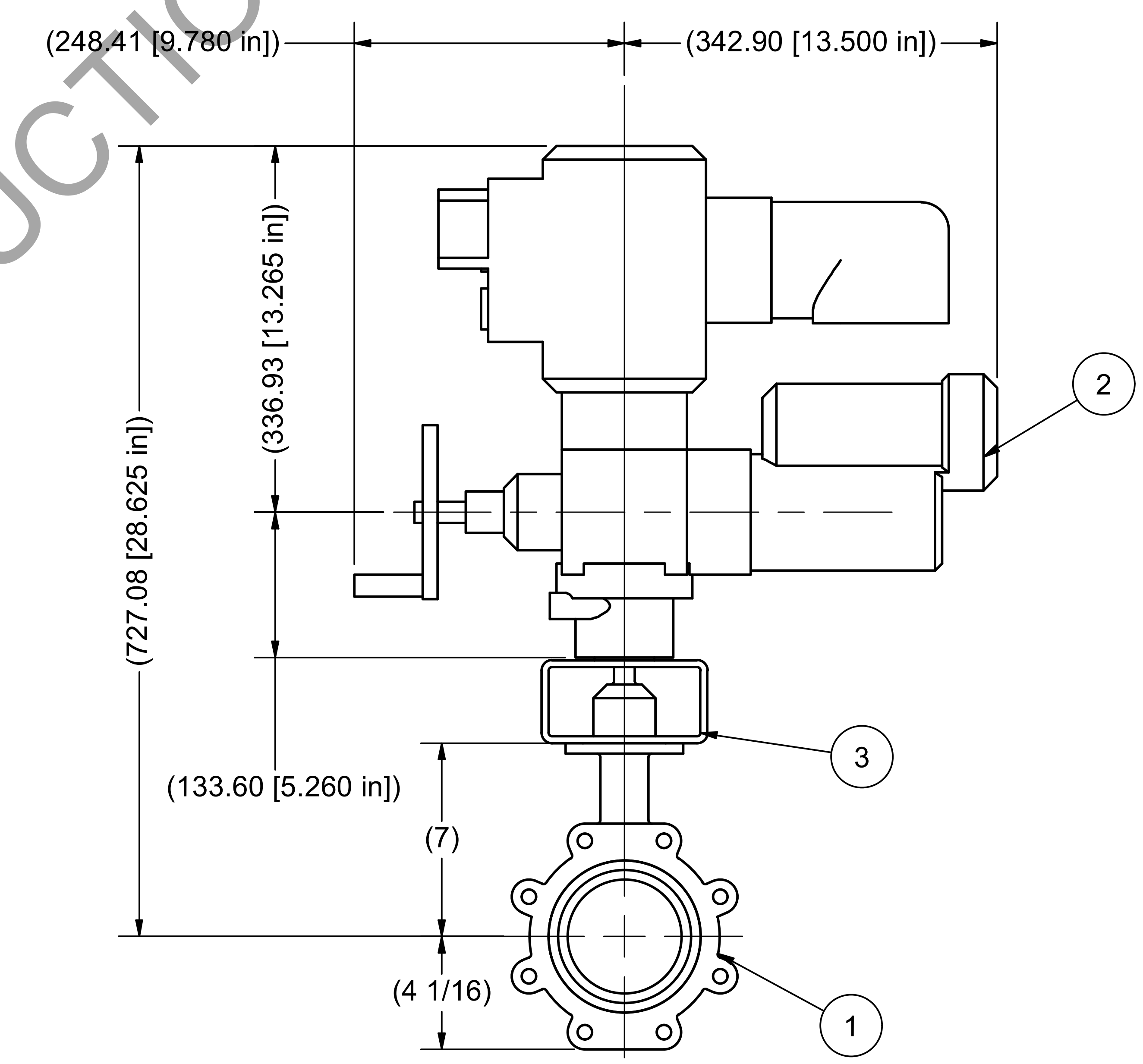
POS	View
1	
2	



NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED PER DIAGRAM #2702997, AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART, SERIAL AND PURCHASE ORDER NUMBERS.
2. 90° OPERATING TIME: 12 SECONDS.





ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2621522-SX0	MTG KIT, 4" ABZ 397 TO AUMA SQ07.2	304 SS	-
2	1	9704419A30136	ACTUATOR ASSY, AUMA, SQEx07.2, 115V, LC, CSA	-	Y
1	1	2617008	VALVE, BFLY, 4", ABZ FIGURE 397, LO	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARION, CANADA

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

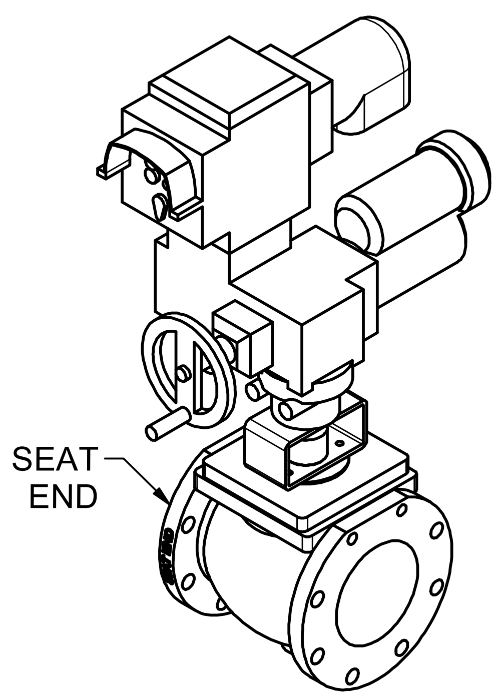
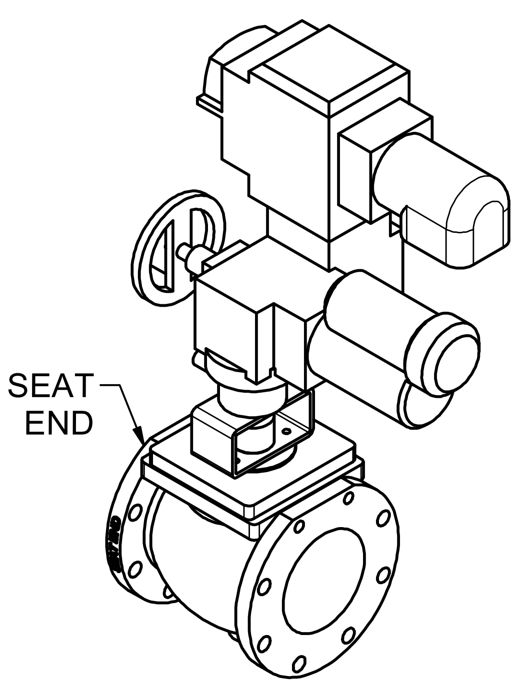
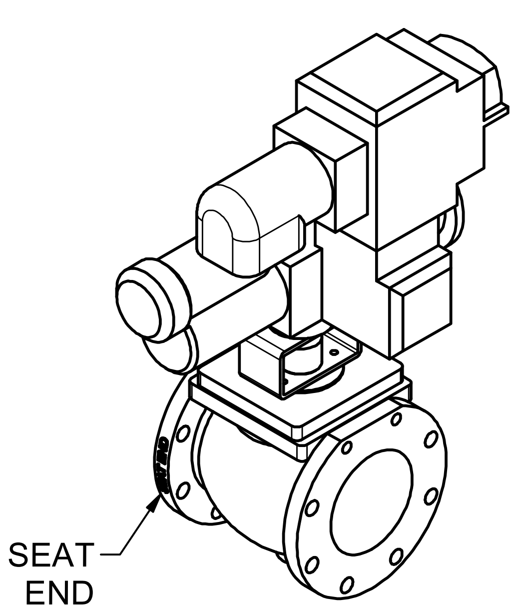
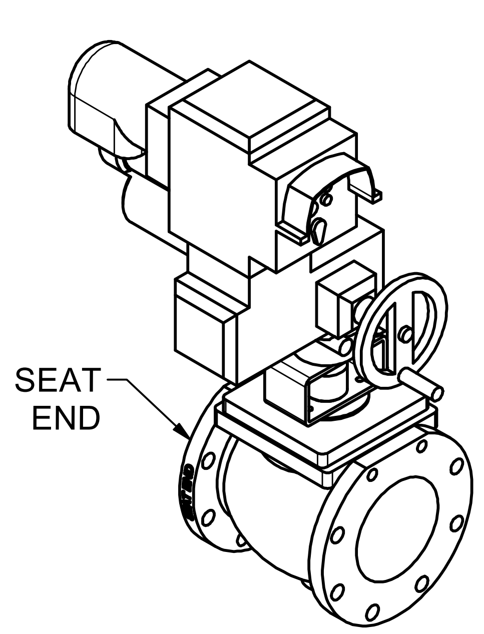
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 2969211
TYPE: VALVE
DRAWN BY: CJC DATE: 2025-01-28
WEIGHT: 22 KG SHEET: 1 OF 1

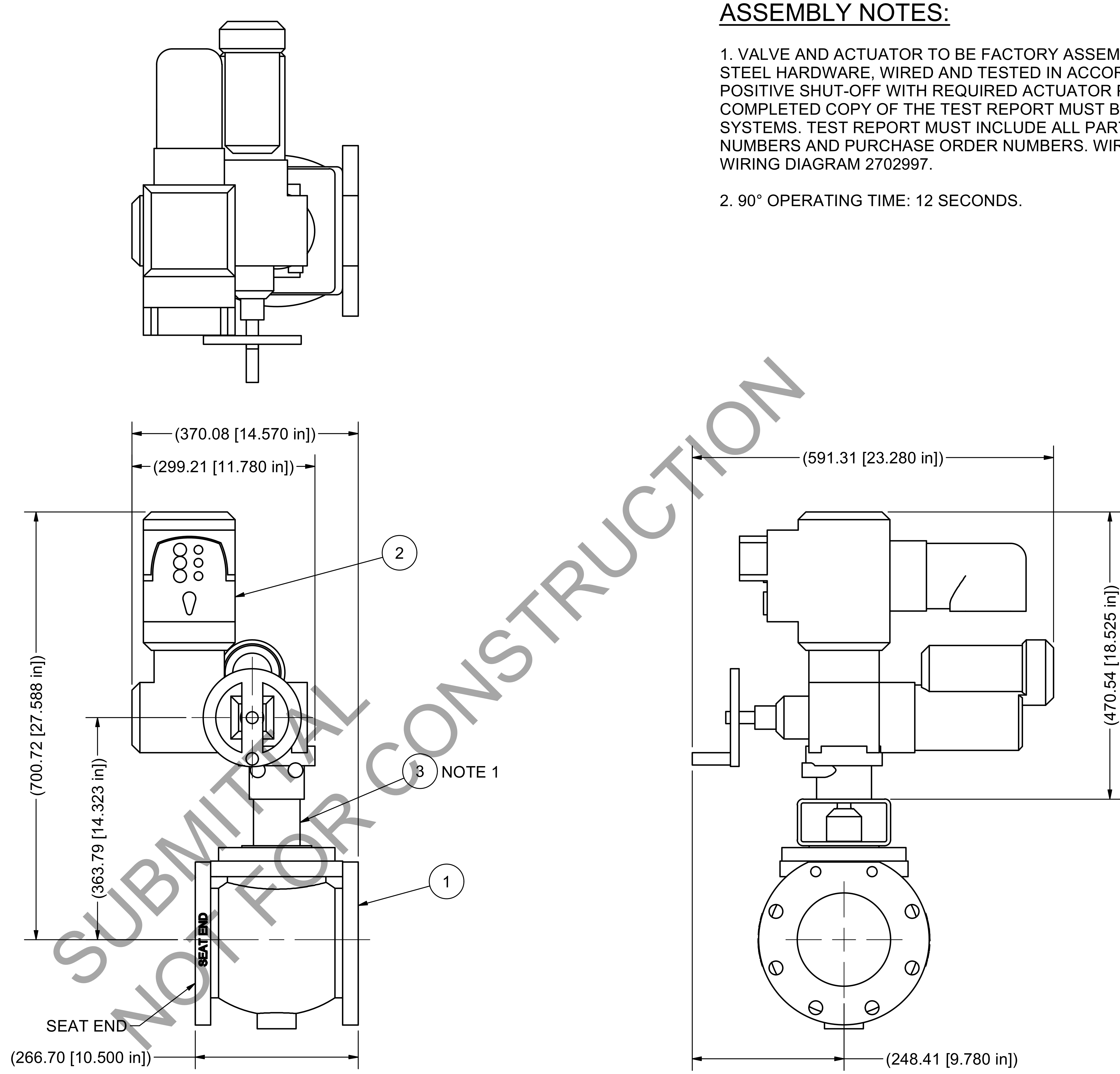
DRAWING NAME: VALVE ASSY, 4", BFLY, AUMA SQEX07.2, 115V
DRAWING NUMBER: 9704419A30129 SCALE: 1/4 SIZE: C

POS	VIEW
1	
2	
3	
4	

ASSEMBLY NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART NUMBERS, SERIAL NUMBERS AND PURCHASE ORDER NUMBERS. WIRE THE ACTUATOR PER WIRING DIAGRAM 2702997.

2. 90° OPERATING TIME: 12 SECONDS.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2617237-SX0	MOUNTING KIT, 6" MIL PLUG TO AUMA SQ07.2	304 SS	-
2	1	9704419A30136	ACTUATOR ASSY, AUMA, SQEx07.2, 115V, LC, CSA	-	Y
1	1	2613169	VALVE, PLUG, 6", MILL 601, LO	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

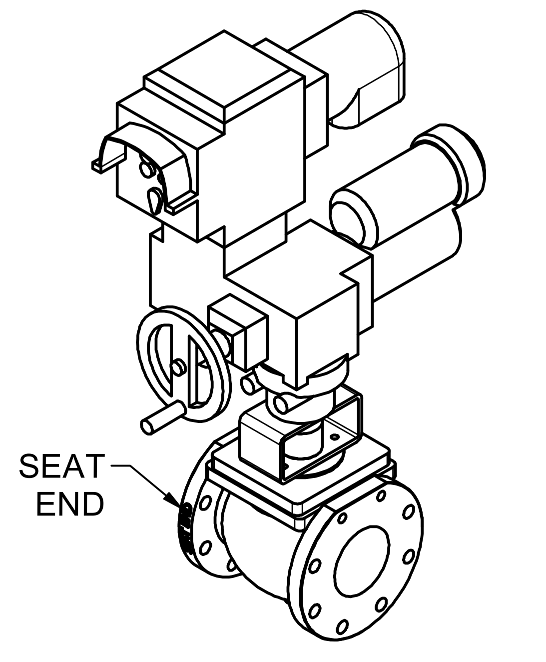
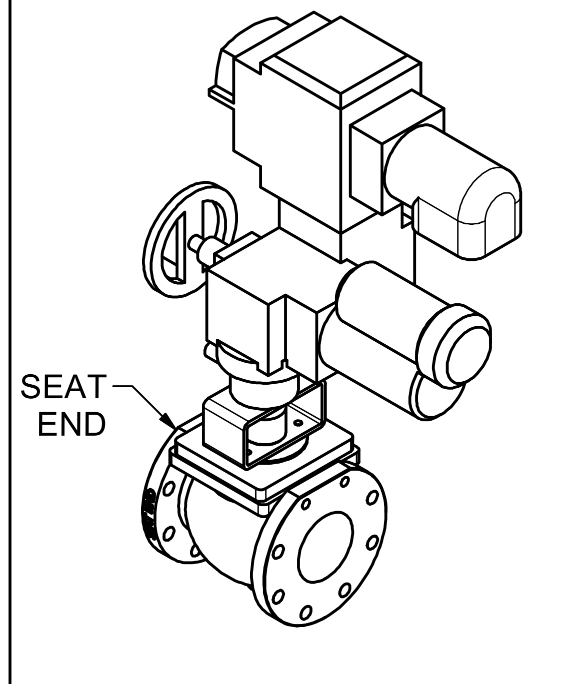
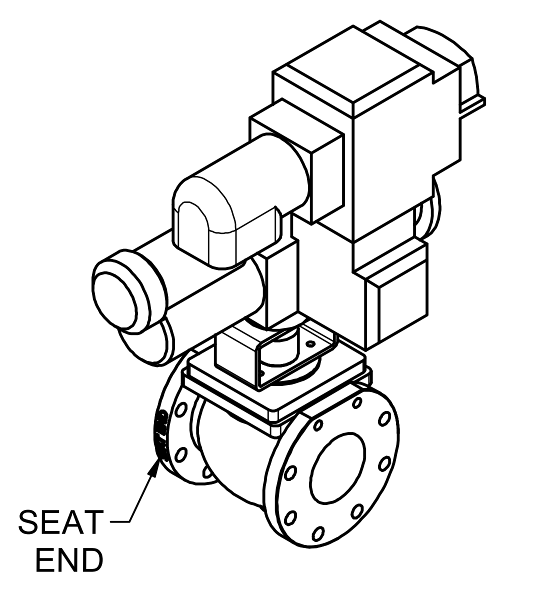
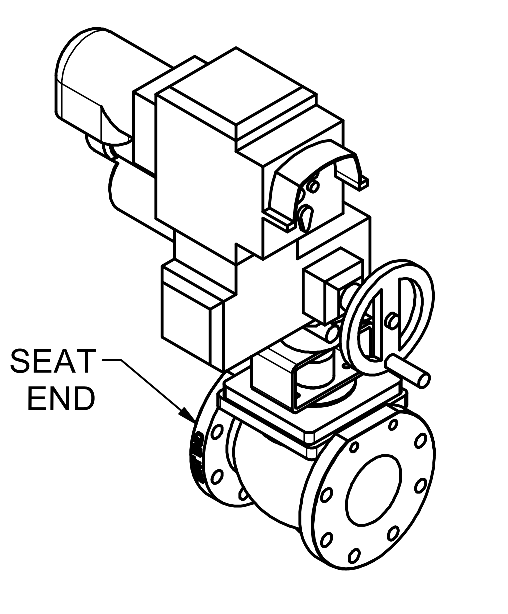
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

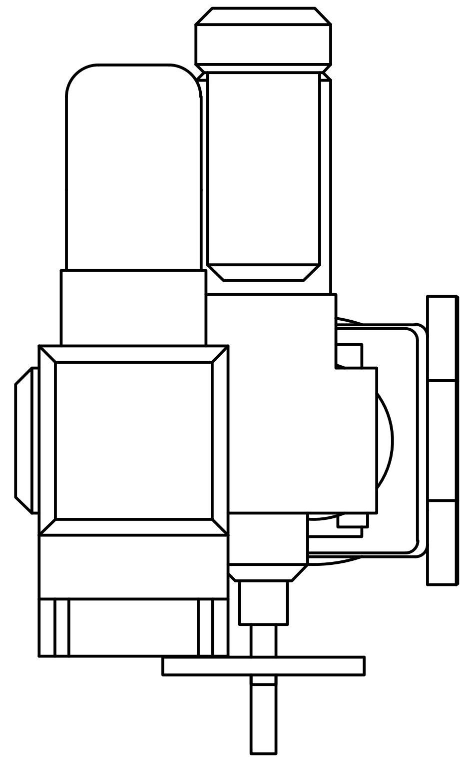
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 2968862
TYPE: VALVE
DRAWN BY: CJC
DATE: 2025-01-28
WEIGHT: 66 KG
SHEET: 1 OF 1
DRAWING NAME: VALVE ASSY, 6", PLUG, AUMA SQEX07.2, 115V
DRAWING NUMBER: 9704419A30130
SCALE: 1/6
SIZE: C

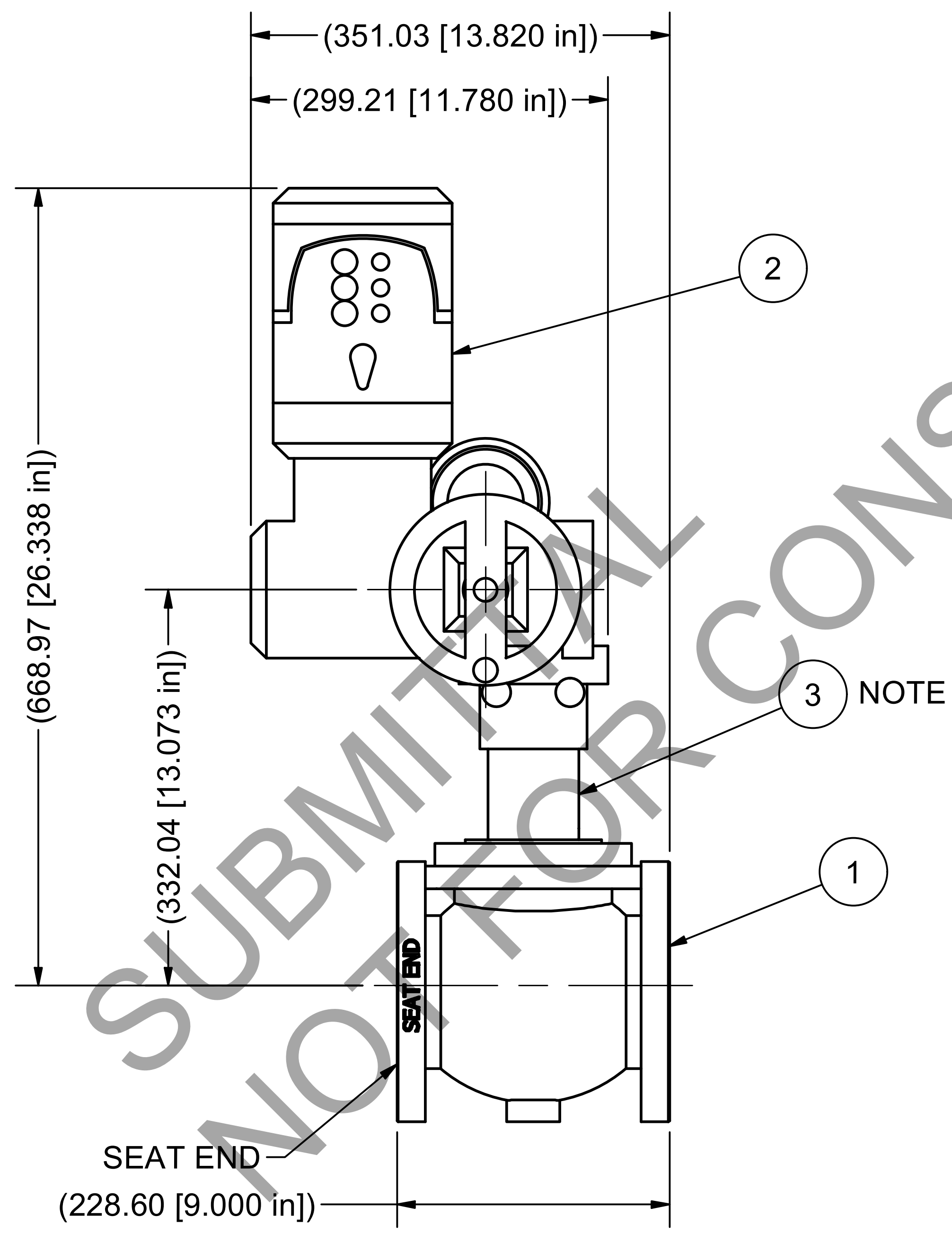
POS	VIEW
1	
2	
3	
4	

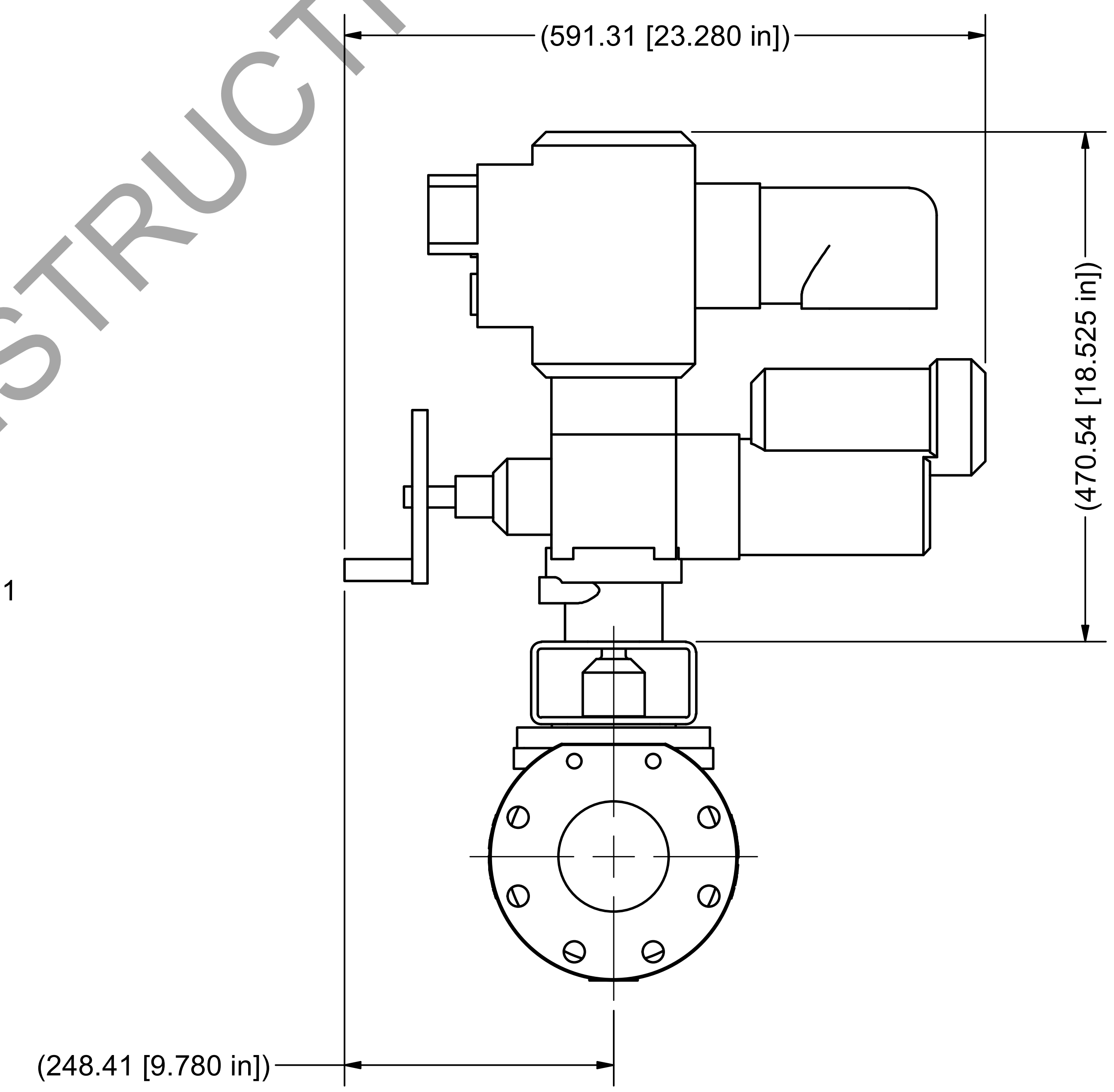


ASSEMBLY NOTES:

1. VALVE AND ACTUATOR TO BE FACTORY ASSEMBLED WITH 304 STAINLESS STEEL HARDWARE, WIRED AND TESTED IN ACCORDANCE WITH ES-1052 POSITIVE SHUT-OFF WITH REQUIRED ACTUATOR PRIOR TO SHIPPING. A COMPLETED COPY OF THE TEST REPORT MUST BE SENT TO AQUA-AEROBIC SYSTEMS. TEST REPORT MUST INCLUDE ALL PART NUMBERS, SERIAL NUMBERS AND PURCHASE ORDER NUMBERS. WIRE THE ACTUATOR PER WIRING DIAGRAM 2702997.

2. 90° OPERATING TIME: 12 SECONDS.





ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2617164-SX0	MOUNTING KIT, 4" MIL PLUG TO AUMA SQ07.2	304 SS	-
2	1	9704419A30136	ACTUATOR ASSY, AUMA, SQEx07.2, 115V, LC, CSA	-	Y
1	1	2613166	VALVE, PLUG, 4", MILL 601, LO	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

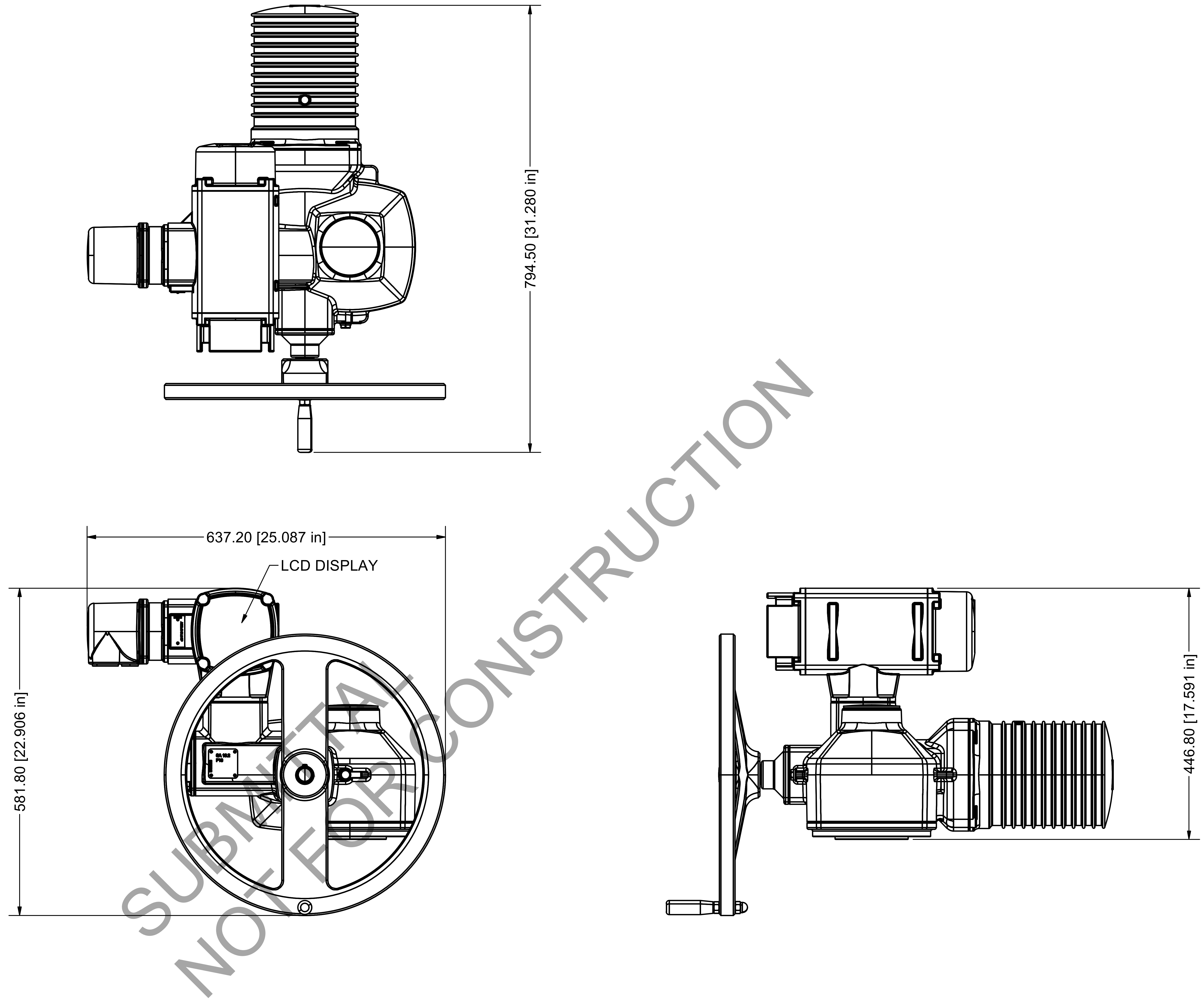
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL:
SIMILAR TO: 2968850
TYPE: VALVE
DRAWN BY: CJC — DATE: 2025-01-28
WEIGHT: 44 KG — SHEET: 1 OF 1

DRAWING NAME: VALVE ASSY, 4", PLUG, AUMA SQEX07.2, 115V
DRAWING NUMBER: 9704419A30131 — SCALE: 1/6 — SIZE: C



NOTES:

1. USE PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO WIRING DIAGRAM ON BILL OF MATERIAL FOR WIRING SCHEMATIC.

3. ADD ALL JUMPER WIRES TO THE INSIDE OF THE ACTUATOR PER WIRING SCHEMATIC WITH NO RECEPTACLE PLUG - TO BE HARD-WIRED AT SITE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2702815	AUMA SA/SQ WIRING DIAGRAM, 3PH, LOCAL CONTRL	-	Y
1	1	9704419A30359	ACTUATOR, AUMA, SAEX16.2, 575V, CSA	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

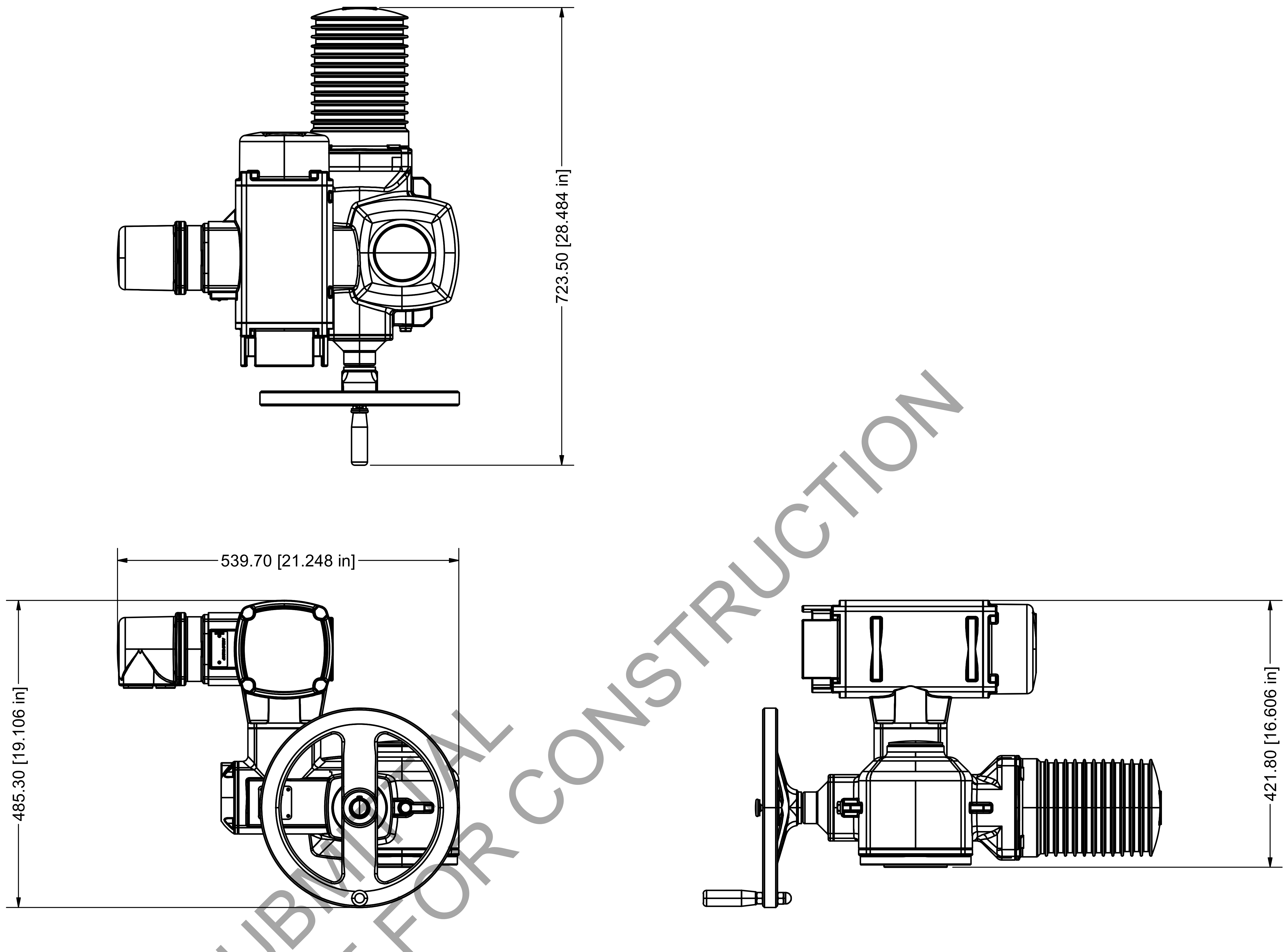
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 2968806
TYPE:
DRAWN BY: CJC — DATE: 2025-01-28
WEIGHT: 108 KG — SHEET: 1 OF 1

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DRAWING NAME: ACTUATOR ASSY, AUMA, SAEX16.2, 575V, CSA
DRAWING NUMBER: 9704419A30132
SCALE: 1/6
SIZE: C



NOTES:

1. USE PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO WIRING DIAGRAM ON BILL OF MATERIAL FOR WIRING SCHEMATIC.

3. ADD ALL JUMPER WIRES TO THE INSIDE OF THE ACTUATOR PER WIRING SCHEMATIC WITH NO RECEPTACLE PLUG - TO BE HARD-WIRED AT SITE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2702815	AUMA SA/SQ WIRING DIAGRAM, 3PH, LOCAL CONTRL	-	Y
1	1	9704419A30358	ACTUATOR, AUMA, SAEX14.6, 575V, CSA	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

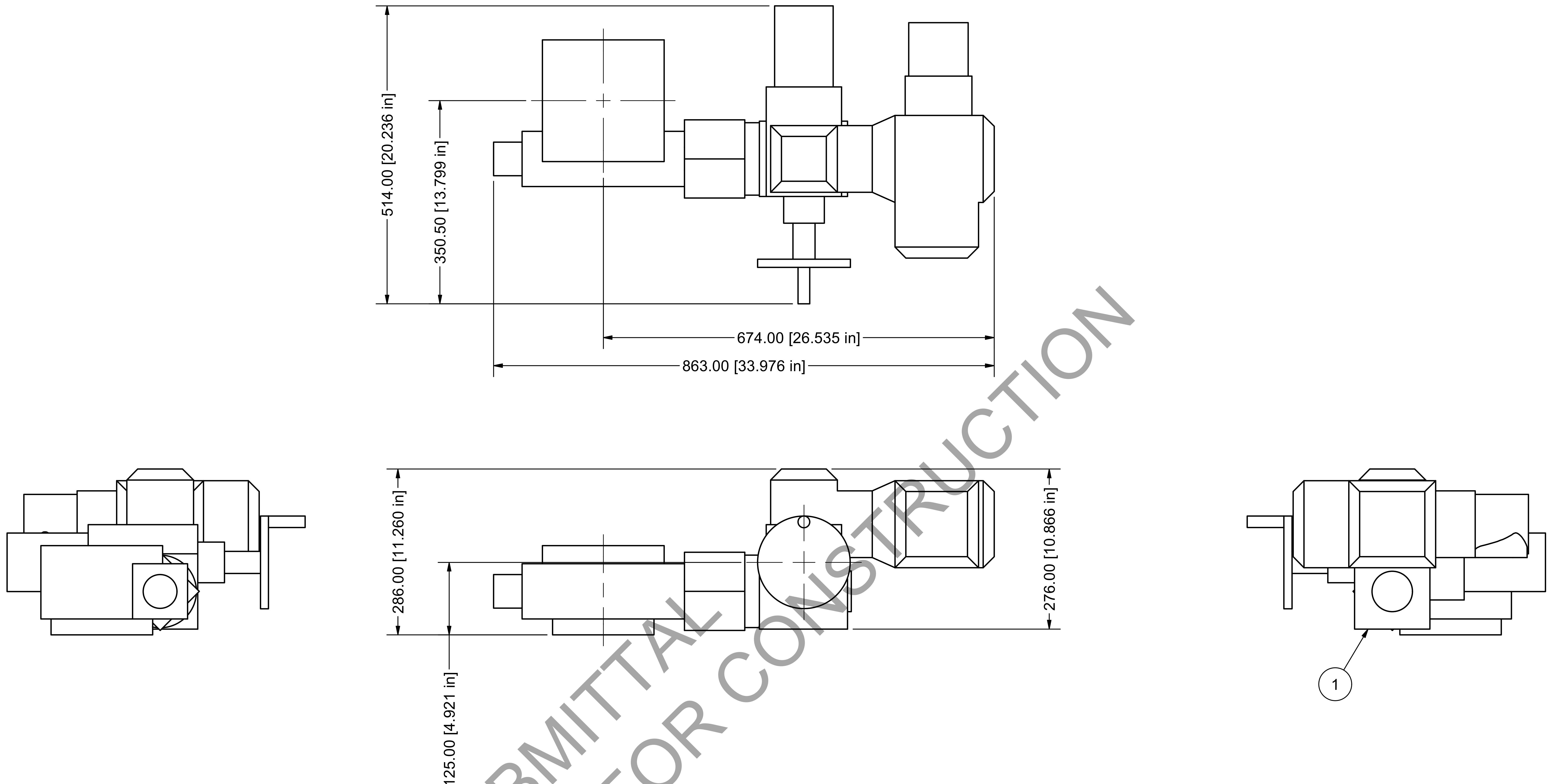
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 2968806
TYPE:
DRAWN BY: CJC — DATE: 2025-02-04
WEIGHT: 78 KG — SHEET: 1 OF 1

DRAWING NAME: ACTUATOR ASSY, AUMA, SAEX14.6, 575V, CSA
DRAWING NUMBER: 9704419A30133 — SCALE: 1/6 — SIZE: C



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2702815	AUMA SA/SQ WIRING DIAGRAM, 3PH, LOCAL CONTRL	-	Y
1	1	9704419A30354	ACTUATOR, AUMA SAExC07.6/GS100.3/VZ4.3, LC	-	-

NOTES:

1. USE PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO WIRING DIAGRAM ON BILL OF MATERIAL FOR WIRING SCHEMATIC.

3. ADD ALL JUMPER WIRES TO THE INSIDE OF THE ACTUATOR PER WIRING SCHEMATIC WITH NO RECEPTACLE PLUG - TO BE HARD-WIRED AT SITE.

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

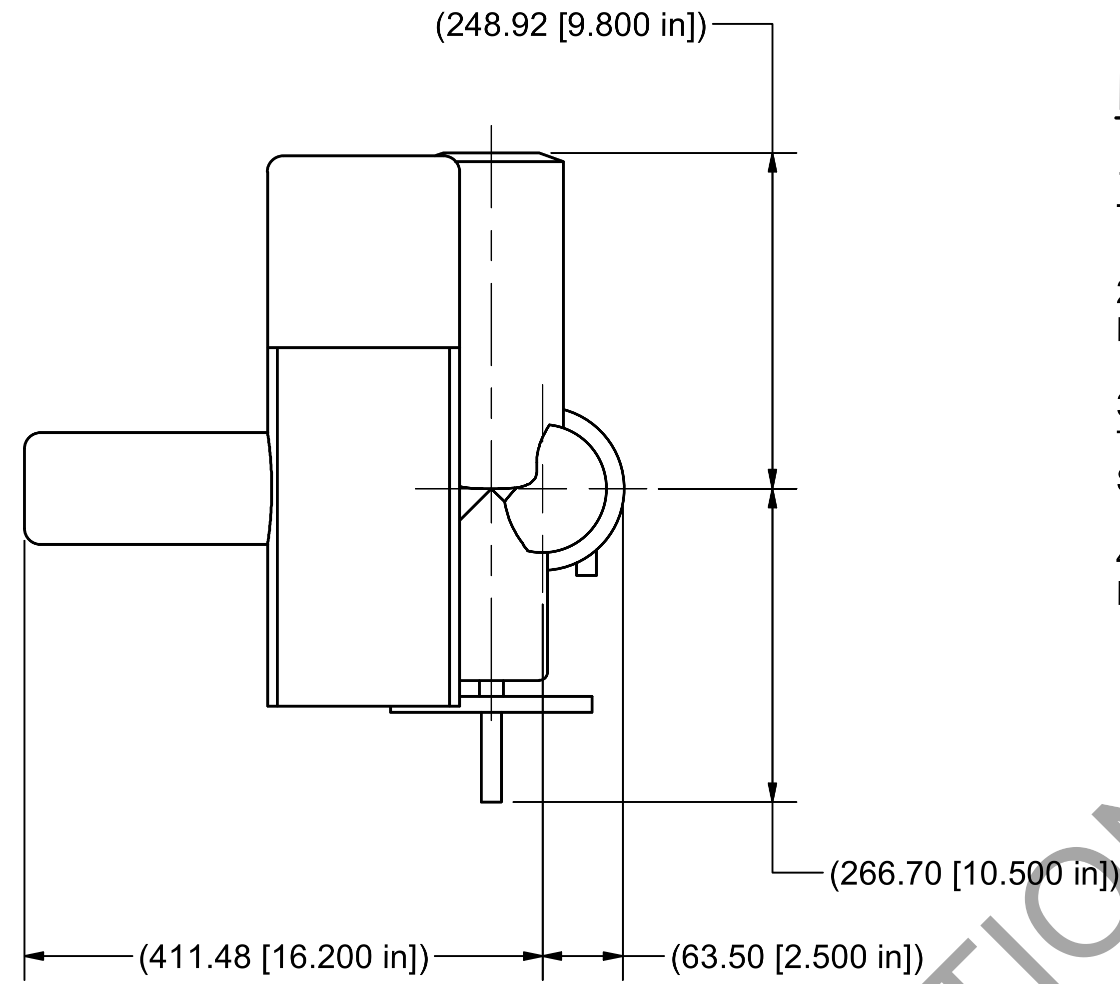
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 2968806
TYPE:
DRAWN BY: CJC — DATE: 2025-01-28
WEIGHT: 73 KG — SHEET: 1 OF 1

DRAWING NAME: ACTUATOR ASSY, AUMA, SAEX07.6, 575V, CSA
DRAWING NUMBER: 9704419A30134 — SCALE: 1/6 — SIZE: C



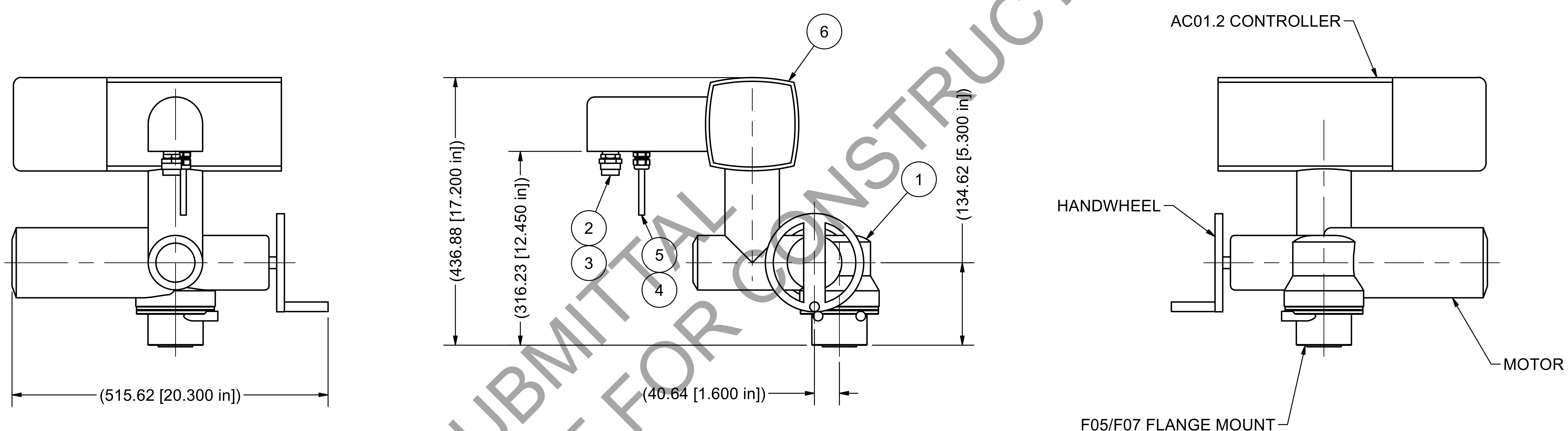
NOTES:

1. USE TEFLON PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO THE WIRING DIAGRAM ON THE BILL OF MATERIAL FOR THE WIRING SCHEMATIC.

3. ENG. NOTE, THIS ACTUATOR DELIVERS 221 FT-LBS TORQUE & OPERATING TIME FOR 90 DEG TURN IS 12 SECONDS.

4. SEVEN INCH MIN CLEARANCE RECOMMENDED TO REMOVE COVER AND EQUIPMENT ADJUSTMENT.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
6	1	2702953	AQUA 3-PHASE SQR MOD WIRING DIAGRAM	-	Y
5	20 FT	2702210	CABLE, 2-PAIR, 18 AWG	PVC	-
4	1	2620336	CORDGRIP, .24-.47", 1/2" NPT, STRT, BLACK NYLON, IP68	PA	-
3	1	2605748	BUSHING, RED, NPT, S80, 3/4" X 1/2"	PVC	-
2	1	2612932	RECEPTACLE, 12P, MALE 12" LEAD	NYLON	-
1	1	9704419A30135	ACTUATOR, AUMA, SQR07.2, 575V, CSA	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

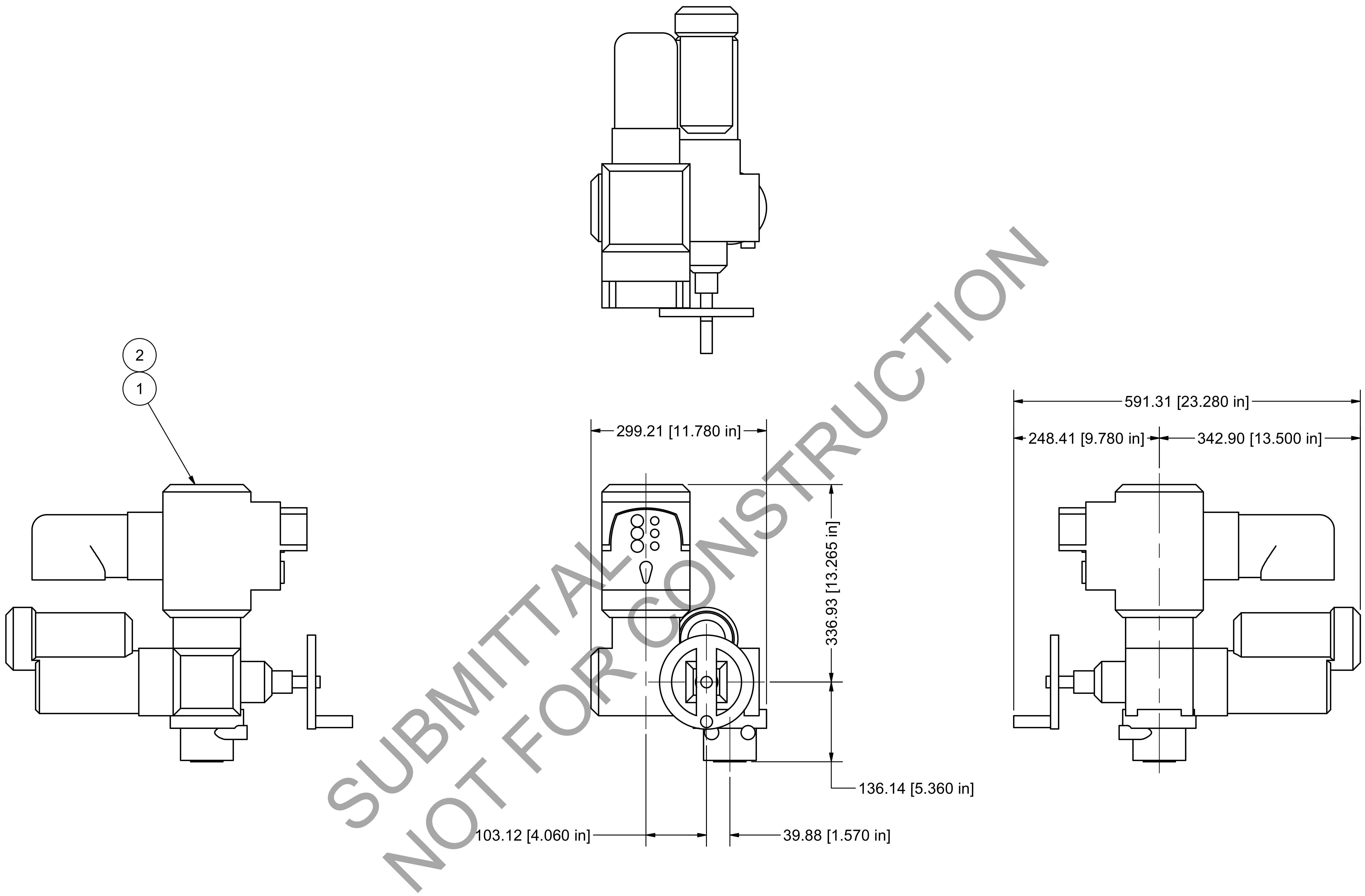
REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: -
SIMILAR TO: 2968826
TYPE: ACTUATOR
DRAWN BY: CJC DATE: 2025-01-28
WEIGHT: 28 KG SHEET: 1 OF 1

DRAWING NAME: ACTUATOR ASSY, AUMA SQR07.2, 575V, CSA
DRAWING NUMBER: 9704419A30135
SCALE: 1/6
SIZE: C



NOTES:

1. USE PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO THE WIRING DIAGRAM ON THE BILL OF MATERIAL FOR WIRING SCHEMATIC.

3. ADD ALL JUMPER WIRES TO THE INSIDE OF THE ACTUATOR PER WIRING SCHEMATIC, NO RECEPTACLE PLUG, TO BE HARD WIRED AT SITE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2702997	AUMA SQ WIRING DIAGRAM	-	Y
1	1	9704419A30352	ACTUATOR, AUMA, SQEx07.2, 115V, LC, CSA	-	-

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

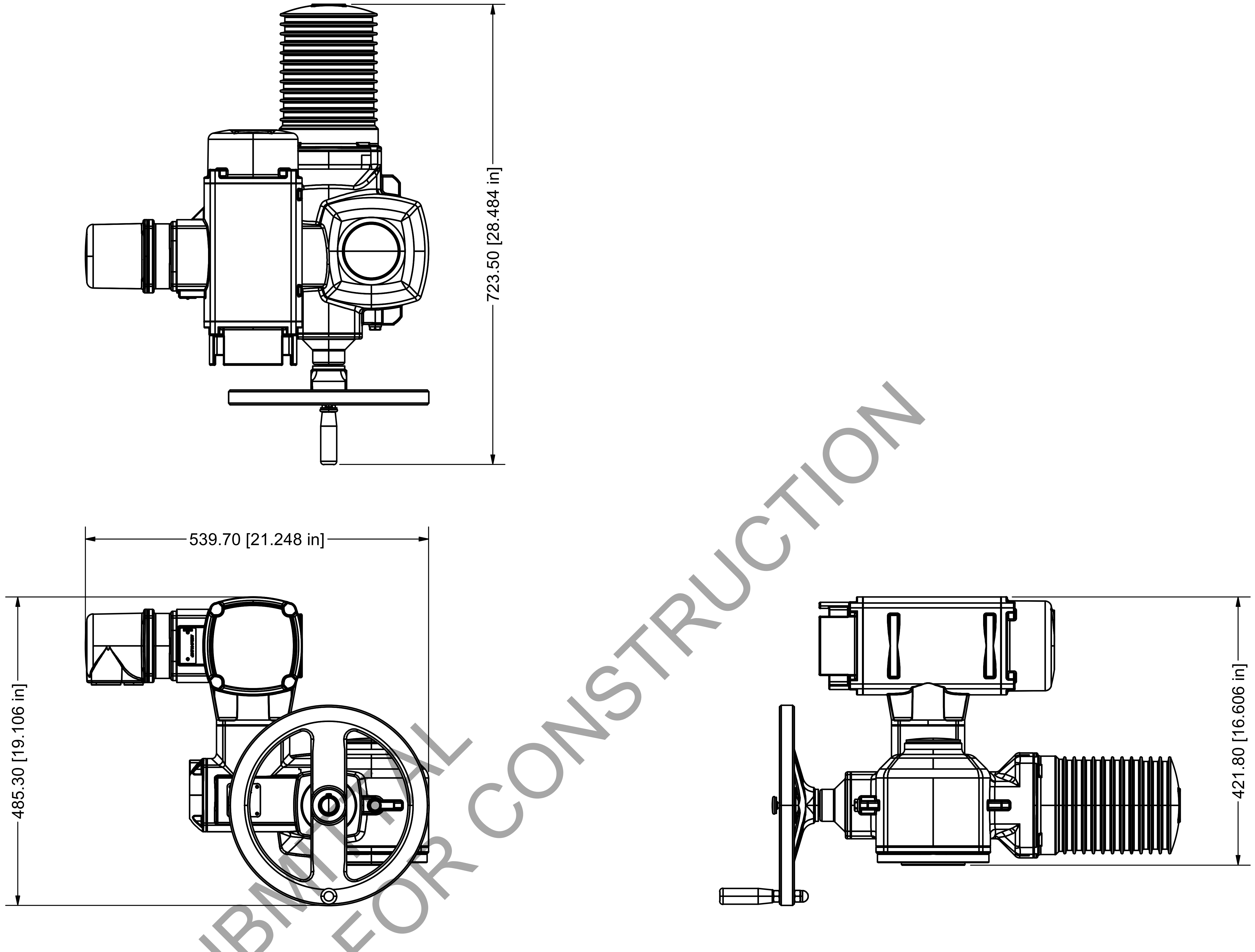
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

MATERIAL: -
SIMILAR TO: 2968634
TYPE: ACTUATOR
DRAWN BY: CJC | DATE: 2025-01-28
WEIGHT: 10 KG | SHEET: 1 OF 1

DRAWING NAME: ACTUATOR ASSY, AUMA, SQEx07.2, 115V, LC, CSA
DRAWING NUMBER: 9704419A30136
SCALE: 1/6
SIZE: C



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2702815	AUMA SA/SQ WIRING DIAGRAM, 3PH, LOCAL CONTRL	-	Y
1	1	9704419A30363	ACTUATOR, AUMA, SAEX14.6, 575V, CSA	-	-

NOTES:

1. USE PIPE TAPE OR PASTE ON ALL THREADED CONNECTIONS.

2. REFER TO WIRING DIAGRAM ON BILL OF MATERIAL FOR WIRING SCHEMATIC.

3. ADD ALL JUMPER WIRES TO THE INSIDE OF THE ACTUATOR PER WIRING SCHEMATIC WITH NO RECEPTACLE PLUG - TO BE HARD-WIRED AT SITE.

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

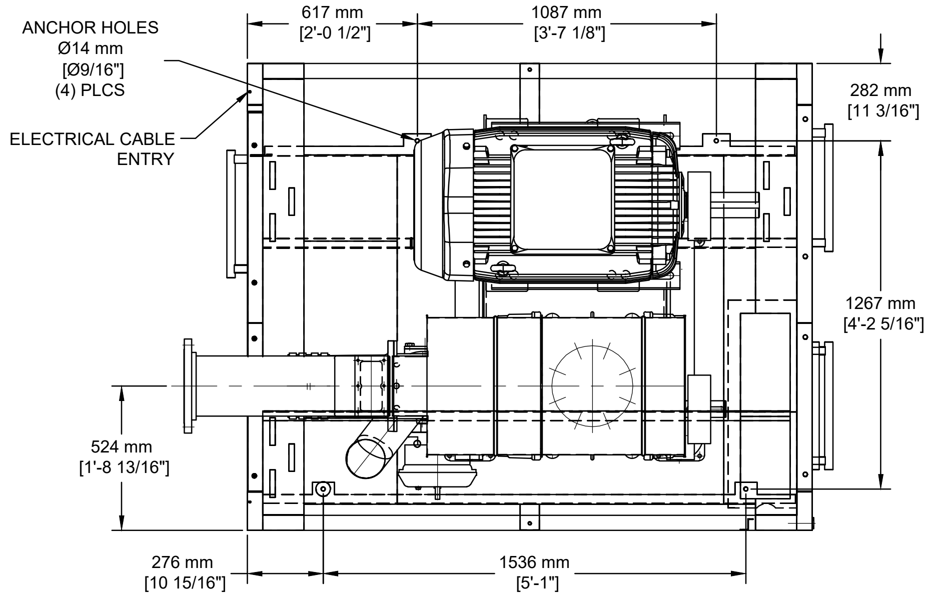
MATERIAL:
SIMILAR TO: 2968806
TYPE:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A		2025-02-14	CJC	FULL SUBMITTAL

DRAWN BY: CJC | DATE: 2025-01-28
WEIGHT: 73 KG | SHEET: 1 OF 1

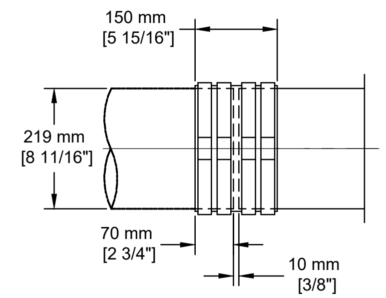
DRAWING NAME: ACTUATOR ASSY, AUMA, SAEX14.6, 575V, CSA
DRAWING NUMBER: 9704419A30137 | SCALE: 1/6 | SIZE: C

ITEM	QTY	DESCRIPTION	DESCRIPTION 2
100	1	BLOWER TORSO	GM60S, DN200
110	1	PRESSURE RELIEF VALVE	
200	1	SOUND ENCLOSURE	
300	1	ELECTRIC MOTOR	SHOWN WITH A 440 NEMA MOTOR
310	1	MOTOR MOUNTING	
320	1	BELT DRIVE	
400	1	BELT GUARD	
500	1	COOLING FAN	
600	1	DISCHARGE CONNECTION	8"-150# ANSI
700	1	INLET CONNECTION	8"-150# ANSI
800	1	INSTRUMENTATION	



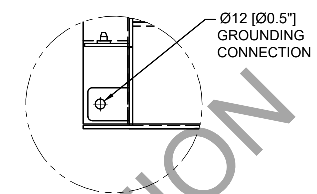
PLAN VIEW

SHOWN WITHOUT ROOF FOR CLARITY



DETAIL Z

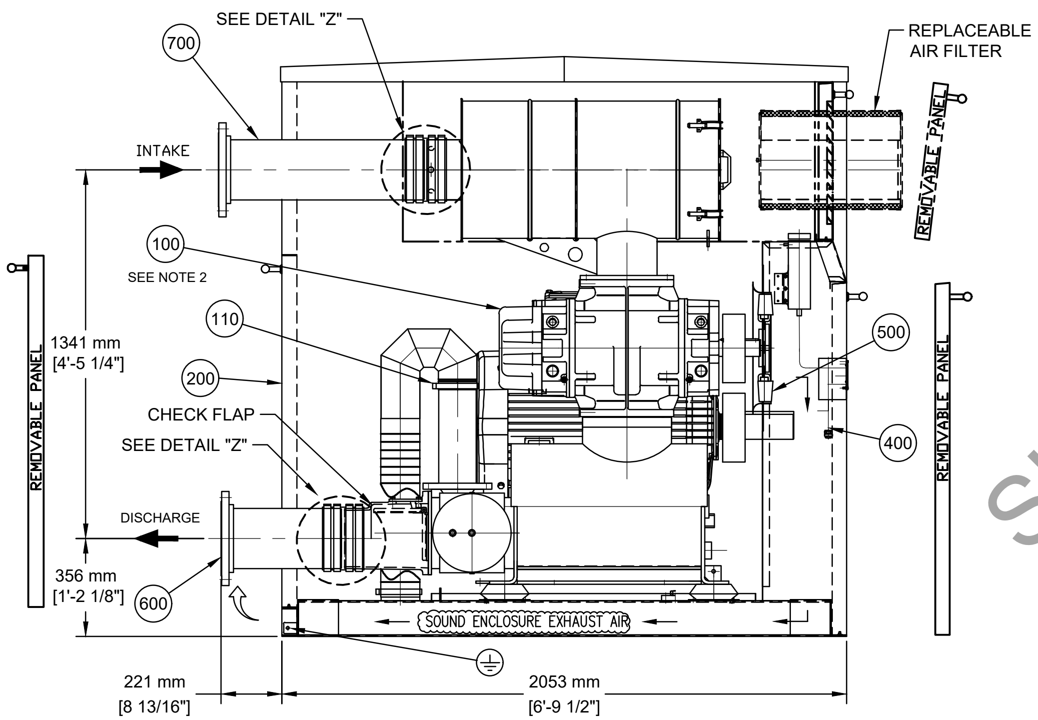
SLEEVE CONNECTION
CUSTOMER PIPE ENGAGEMENT
LEAVES 10 [0.4"] GAP
2X SCALE



EARTH GROUND

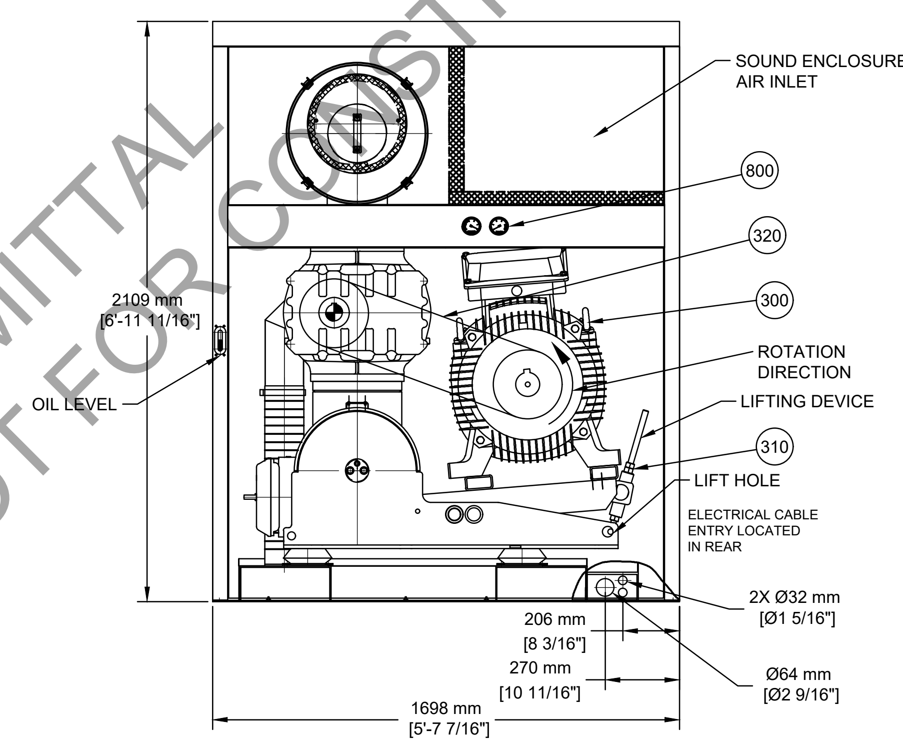
MAT'L: 304 SS
3X SCALE

SUBMITTAL
NOT FOR CONSTRUCTION



SIDE VIEW

SHOWN WITHOUT SIDE WALL FOR CLARITY



FRONT VIEW

SHOWN WITHOUT REMOVABLE PANELS FOR CLARITY

NOTES:

1. TOLERANCE ON DIMENSIONS = ±12mm [0.5"]
2. ITEM 100 (BLOWER TORSO) INCLUDES BLOWER STAGE, INLET SILENCER, BASE FRAME/DISCHARGE SILENCER, VIBRATION ISOLATORS, & CONNECTION HOUSING WITH CHECK FLAP
3. CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFT PACKAGE FROM FRONT SIDE THROUGH FORK LIFT POCKETS IN BASE
5. SEE JOB DATA SHEETS FOR PERFORMANCE DATA, PART NUMBERS, TOTAL PACKAGE WEIGHT, INSTRUMENTATION, ANY OTHER OPTIONAL EQUIPMENT & OWNERS MANUAL
6. REGUARDLESS OF THE OPERATING CONDITION, NO FORCES AND TORQUES MAY ACT ON THE MACHINE THROUGH THE CONNECTED SYSTEM PIPING. ALL CUSTOMER PIPING CONNECTIONS MUST BE DESIGNED AS FIXED POINTS AT THE AERZEN MACHINE LIMIT.

WEIGHT

BLOWER PACKAGE (LESS MOTOR)	1413 kg	3115 lb
ELECTRIC MOTOR (ITEM 300)	749 kg	1651 lb
TOTAL (WET WEIGHT)	2162 kg	4766 lb

JOB NAME: NAPANEE WPCP UPGRADES
JOB LOCATION: NAPANEE, ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R22845	2024-08-20	JFM	PRE-ORDER

DRAWING NAME: BLOWER PACKAGE, 125HP

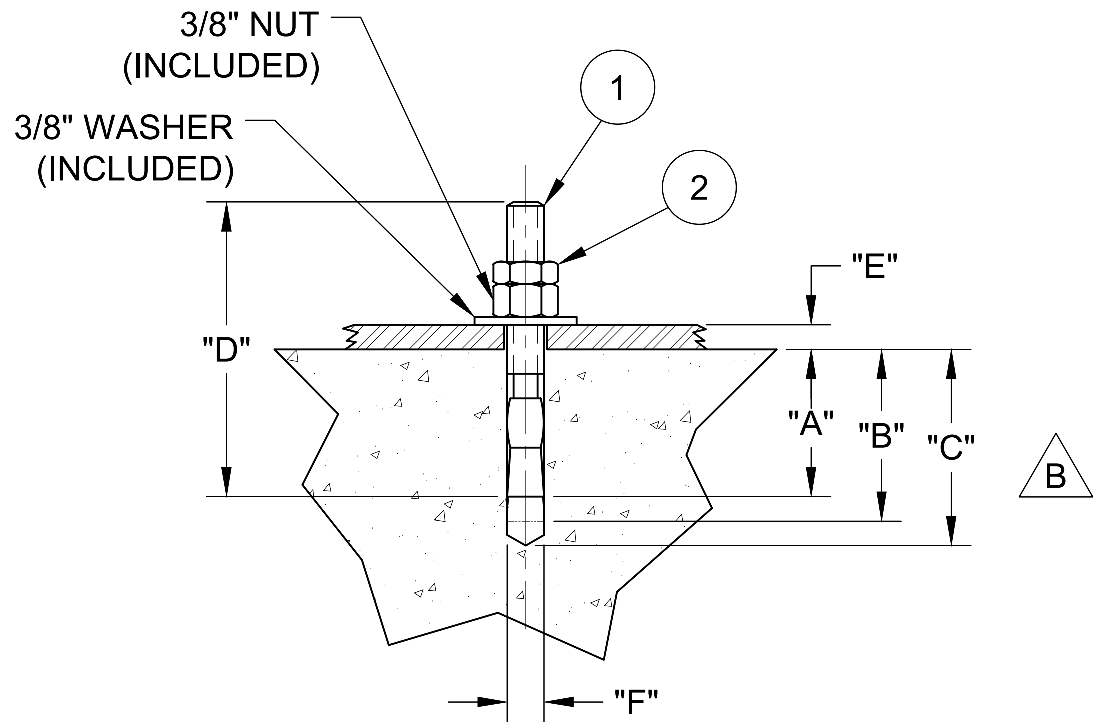
AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: CJC DATE: 2024-10-03
WEIGHT: SHEET: 1 OF 1
DRAWING NUMBER: 9704419A30400 SCALE: 1/14 SIZE: D

EFFECTIVE EMBEDMENT "A"	NOMINAL EMBEDMENT "B"	MINIMUM HOLE DEPTH "C"	ANCHOR LENGTH "D"	MAXIMUM PLATE THICKNESS "E"	DRILL BIT DIAMETER "F"
1 3/4"	2"	2 1/2"	3"	5/8"	Ø3/8"



C B

INSTALLATION NOTES:

1. REVIEW ANCHOR INSTALLATION INSTRUCTIONS (EP-50329) LOCATED IN THE INSTALLATION SECTION OF THE O&M.

2. SELECT A CARBIDE HAMMER DRILL BIT WITH A DIAMETER EQUAL TO THE DIAMETER OF THE ANCHOR. LOCATE AND HAMMER DRILL A STRAIGHT HOLE TO THE EMBEDMENT DEPTH SHOWN. CLEAN HOLE WITH COMPRESSED AIR TO REMOVE DUST AND DEBRIS.

3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.

D

4. PLACE EQUIPMENT IN POSITION AND INSERT ASSEMBLED ANCHOR. INSTALL FULL NUT AND JAM NUT FLUSH WITH TOP OF ANCHOR. HAMMER ANCHOR INTO HOLE UNTIL WASHER AND FULL NUT ARE TIGHT AGAINST THE EQUIPMENT.

5. EXPAND WEDGE BY TIGHTENING FULL NUT, DO NOT USE AN IMPACT WRENCH TO SET OR TIGHTEN. USE AN INSTALLATION TORQUE OF 19 LB-FT. WHILE HOLDING THE FULL NUT IN PLACE, TIGHTEN JAM NUT TO THE SAME TORQUE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
1	1	2610898	WEDGE ANCHOR, 3/8-16 X 3.00", RED HEAD SWW	316 SS	-

A

JOB NAME:

JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
	R6415	2003-01-24	KMV	NEW
A	C7946	2003-03-13	KMV	WAS 2610897
B	C15375	2012-12-20	JFF	REV'D EMBEDMENT, INSTALLATION NOTES
C	C16309	2014-05-28	CJC	REV'D NOTES
D	C16382	2014-07-10	CJC	REV'D NOTE 4

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL: 316 SS

SIMILAR TO: 2962622

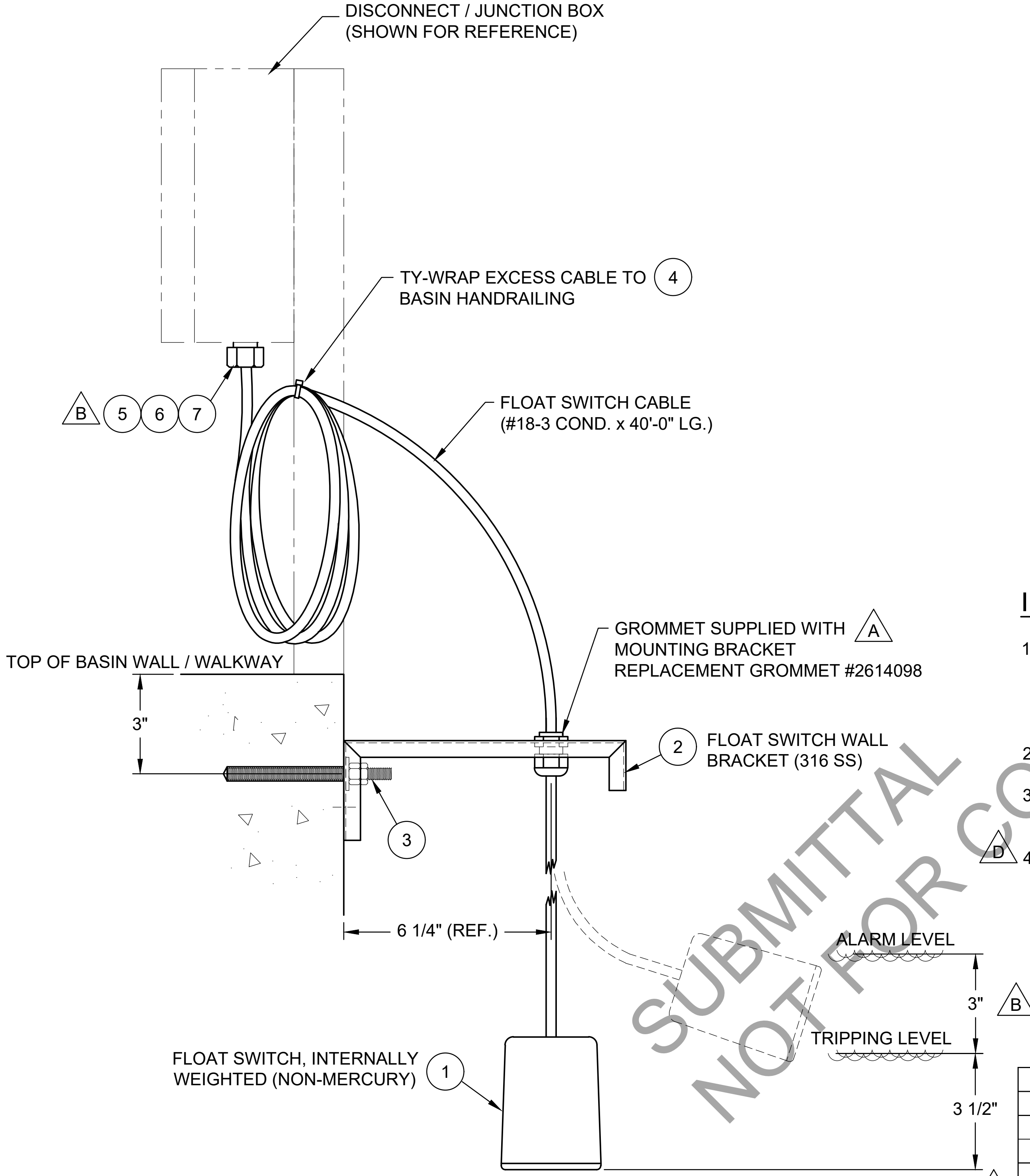
TYPE:

DRAWN BY: KMV — DATE: 2003-01-23

WEIGHT: — SHEET: 1 OF 1

DRAWING NAME: KIT, WEDGE ANCHOR, 3/8", RED HEAD SWW

DRAWING NUMBER: 2962764 — SCALE: 1:2 — SIZE: B



* NOTE: FLOAT SWITCH LEVEL MAY BE FIELD
ADJUSTED AS REQUIRED AFTER INSTALLATION.

INSTALLATION NOTES:

1. NOTE: JUNCTION BOX FOR FLOAT SWITCH MUST BE LOCATED WITHIN 3 - 4 FEET OF THE MOUNTING BRACKET, AT THE TOP OF THE BASIN WALL. THE FLOAT SWITCH IS PROVIDED WITH 40 FEET OF #18-3 CONDUCTOR CABLE. THIS CABLE SHOULD NOT BE CUT, BUT COILED TOGETHER AND ATTACHED TO THE BASIN HANDRAILING FOR FUTURE ADJUSTMENTS.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.
4. (D) USE TY-WRAPS (ITEM #4) TO COIL EXCESS LENGTH OF FLOAT SWITCH CABLE TO BASIN HANDRAILING.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
7	1	2607162	SEAL RING 1/2"NPT NITR	RUBBER	-
6	1	2606312	LOCKNUT, NPT, 1/2", PLTD	STEEL	-
5	1	2605993	CORDGRIP, 0.250-0.375, NPT, 1/2", STRT, PLTD	-	-
4	2	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
3	1	2967161-1	KIT, ADHESIVE ANCHOR, 3/8", SET ADHESIVE	304 SS	Y
2	1	2608570	FLOAT SWITCH MOUNTING BRACKET	316 SS	-
1	1	2611183	FLOAT SWITCH ANCHOR GSI 40NONC-STO	-	-

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	C9850	2009-02-05	TWA	ADDED GROMMET INFORMATION
B	C15451	2013-02-11	GML	REVISED DIMS. TO WATER LEVEL
C	C16583	2014-10-03	GBM	CHG'D ITEM 3 P/N, WAS 2965016
D	C22247	2023-08-22	TTL	NOTE# 4 LISTED TY-WRAPS AS ITEM 7

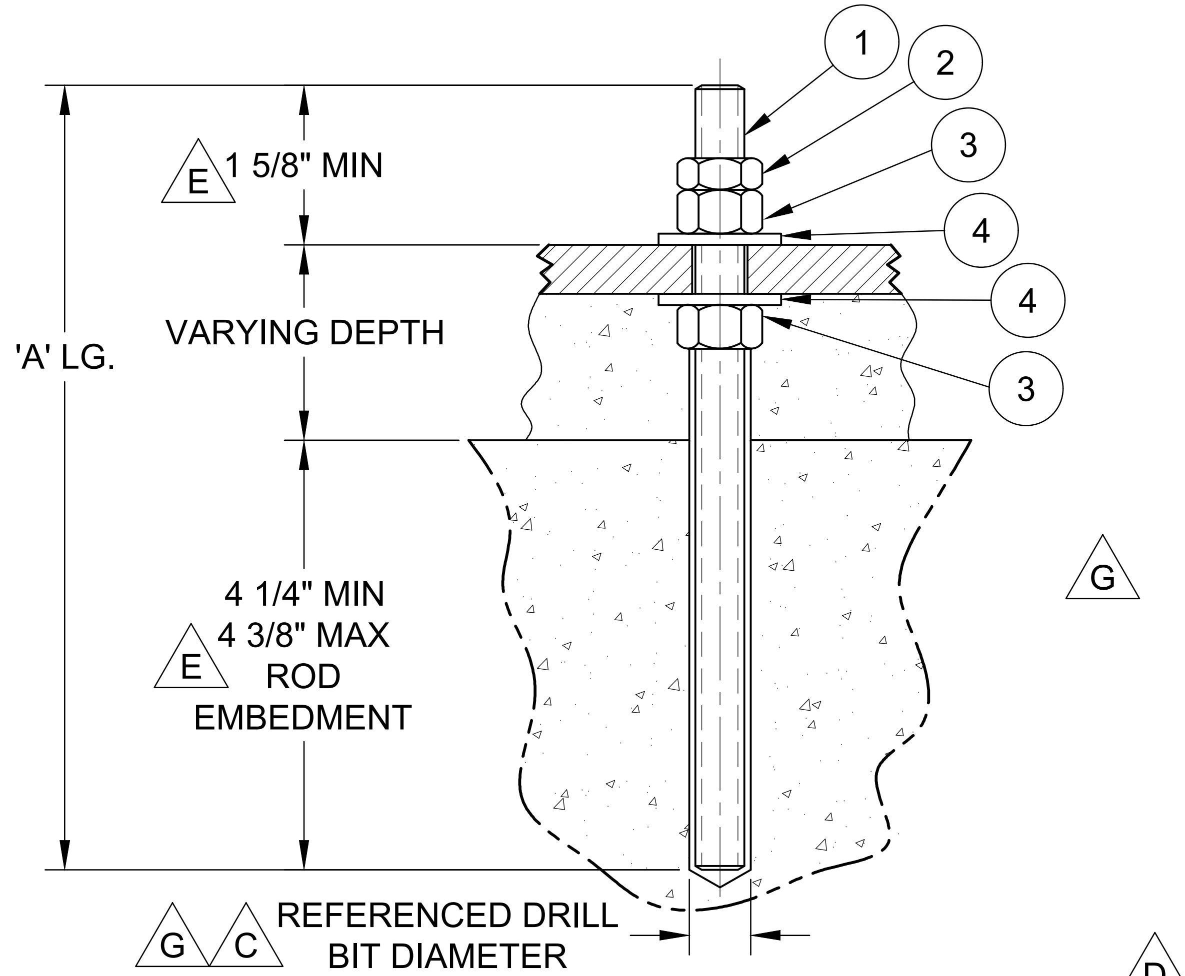
AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: GML | DATE: 2003-05-07
WEIGHT: | SHEET: 1 OF 1

DRAWING NAME: HIGH LEVEL ALARM FLOAT SWITCH INSTALLATION
DRAWING NUMBER: 2962926 | SCALE: 1:3 | SIZE: C



INSTALLATION NOTES:

1. LOCATE ADHESIVE GUN DISPENSER, ADHESIVE CARTRIDGES AND REPLACEMENT TIPS PROVIDED WITH EQUIPMENT CALLED OUT ON SYSTEM PLAN VIEW DRAWING.

2. READ AND FOLLOW ALL INSTALLATION INSTRUCTIONS PROVIDED IN THE MECHANICAL COMPONENTS SECTION OF THE O&M MANUAL BEFORE ATTEMPTING TO INSTALL ANCHORS. REFERENCE ADHESIVE DATASHEET FOR DRILL BIT DIAMETER, TORQUE SPECS, AND GEL/CURE TIMES.

3. LOCATE AND DRILL ANCHOR HOLE STRAIGHT AND TO DEPTH SHOWN. CLEAN HOLE BY BLOWING OUT DEBRIS WITH SMALL PIECE OF TUBING AND 80 PSI COMPRESSED AIR FOR A MINIMUM OF 2 SECONDS. RUN A STEEL WIRE BRUSH IN HOLE FOR A MINIMUM OF 2 CYCLES. BLOW OUT ANY NEW DEBRIS.

4. STARTING WITH THE NOZZLE AT THE BOTTOM OF HOLE, FILL HOLE 1/2 TO 2/3 FULL OF ADHESIVE COMPOUND, WITHDRAWING NOZZLE SLOWLY. INSERT ANCHOR ROD INTO HOLE, TWISTING SLOWLY UNTIL ROD CONTACTS BOTTOM OF HOLE. ANCHOR ROD MAY BE ADJUSTED DURING REFERENCED GEL TIME. DO NOT DISTURB ANCHOR ROD UNTIL REFERENCED CURE TIME HAS ELAPSED.

5. IF GROUT IS SPECIFIED: ONCE REFERENCED CURE TIME HAS ELAPSED, INSTALL LEVELING NUT AND WASHER. PLACE THE EQUIPMENT INTO POSITION AND ADJUST THE LEVELING NUT TO SET THE PROPER HEIGHT. IF GAP IS LESS THAN 1/2", USE SHIMS IN LIEU OF GROUT.

6. IF SHIMS ARE USED OR NO GROUT IS NECESSARY: ONCE REFERENCED CURE TIME HAS ELAPSED, PLACE EQUIPMENT, OMITTING LEVELING NUT AND WASHER.

7. INSTALL UPPER WASHER AND FULL NUT, TORQUE PER REFERENCE. INSTALL JAM NUT. HOLD FULL NUT AND APPLY THE SAME TORQUE TO THE JAM NUT.

8. ONCE EQUIPMENT IS LEVELED AND SET, GROUT THE AREA BETWEEN GROUND AND EQUIPMENT IF SPECIFIED.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
4	2	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
3	2	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
2	1	2600234	NUT, HEX, JAM, 1/2-13	316 SS	-
1	1	SEE TABLE	THREADED ROD, 1/2-13 X 'A'	304 SS	-

PART NO.	THREADED ROD PART NO.	LENGTH 'A'	MAX VARYING DEPTH
2965006-6	2617042	17"	11"
2965006-5	2615043	12"	6"
2965006-4	2612742	11"	5"
2965006-3	2612677	10"	4"
2965006-2	2612676	9"	3"
2965006-1	2612675	8"	2"

JOB NAME:

JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R10825	2009-07-16	SDS	NEW PART
B	C12350	2009-08-26	CJC	ADDED TAB 2965006-6
C	C13005	2010-05-18	JFF	DRILL SIZE WAS 9/16" NOW 5/8"
D	C14590	2012-01-06	AMG	WAS 40 FT-LBS, UPDATED DWG FORM
E	C16383	2014-07-21	GBM	ADDED MAX EMBEDMENT
F	C21966	2023-03-30	BLU	SIMPSON SET ADHESIVE NOW SET-XP
G	C22650	2024-02-07	BLU	REMOVED ADHESIVE DATA, UPDATED NOTES

AQUA-AEROBIC SYSTEMS, INC.

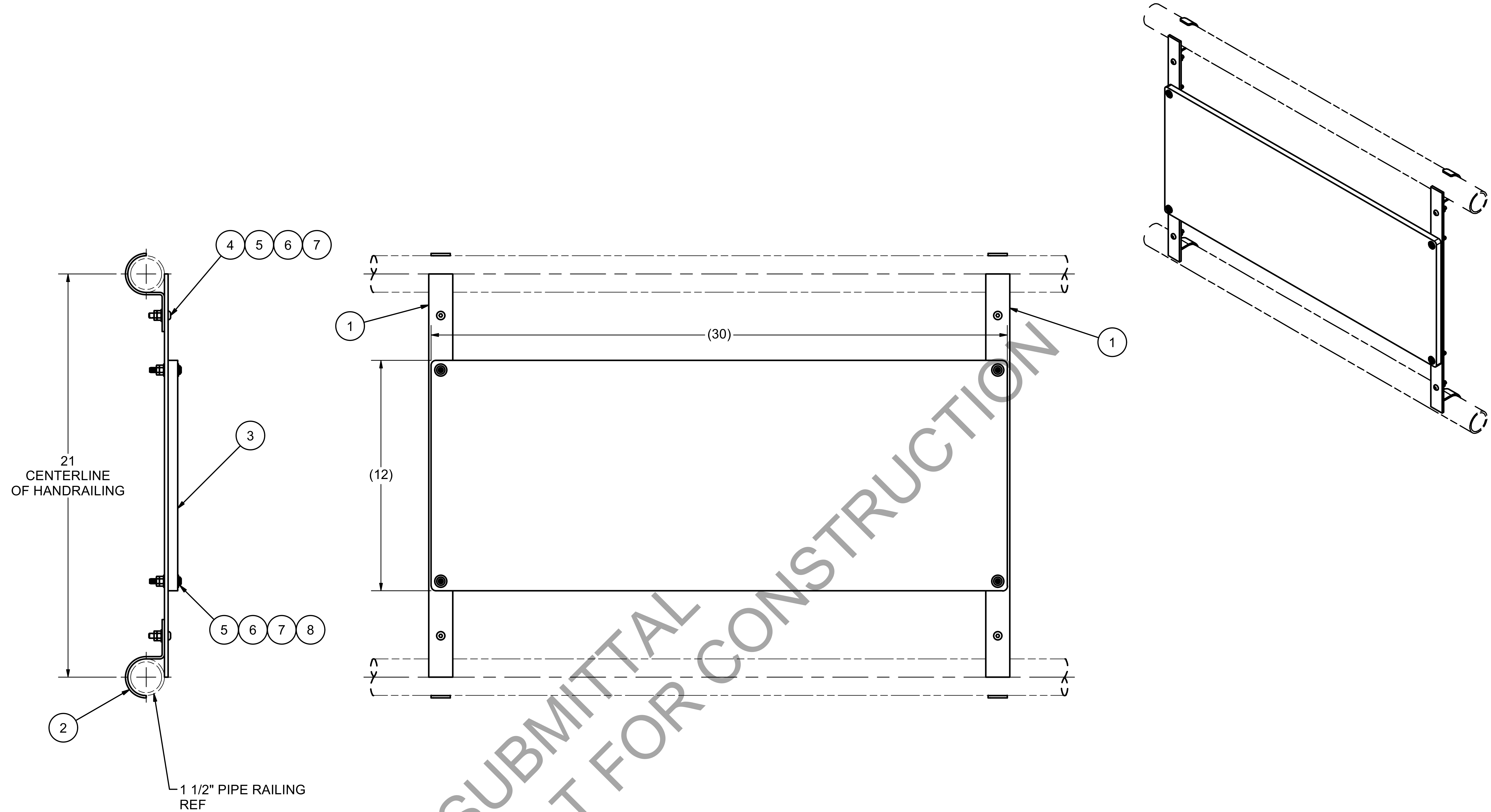
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: 304 SS
SIMILAR TO: 2963944
TYPE:
DRAWN BY: SDS DATE: 2009-07-16
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF 1

DRAWING NAME: KIT, ADHV ANCR, 1/2", TAB DWG

DRAWING NUMBER: 2965006 SCALE: 1:2 SIZE: B



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
8	4	2614965	BHMS, 1/4-20 X 1.5"	316 SS	-
7	8	2603011	NUT, HEX, JAM, 1/4-20	316 SS	-
6	8	2600476	NUT, HEX, FULL, 1/4-20	316 SS	-
5	12	2600224	WASHER, FLAT, 1/4" X 5/8" X .044"	316 SS	-
4	4	2600222	BHMS, 1/4-20 X 1"	316 SS	-
3	1	"A"	AQUA NAMEPLATE , 12" X 30"	SINTRA	Y
2	4	2611112	CONDUIT STRAP, 1-1/2 PIPE (1 HOLE)	18-8 SS	-
1	2	2506956	SUPPORT STRAP, NAMEPLATE	304 SS	Y

PART NUMBER	PRODUCT	"A"
2965501-14	AquaStorm	2619812
2965501-13	AquaNereda	2619388
2965501-12	AquaPrime	2618059
2965501-11	Aqua UltraFiltration System	2616454
2965501-10	Aqua MegaDisk	2616349
2965501-9	Aqua MiniDisk	2615956
2965501-8	AquaDisk	2614963
2965501-7	AquaExcel	2614763
2965501-6	AquaMB Process	2611162
2965501-5	AquaMSBR	2608777
2965501-4	AquaPASS	2612288
2965501-3	Aqua-Aerobic MBR	2613780
2965501-2	AquaMixAir	2614764
2965501-1	AquaSBR	2603855

JOB NAME:

JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R11572	2010-05-19	JFF	NEW PART
B	C13083	2010-06-10	JFF	ADDED DASH 1,3,4,5 & 6; REV'D 5 & 8
C	C12813	2010-07-01	JFF	ADDED TAB -7 & -8
D	C14887	2012-04-25	GBM	ADDED TAB -9
E	C15413	2013-01-11	CJC	ADDED TAB -10
F	C15626	2013-05-22	CJC	ADDED TAB -11
G	C17969	2017-01-10	CJC	ADDED TAB -12
H	C18943	2018-06-11	FTS	ADDED TAB -13
I	C19532	2019-05-13	LJB	ADDED TAB -14

DRAWING NAME: NAMEPLATE INSTALLATION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:

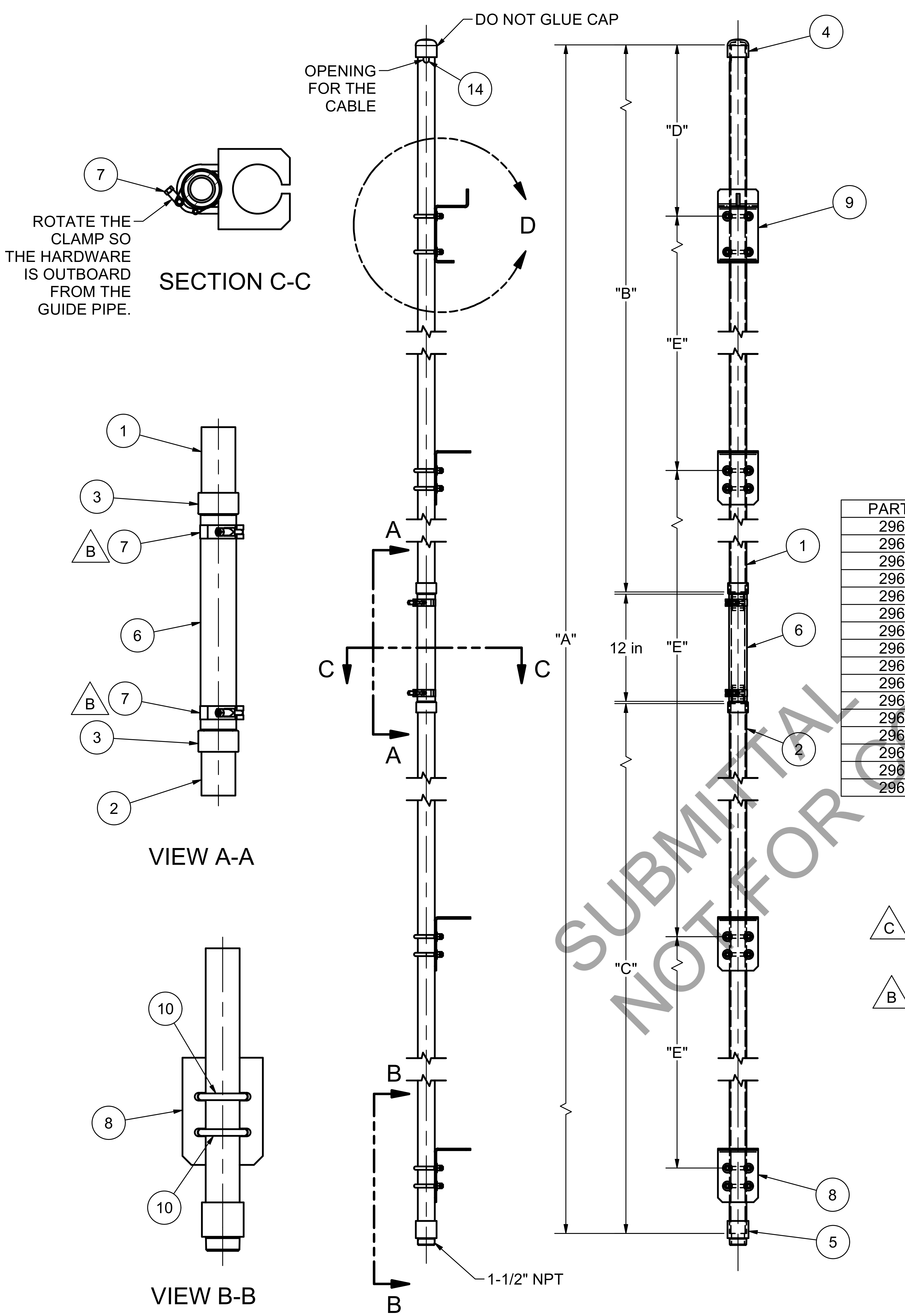
SIMILAR TO:

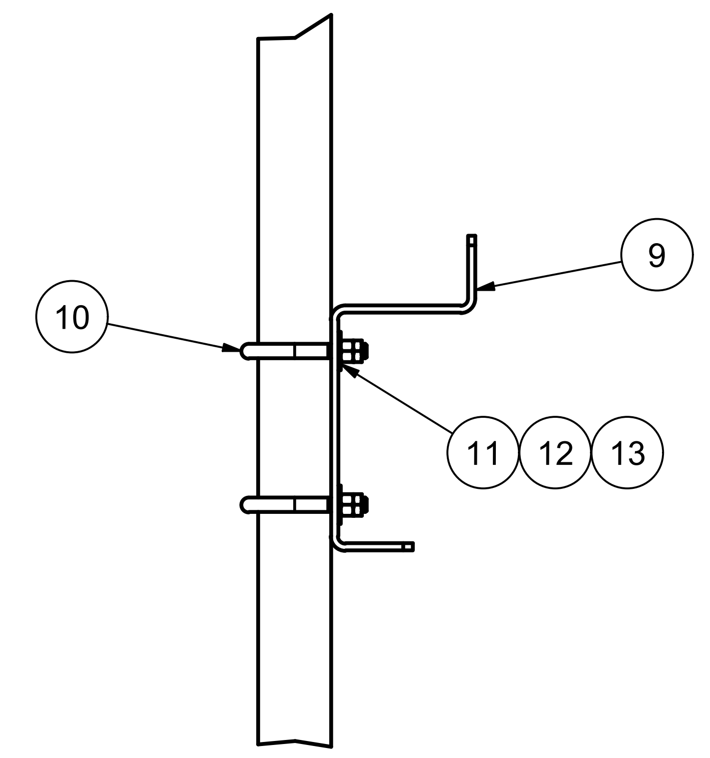
TYPE:

DRAWN BY: JFF — DATE: 2010-05-19

WEIGHT: — SHEET: 1 OF 1

DRAWING NUMBER: 2965501 — SCALE: 1/4 — SIZE: C





DETAIL D
TYP HARDWARE ARRANGEMENT

NOTES:

1. PVC PIPE AND FITTINGS ARE TO BE SOLVENT BONDED TOGETHER, EXCEPT FOR THE CAP (ITEM #4).

2. ASSEMBLE THE GUIDE CLAMPS (ITEM #8 & #9) IN LINE AS SHOWN.

3. ROTATE THE HOSE CLAMPS SO THE HARDWARE IS OUTBOARD FROM THE GUIDE PIPE AS SHOWN.

4. ASSEMBLE AND SHIP WITH THE GUIDE RAIL ASSEMBLY.

5. REFER TO AASI PURCHASE ORDER, ROUTING OR MATERIAL SCHEDULE FOR MATERIAL TYPE, FINISH AND CERTIFICATION INFORMATION.

6. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS, UNLESS OTHERWISE SPECIFIED.

C

PART NUMBER	"A" LENGTH	"B"	"C"	"D"	"E"	"F" P/N (ITEM #1)	"G" P/N (ITEM #2)	WEIGHT
2965755-129	128-1/2"	58"	58"	19-3/16"	34"	2517285-58	2614197-58	17.4 LBS
2965755-141	140-1/2"	64"	64"	19-3/16"	38"	2517285-64	2614197-64	17.9 LBS
2965755-153	152-1/2"	70"	70"	19-3/16"	42"	2517285-70	2614197-70	18.4 LBS
2965755-165	164-1/2"	76"	76"	19-3/16"	46"	2517285-76	2614197-76	18.9 LBS
2965755-177	176-1/2"	82"	82"	19-3/16"	50"	2517285-82	2614197-82	19.3 LBS
2965755-189	188-1/2"	88"	88"	19-3/16"	54"	2517285-88	2614197-88	19.8 LBS
2965755-201	200-1/2"	94"	94"	19-3/16"	58"	2517285-94	2614197-94	20.3 LBS
2965755-213	212-1/2"	100"	100"	19-3/16"	62"	2517285-100	2614197-100	20.8 LBS
2965755-225	224-1/2"	106"	106"	19-3/16"	66"	2517285-106	2614197-106	21.3 LBS
2965755-237	236-1/2"	112"	112"	19-3/16"	70"	2517285-112	2614197-112	21.8 LBS
2965755-249	248-1/2"	118"	118"	19-3/16"	74"	2517285-118	2614197-118	22.3 LBS
2965755-261	260-1/2"	124"	124"	19-3/16"	78"	2517285-124	2614197-124	22.7 LBS
2965755-273	272-1/2"	130"	130"	19-3/16"	82"	2517285-130	2614197-130	23.2 LBS
2965755-285	284-1/2"	136"	136"	19-3/16"	86"	2517285-136	2614197-136	23.7 LBS
2965755-297	296-1/2"	142"	142"	19-3/16"	90"	2517285-142	2614197-142	24.2 LBS
2965755-309	308-1/2"	148"	148"	19-3/16"	94"	2517285-148	2614197-148	24.7 LBS

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
14	1	2611331	GROMMIT, 3/8 ID X 5/8 OD	RUBBER	-
13	16	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
12	16	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
11	16	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
10 (C)	8	2606398	U-BOLT, 1-1/2" PIPE	316 SS	Y
9	1	2518686	TOP SUPPORT, SENSOR PIPE	-	Y
8	3	2518879	INTERMEDIATE SUPPORT, SENSOR PIPE	-	Y
7 (B)	2	2615640	HOSE CLAMP, SS 1.844 - 2.062 ID	SS	-
6	1	2612035-12	HOSE. 1-1/2" I.D. X .12" THK	Rubber	-
5	1	2614080	ADAPTER 1 1/2" MNPT X 1 1/2" SOC	PVC-Piping	-
4	1	2614052	PIPE CAP, 1-1/2" PVC SCH80 SOC	PVC-Piping	-
3	2	2614049	INSET FITTING 1-1/2" HOSE X 1-1/2" SOC	PVC-Piping	-
2	1	"G"	PIPE, 1-1/2" SCH 40 X "C" LG	PVC-Piping	-
1	1	"F"	SENSOR MOUNTING PIPE, 1-1/2"	PVC-Piping	Y

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
C	C16404	2014-07-23	CJC	ADDED WEIGHTS
B	C14271	2011-08-15	GBM	CHG ITEM #7 (BIGGER)
A	R11827	2010-08-24	GBM	NEW RELEASE

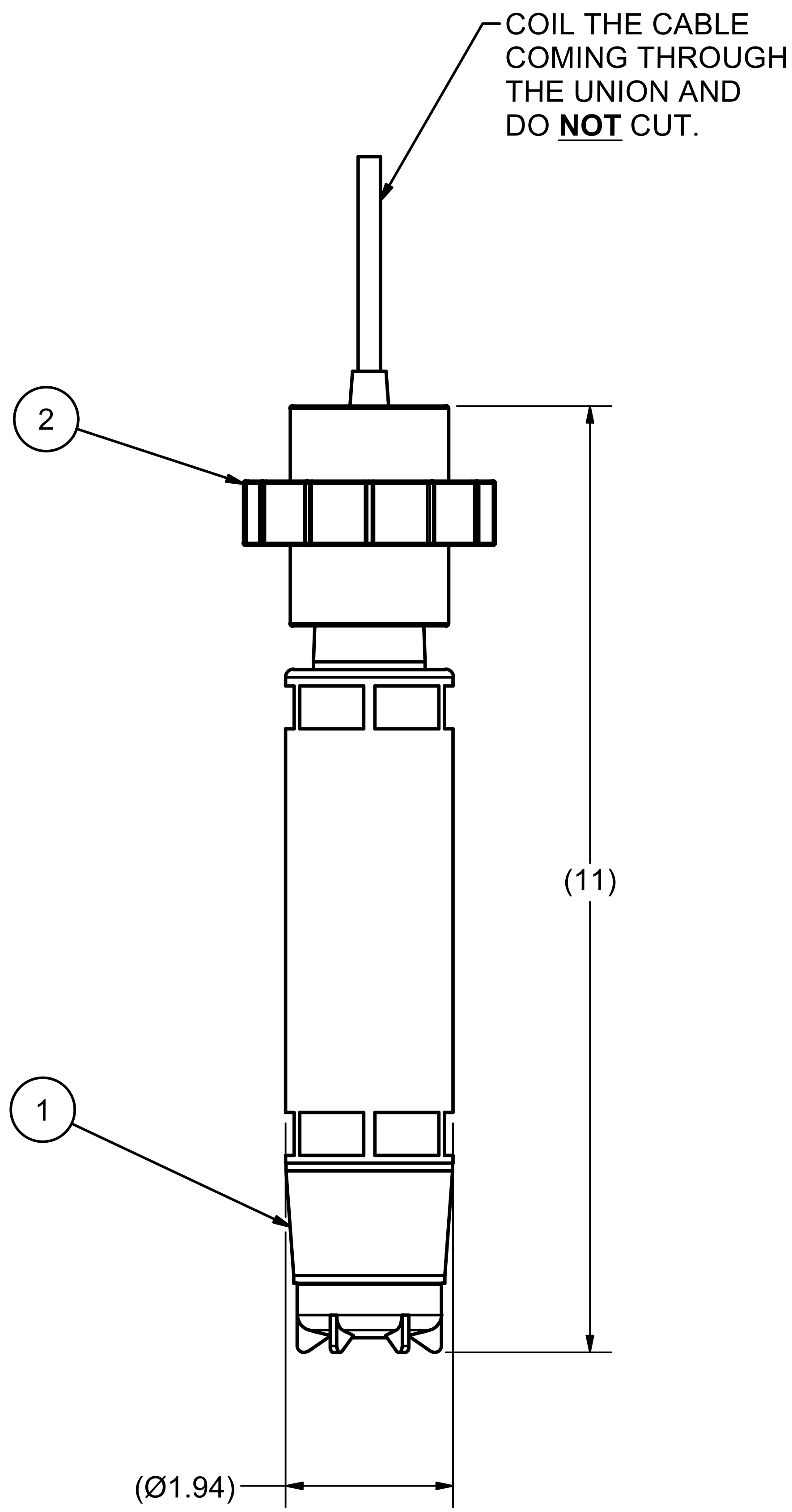
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.
MANUFACTURERS OF WASTEWATER TREATMENT EQUIPMENT

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: -
SIMILAR TO:
TYPE: SBR
DRAWN BY: GBM DATE: 2010-08-24
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF 1

DRAWING NAME: SENSOR MOUNTING PIPE ASSEMBLY, RETRIEVAL
DRAWING NUMBER: 2965755 SCALE: SIZE: C



WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL SENSOR CABLE SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

AT AQUA-AEROBIC SYSTEMS, INC.

1. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.
2. BOX FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.
2. DO **NOT** CUT SENSOR CABLE. PASS SENSOR CABLE THROUGH THE MOUNTING PIPE. RUN SENSOR CABLE TO THE CONTROLLER. COIL AND TY-WRAP EXCESS SENSOR CABLE AND ATTACH TO BASIN HANDRAIL. PROTECT EXPOSED SENSOR CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.

B

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2616936	UNION, 1" NPT S80, PVC, SPEARS 898-010 OLD STYLE	PVC	-
1	1	2616326	SENSOR, DISSOLVED OXYGEN, LDO, C1D2	-	-

JOB NAME:

JOB LOCATION:

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R13781	2012-12-14	JFF	NEW RELEASE
B	C16447	2014-08-20	JFM	ITEM 2 WAS 2616327
C	C21216	2022-03-18	BLU	CORRECTED WEIGHT

MATERIAL:

SIMILAR TO: 2966360

TYPE: SBR

DRAWN BY: JFF DATE: 2012-12-14

WEIGHT: 2.6 LBS SHEET: 1 OF 1

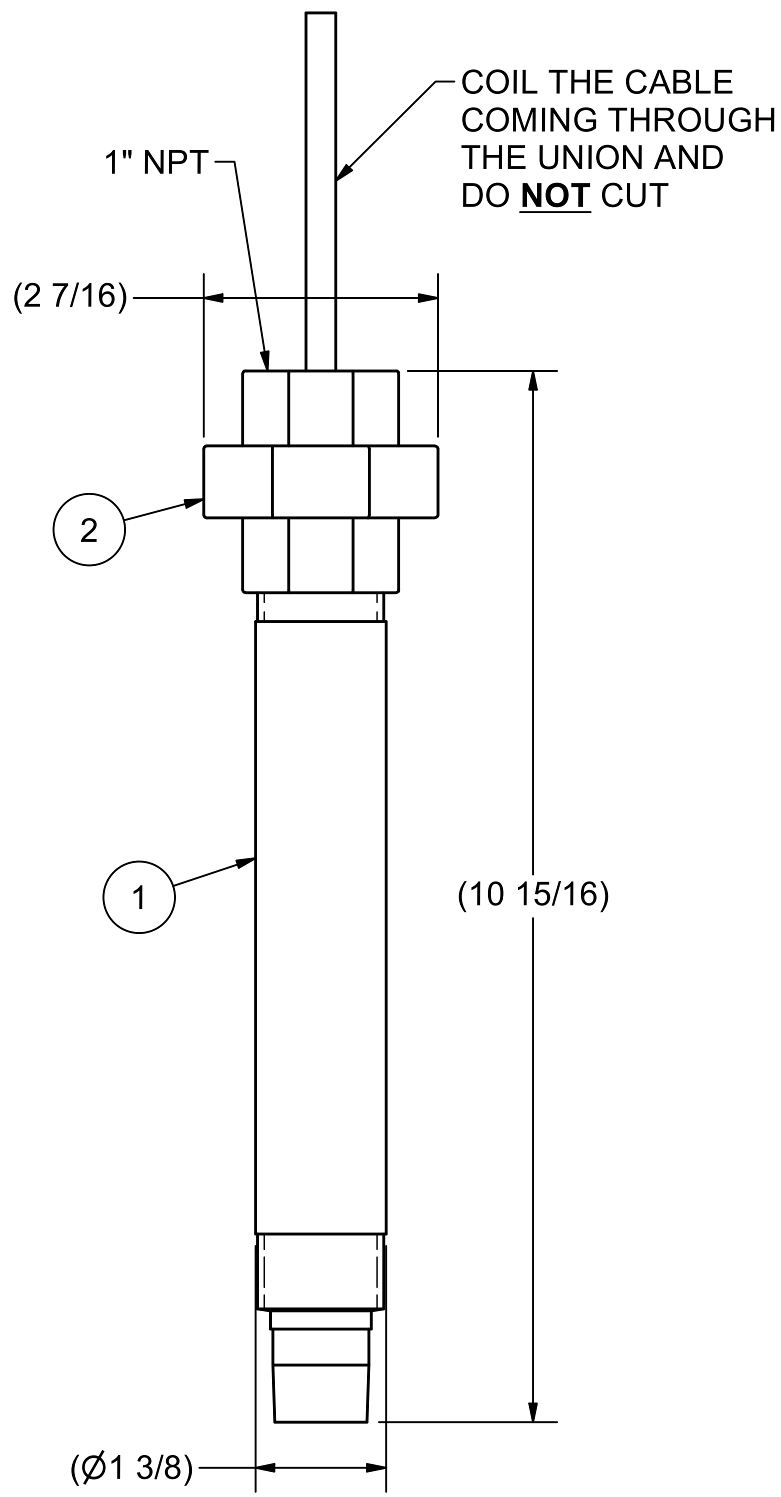
DRAWING NAME:
DISSOLVED OXYGEN SENSOR ASSY, FIXED MTG, C1D2

DRAWING NUMBER: 2966772

SCALE: 1 : 2

SIZE: B

NOTE: REFER TO MATERIAL SCHEDULE FOR MATERIAL, FINISH AND CERTIFICATION.



WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL SENSOR CABLE SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

AT AQUA-AEROBIC SYSTEMS, INC.

1. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. BOX FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. DO **NOT** CUT SENSOR CABLE. PASS SENSOR CABLE THROUGH THE MOUNTING PIPE. RUN SENSOR CABLE TO THE CONTROLLER. COIL AND TY-WRAP EXCESS SENSOR CABLE AND ATTACH TO BASIN HANDRAIL. PROTECT EXPOSED SENSOR CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2615184-010	UNION, 1", NPT	-	-
1	1	2617022	SENSOR, PH, HACH, ANALOG, C1D2	-	-

JOB NAME:
JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R14810	2014-06-18	SAH	RELEASE TO PRODUCTION
B	C21216	2022-03-18	BLU	ADDED WEIGHT

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

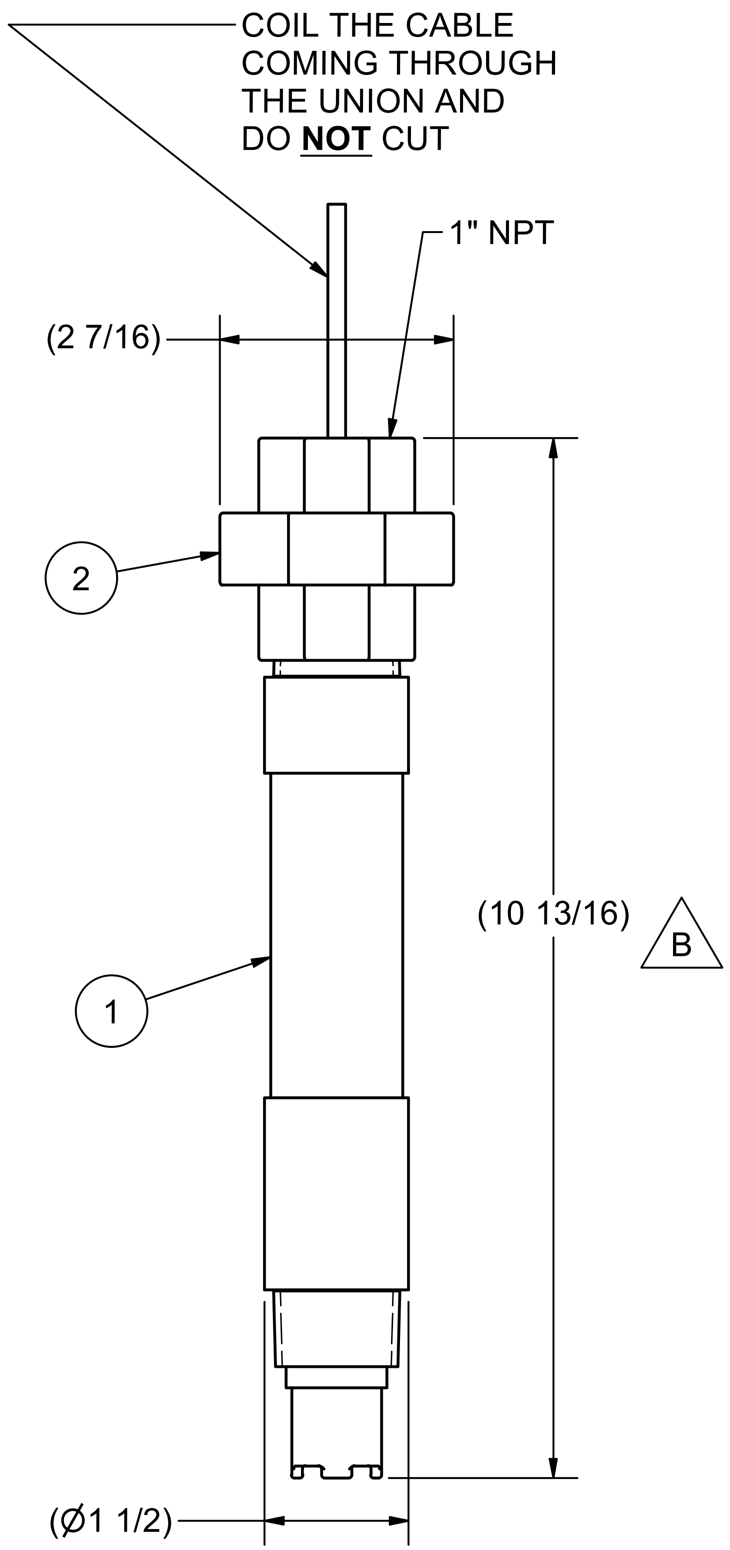
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 2966852
TYPE: SBR
DRAWN BY: CJC DATE: 2014-06-18
WEIGHT: 2 LB SHEET: 1 OF 1

DRAWING NAME: PH SENSOR ASSY, FIXED MTG, C1D2
DRAWING NUMBER: 2967134 SCALE: 1/2 SIZE: B

NOTE: REFER TO MATERIAL SCHEDULE FOR MATERIAL, FINISH AND CERTIFICATION.



WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL SENSOR CABLE SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

AT AQUA-AEROBIC SYSTEMS, INC.

1. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. BOX FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. DO **NOT** CUT SENSOR CABLE. PASS SENSOR CABLE THROUGH THE MOUNTING PIPE. RUN SENSOR CABLE TO THE CONTROLLER. COIL AND TY-WRAP EXCESS SENSOR CABLE AND ATTACH TO BASIN HANDRAIL. PROTECT EXPOSED SENSOR CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
2	1	2615184-010	UNION, 1", NPT	-	-
1	1	2617023	SENSOR, ORP, HACH, ANALOG, C1D2	-	-

JOB NAME:

JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R14810	2014-06-18	SAH	RELEASE TO PRODUCTION
B	C21216	2022-03-18	BLU	CORRECTED LENGTH AND ADDED WEIGHT

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:
SIMILAR TO: 296853
TYPE: SBR
DRAWN BY: CJC DATE: 2014-06-18
WEIGHT: 2 LB SHEET: 1 OF 1

DRAWING NAME: ORP SENSOR ASSY, FIXED MTG, C1D2
DRAWING NUMBER: 2967135
SCALE: 1/2
SIZE: B

PART NO	"A" (DIA)	"B" (LG)	MATERIAL	"C" (EMBEDMENT)	"D" (DRILL BIT)	"E" REF	"F" TORQUE	ITEM 1 P/N	ITEM 2 P/N	ITEM 3 P/N	ITEM 4 P/N
2967161-1	3/8" DIA	5.125"	304 SS	3-1/2 TO 3-5/8"	SEE NOTE 2	1-5/8 TO 1-1/2"	SEE NOTE 2	2610450	2600381	2600481	2600403
2967161-2	3/8" DIA	5.125"	316 SS	3-1/2 TO 3-5/8"	SEE NOTE 2	1-5/8 TO 1-1/2"	SEE NOTE 2	2612402	2600381	2600481	2600403
2967161-3	1/2" DIA	6.5"	304 SS	4-1/4 TO 4-3/8"	SEE NOTE 2	2-1/4 TO 2-1/8"	SEE NOTE 2	2610325	2600426	2600517	2600234
2967161-4	1/2" DIA	6.5"	316 SS	4-1/4 TO 4-3/8"	SEE NOTE 2	2-1/4 TO 2-1/8"	SEE NOTE 2	2610686	2600426	2600517	2600234
2967161-5	5/8" DIA	7.625"	304 SS	5 TO 5-1/8"	SEE NOTE 2	2-5/8 TO 2-1/2"	SEE NOTE 2	2610451	2602498	2600301	2600302
2967161-6	5/8" DIA	7.625"	316 SS	5 TO 5-1/8"	SEE NOTE 2	2-5/8 TO 2-1/2"	SEE NOTE 2	2614713	2602498	2600301	2600302
2967161-7	3/4" DIA	9.625"	304 SS	6-3/4 TO 6-7/8"	SEE NOTE 2	2-7/8 TO 2-3/4"	SEE NOTE 2	2610452	2602580	2600496	2602579
2967161-8	3/4" DIA	9.625"	316 SS	6-3/4 TO 6-7/8"	SEE NOTE 2	2-7/8 TO 2-3/4"	SEE NOTE 2	2613420	2602580	2600496	2602579
2967161-9	7/8" DIA	10"	304 SS	7-3/4 TO 7-7/8"	SEE NOTE 2	2-1/4 TO 2-1/8"	SEE NOTE 2	2617078	2607554	2606362	2606363
2967161-10	7/8" DIA	10"	316 SS	7-3/4 TO 7-7/8"	SEE NOTE 2	2-1/4 TO 2-1/8"	SEE NOTE 2	2517154	2607554	2606362	2606363

INSTALLATION NOTES:

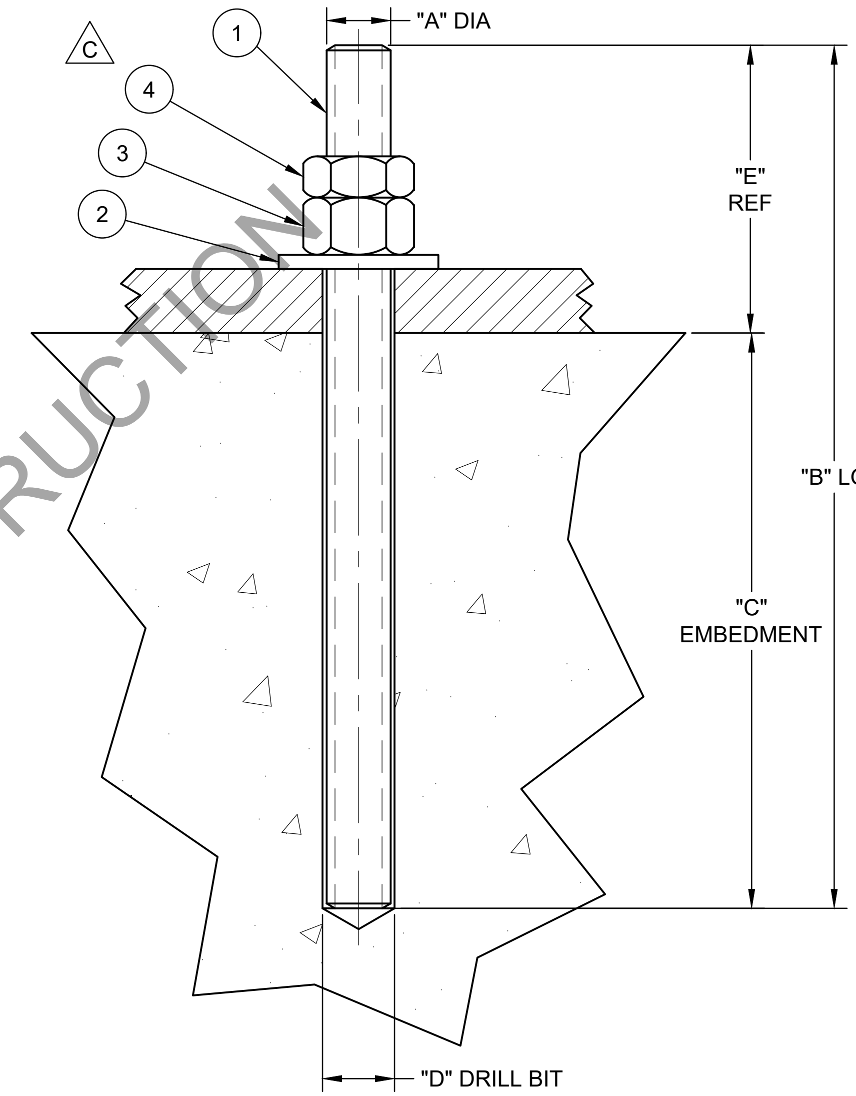
1. LOCATE ADHESIVE GUN DISPENSER, ADHESIVE CARTRIDGES AND REPLACEMENT TIPS PROVIDED WITH EQUIPMENT CALLED OUT ON SYSTEM PLAN VIEW DRAWING.

2. READ AND FOLLOW ALL INSTALLATION INSTRUCTIONS PROVIDED IN THE MECHANICAL COMPONENTS SECTION OF THE O&M MANUAL BEFORE ATTEMPTING TO INSTALL ANCHORS. REFERENCE ADHESIVE DATASHEET FOR DRILL BIT DIAMETER, TORQUE SPECS, AND GEL/CURE TIMES.

3. LOCATE AND DRILL ANCHOR HOLE STRAIGHT AND TO DEPTH SHOWN. CLEAN HOLE BY BLOWING OUT DEBRIS WITH SMALL PIECE OF TUBING AND 80 PSI COMPRESSED AIR FOR A MINIMUM OF 2 SECONDS. RUN A STEEL WIRE BRUSH IN HOLE FOR A MINIMUM OF 2 CYCLES. BLOW OUT ANY NEW DEBRIS.

4. STARTING WITH THE NOZZLE AT THE BOTTOM OF HOLE, FILL HOLE 1/2 TO 2/3 FULL OF ADHESIVE COMPOUND, WITHDRAWING NOZZLE SLOWLY. INSERT ANCHOR ROD INTO HOLE, TWISTING SLOWLY UNTIL ROD CONTACTS BOTTOM OF HOLE. ANCHOR ROD MAY BE ADJUSTED DURING REFERENCED GEL TIME. DO NOT DISTURB ANCHOR ROD UNTIL REFERENCED CURE TIME HAS ELAPSED.

5. ONCE REFERENCED CURE TIME HAS ELAPSED, PLACE EQUIPMENT AND INSTALL UPPER WASHER AND FULL NUT, TORQUE PER REFERENCE. INSTALL JAM NUT. HOLD FULL NUT AND APPLY THE SAME TORQUE TO THE JAM NUT.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
4	1	"ITEM 4 P/N"	NUT, HEX, JAM, "A" DIA	316 SS	-
3	1	"ITEM 3 P/N"	NUT, HEX, FULL, "A" DIA	316 SS	-
2	1	"ITEM 2 P/N"	WASHER, FLAT, "A" DIA	316 SS	-
1	1	"ITEM 1 P/N"	THREADED ROD, "A" DIA X "B" LG	"MATERIAL"	-

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	R14929	2014-08-12	GBM	NEW RELEASE, R14859
B	C21966	2023-03-31	BLU	SIMPSON SET ADHESIVE NOW SET-XP
C	C22650	2024-02-08	BLU	REMOVED ADHESIVE DATA, UPDATED NOTES
D	C23573	2025-01-15	MAI	ADDED 2967161-10 ROW TO TABLE

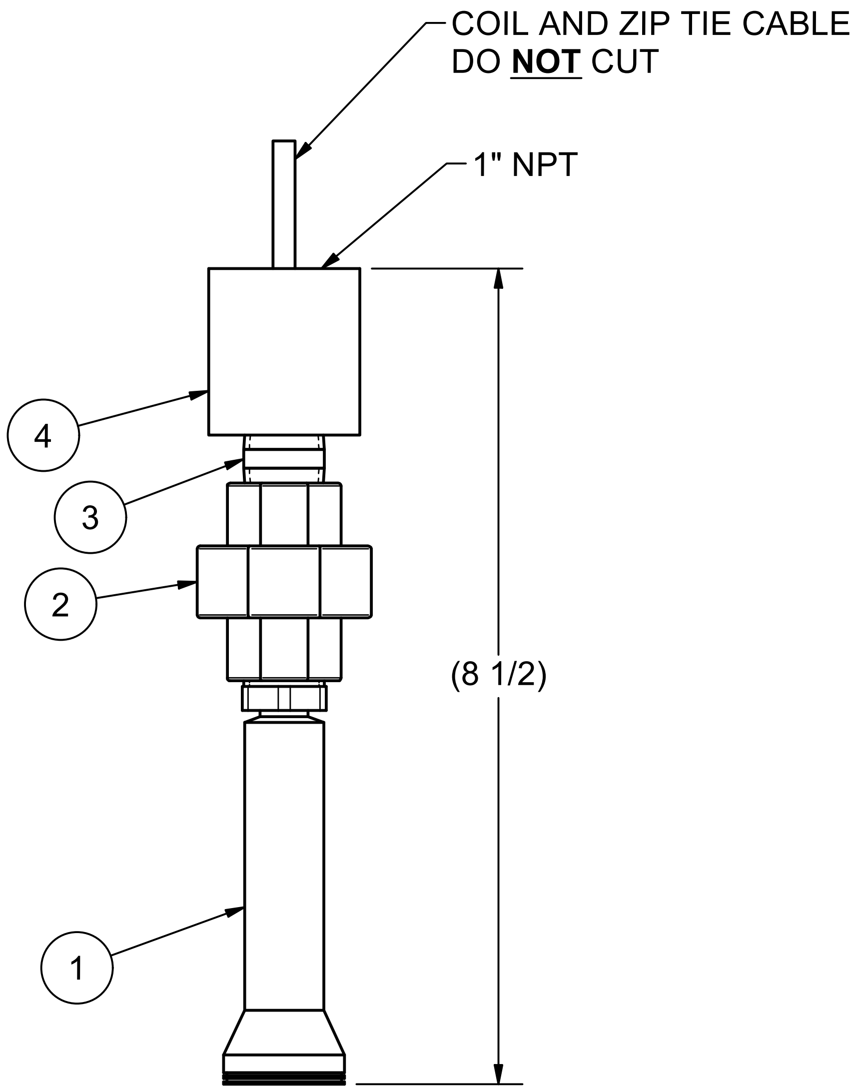
AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL: STAINLESS STEEL
SIMILAR TO: 2965017
TYPE:
DRAWN BY: GBM DATE: 2014-08-12
WEIGHT: SHEET: 1 OF 1

DRAWING NAME: KIT, ADHESIVE ANCHOR
DRAWING NUMBER: 2967161 SCALE: 1:1 SIZE: C



WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL ELECTRICAL SENSOR CABLES SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

AT AQUA-AEROBIC SYSTEMS, INC.

1. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. BOX SENSOR WITH BELLOWS FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. DO **NOT** CUT CABLE. THREAD CABLE THROUGH THE MOUNTING PIPE. RUN CABLE TO THE J-BOX. COIL EXCESS CABLE AND ATTACH TO BASIN HANDRAIL, USE TY-WRAPS. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE. THE TRANSDUCER CABLE CONTAINS A VENT TUBE TO REFERENCE THE LOCAL ATMOSPHERIC PRESSURE, DO NOT CRIMP OR DISTORT CABLE. **LIMIT THE MINIMUM BEND RADIUS TO 2".**

3. REFER TO AASI PURCHASE ORDER, ROUTING, OR MATERIAL SCHEDULE FOR MATERIAL TYPE, FINISH, AND CERTIFICATION INFORMATION.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
4	1	2615183	COUPLING, RED, NPT, 1" x 1/2"	-	-
3	1	2615401-000	NIPPLE, 1/2", S40, CLOSE	-	-
2	1	2615184-005	UNION, NPT, 1/2"	-	-
1	1	'A'	PRESSURE TRANS. AND BELLOWS, LEVELRAT	-	-

DWG TAB	TRANSDUCER # 'A'	PRESSURE (PSI)	CABLE LG (FT)
2968884-05-050	2968870-05-050	5	50
2968884-10-050	2968870-10-050	10	50

JOB NAME:

JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R20784	2022-04-28	MAS	RELEASE TO PRODUCTION

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:

SIMILAR TO: 2967699 / 2968721

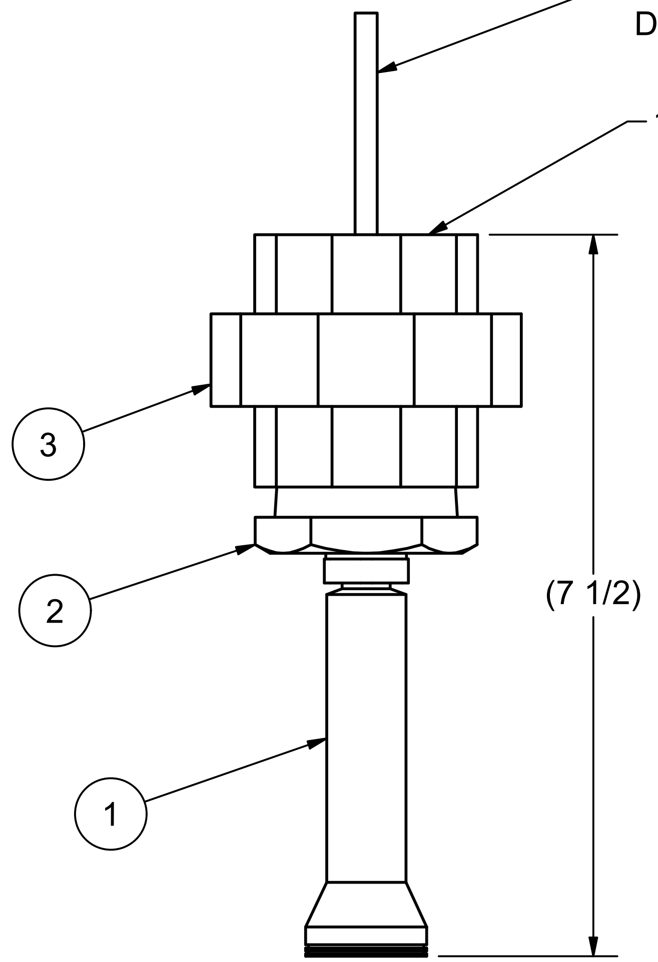
TYPE:

DRAWN BY: MAS DATE: 2022-04-28

WEIGHT: 3 LB SHEET: 1 OF 1

DRAWING NAME: PRESSURE TRANS. SUB ASSY, 1", LEVELRAT

DRAWING NUMBER: 2968884-TAB SCALE: 1/2 SIZE: B



WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL ELECTRICAL SENSOR CABLES SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

AT AQUA-AEROBIC SYSTEMS, INC.

1. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. BOX SENSOR WITH BELLOWS FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. DO **NOT** CUT CABLE. THREAD CABLE THROUGH THE MOUNTING PIPE. RUN CABLE TO THE J-BOX. COIL EXCESS CABLE AND ATTACH TO BASIN HANDRAIL, USE TY-WRAPS. PROTECT EXPOSED CABLE FROM SOURCES OF ACCIDENTAL DAMAGE. THE TRANSDUCER CABLE CONTAINS A VENT TUBE TO REFERENCE THE LOCAL ATMOSPHERIC PRESSURE, DO NOT CRIMP OR DISTORT CABLE. **LIMIT THE MINIMUM BEND RADIUS TO 2".**

3. REFER TO AASI PURCHASE ORDER, ROUTING, OR MATERIAL SCHEDULE FOR MATERIAL TYPE, FINISH, AND CERTIFICATION INFORMATION.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
3	1	2609144	UNION, 1 1/2", S80, NPT, PVC	PVC	-
2	1	2613872	REDUCER BUSHING, 1-1/2" X 1/2" NPT, PVC	PVC	-
1	1	'A'	PRESSURE TRANS. AND BELLOWS, LEVELRAT	-	-

DWG TAB	TRANSDUCER # 'A'	PRESSURE (PSI)	CABLE LG (FT)
2968886-05-050	2968870-05-050	5	50
2968886-10-050	2968870-10-050	10	50

JOB NAME:

JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R20784	2022-04-28	MAS	RELEASE TO PRODUCTION

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

MATERIAL:

SIMILAR TO: 2965768

TYPE:

DRAWN BY: MAS | DATE: 2022-04-28

WEIGHT: 3 LB | SHEET: 1 OF 1

DRAWING NAME: PRESSURE TRANS. SUB ASSY, 1.5", LEVELRAT

DRAWING NUMBER: 2968886-TAB | SCALE: 1/2 | SIZE: B

WARNING

SENSOR MUST BE STORED INDOORS IN AN AREA WHERE THE AMBIENT TEMPERATURE WILL NOT DROP BELOW FREEZING. CARE MUST BE TAKEN TO PREVENT ANY POSSIBLE DAMAGE TO THE SENSOR AND DEVICES WHEN REMOVING THE SYSTEM FROM OPERATION AND / OR DURING THE STORAGE PERIOD. ALL SENSOR EQUIPMENT MUST BE STORED INDOORS OUT OF THE ELEMENTS IN ITS ORIGINAL CONTAINER WITH THE PACKING MATERIAL. DEVICES SHOULD BE STORED IN A CLEAN, DRY, PROTECTED AREA FREE FROM EXCESSIVE VIBRATION AND RAPID TEMPERATURE CHANGES. ALL SENSOR CABLE SHOULD BE PROTECTED FROM DAMAGE AND INDIVIDUALLY TY-WRAPPED IN A COIL AND KEPT FROM BEING KINKED IN ANY WAY DURING INSTALLATION.

NOTES:

1. REFER TO AASI PURCHASE ORDER, ROUTING OR MATERIAL SCHEDULE FOR MATERIAL TYPE, FINISH AND CERTIFICATION INFORMATION.

AT AQUA-AEROBIC SYSTEMS, INC.

1. PRIOR TO INSTALLING SENSOR ADAPTER (ITEM 2) ONTO SENSOR (ITEM 1), INSTALL O-RING FROM MOUNTING KIT (ITEM 3) INTO SLOT ON SMALL END OF SENSOR. SLIDE SENSOR ADAPTER ONTO SENSOR AND TIGHTEN WITH (2) FLAT HEAD SCREWS FROM MOUNTING KIT. DISCARD REMAINING COMPONENTS FROM MOUNTING KIT.

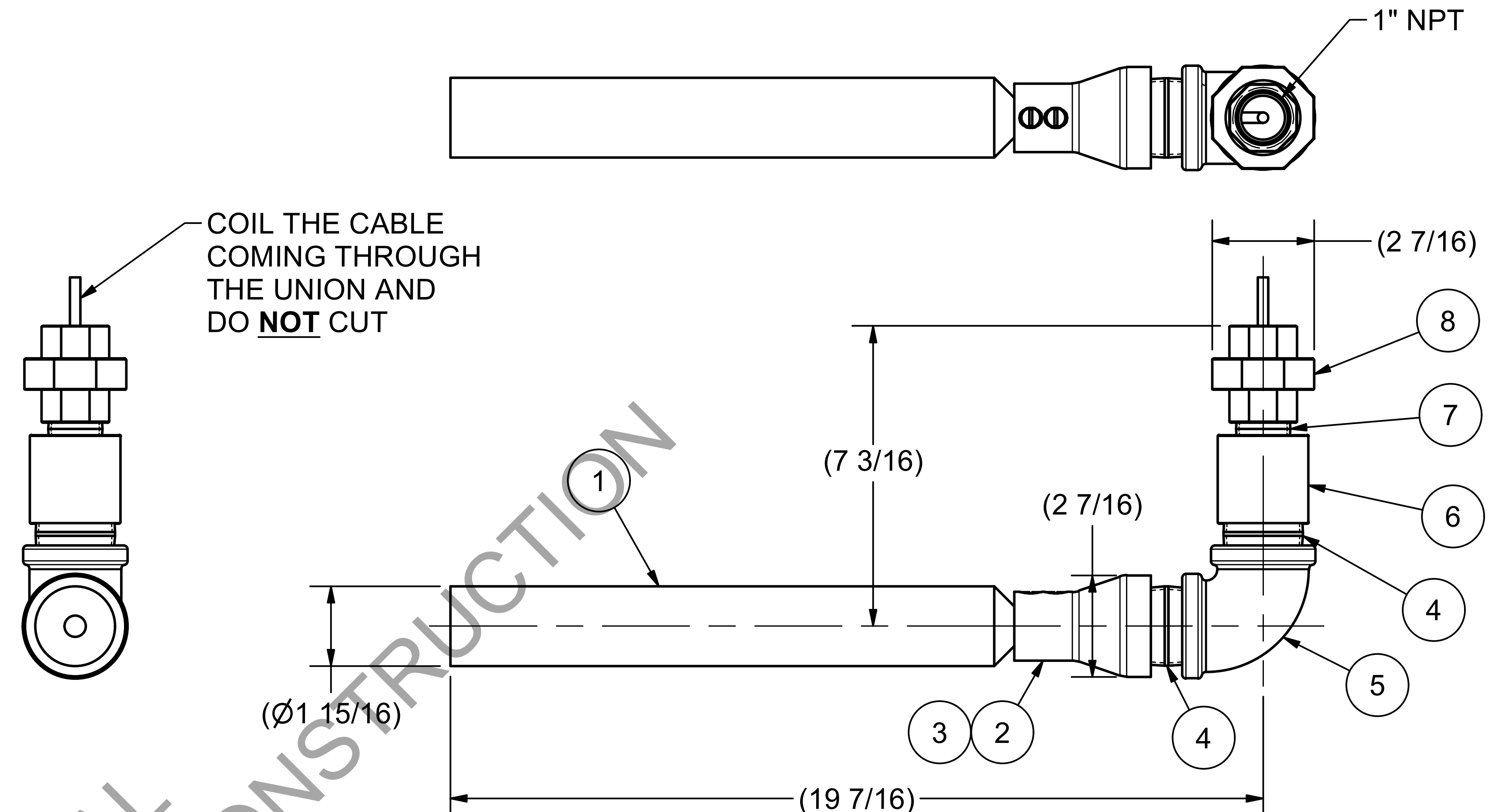
2. ASSEMBLE THE FITTINGS AS SHOWN. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

3. BOX FOR SHIPPING AND LABEL BOX.

AT JOB SITE

1. USE THREAD SEALANT OR TAPE ON ALL FITTINGS.

2. DO **NOT** CUT SENSOR CABLE. PASS SENSOR CABLE THROUGH THE MOUNTING PIPE. RUN SENSOR CABLE TO THE CONTROLLER. COIL AND TY-WRAP EXCESS SENSOR CABLE AND ATTACH TO BASIN HANDRAIL. PROTECT EXPOSED SENSOR CABLE FROM SOURCES OF ACCIDENTAL DAMAGE.



ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
8	1	2615184-010	UNION, 1", NPT	-	-
7	1	2616385-000	NIPPLE, 1", S40, CLOSE	-	-
6	1	2616390	COUPLING, RED, 1 1/2" X 1", NPT	-	-
5	1	2616388-015	ELBOW, 90DEG, NPT, 1 1/2"	-	-
4	2	2616386-000	NIPPLE, 1 1/2", S40, CLOSE	-	-
3	1	2615730	MOUNTING KIT, SENSOR ADAPTER	-	-
2	1	2613274	SENSOR ADAPTER, STRAIGHT, 1 1/2"NPT	304 SS	-
1	1	2618375	PROBE, TSS, HACH EX1 sc, C1D2	-	-

JOB NAME:
JOB LOCATION:

REV	ERN/ECO	DATE	BY	REVISION DESCRIPTION
A	R21176	2022-10-11	DJB	NEW RELEASE

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DO NOT SCALE DRAWING

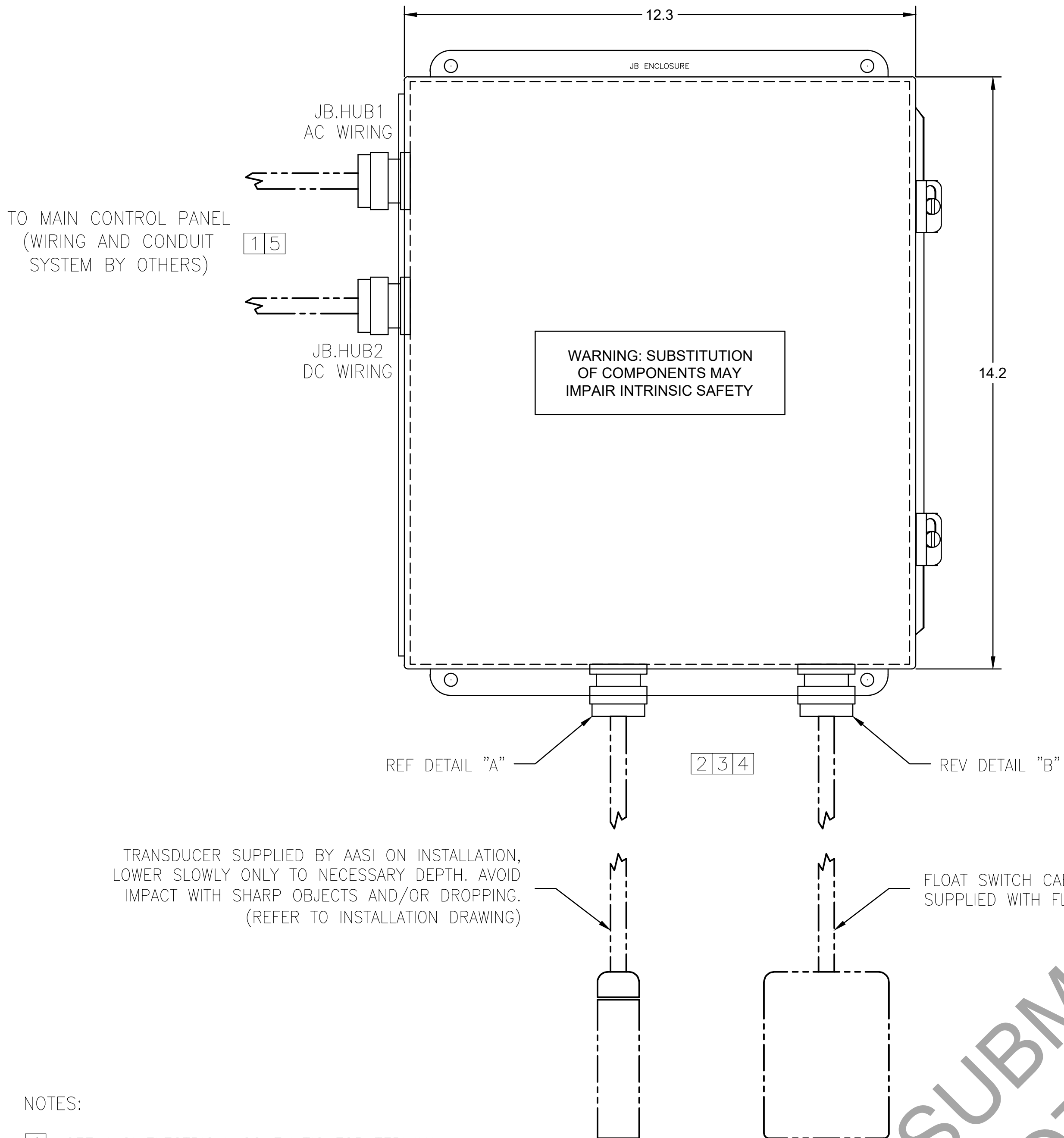
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES

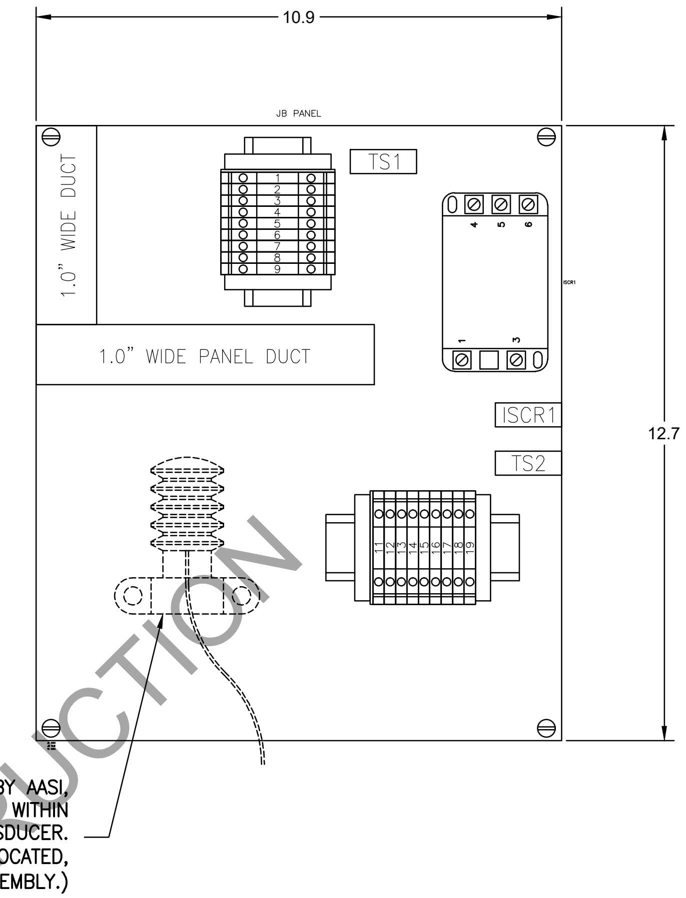
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

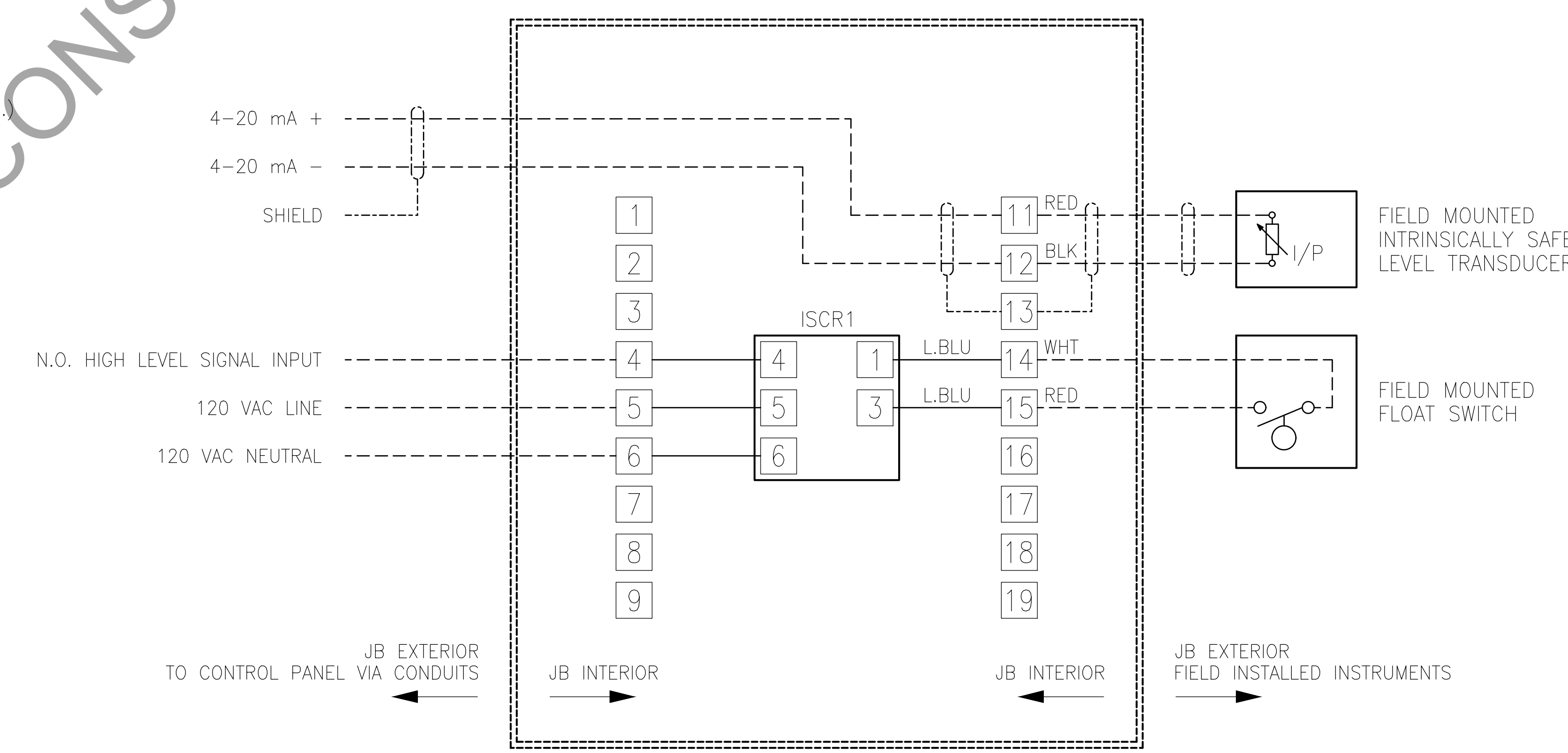
MATERIAL:
SIMILAR TO: 2965700
TYPE:
DRAWN BY: DJB DATE: 2022-10-11
WEIGHT: 11 LB SHEET: 1 OF 1

DRAWING NAME: TSS SENSOR ASSY, FIXED MTG, C1D2
DRAWING NUMBER: 2968942 SCALE: 1/4 SIZE: B





TAGS	QTY	AASI PN	DESCRIPTION
JB ENCLOSURE	1	2751157	JUNCTION BOX HOFFMAN PN: 1412CHNFSS WALL MOUNT, 4X TYPE 304 SS #4 BRUSHED CONTINUOUS HINGE
JB PANEL	1	2751158	SUBPANEL HOFFMAN PN: A14P12 MILD STEEL, PAINTED WHITE
JB.HUB1 JB.HUB2	2	2600273	HUB, 1/2" CONDUIT GEDNEY PN: SR-50-500 STRAIGHT, SS 4X
CORDGRIP1 CORDGRIP2	2	2605993	CORD GRIP, 1/2" NPT GEDNEY PN: SR-50-375 STRAIGHT, Zn-PLATED 4X
JB MISC	1	2609910	DIN RAIL, 35 mm, Al RA, A-B PN: 1492-DR5
ISO KIT	2	2611898	ISOLATION KIT AASI PART DIN RAIL MOUNTING
ISCR1	1	2751159	ISOLATED SWITCH, BARRIER ATC PN: ISO-120-AFN SINGLE CHANNEL, 120 VAC
TS1 TS2 TS3	18	2751299	TERMINAL BLOCK RA, A-B PN: 1492-J4 SINGLE CIRCUIT FEED 35 mm RAIL, 600 V MAX
TS1 TS2 TS3	2	2751302	TERMINAL END BARRIER RA, A-B PN: 1492-EBJ3 FITS 1492-J4 TERMINALS
TS1 TS2 TS3	4	2751304	TERMINAL RAIL ANCHOR RA, A-B PN: 1492-EAJ35
TS MISC	1	2751199	TERMINAL MARKER, WHITE RA, A-B PN: 1492-M6X12 (2) MARKERS PER TERM (120) MARKERS PER CARD



NOTES:

1. SEE AASI ELECTRICAL SCHEMATIC FOR TERMINAL DESIGNATION IN MAIN CONTROL PANEL.

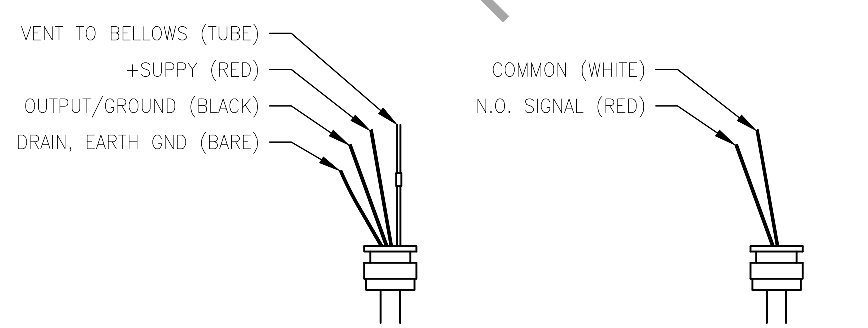
2. COIL EXCESS SENSOR CABLE. DO NOT CUT THE TERMINATION END OF THE CABLE TO SHORTEN LENGTH. CABLE IS FULLY SHIELDED; BLUE SHIELD WIRE SHOULD ALWAYS BE CONNECTED TO A GOOD EARTH GROUND UNLESS ELECTROLYTIC CORROSION IS KNOWN TO BE A PROBLEM.

3. CLEAN PROBE BY RINSING IN A MILD DETERGENT. DO NOT USE COMPRESSED AIR.

4. DO NOT REMOVE VENT LINE CAP PRIOR TO INSTALLATION IN JUNCTION BOX. VENT LINE MUST REMAIN FREE OF MOISTURE AND DEBRIS.

5. A MINIMUM OF 2.0" SPACE IS REQUIRED BETWEEN INTRINSIC SAFE WIRING AND ALL OTHER WIRING.

* CAUTION MUST BE OBSERVED WHEN INSTALLING THE VENT LINE. IF THE VENT LINE BECOMES KINKED OR OTHERWISE DAMAGED THE TRANSDUCER WILL NOT FUNCTION PROPERLY.



DETAIL "A"
CORD GRIP FOR INCOMING PRESSURE TRANSDUCER ONLY

DETAIL "B"
CORD GRIP FOR INCOMING FLOAT SWITCH WIRING ONLY

JOB NAME: STANDARD				
JOB LOCATION: STANDARD				
A	R22821	2024-08-13	ARH	STANDARDS RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: INTRINSICALLY SAFE JUNCTION BOX (LT/FS)				

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE:
DRAWN BY: ARH | DATE: 2024-08-13
WEIGHT: | SHEET: 1 OF 1
DRAWING NUMBER: 2969295 | SCALE: | SIZE: D

ELECTRICAL DRAWINGS

STANDARD NOTES:

A FOR CONTROL PANEL ASSEMBLY AND WIRING GUIDELINES SEE CONTROL PANEL WIRING SPECIFICATION ES-7014.

B SCHEMATIC SYMBOL LEGEND
- SOLID WIRING (———) INDICATES WIRING INSTALLED BY AASI (AQUA-AEROBIC SYSTEMS, INC).
- DASHED WIRING (- - - -) INDICATES WIRING INSTALLED BY OTHERS IN FIELD.
- DIAMONDS "◈" INDICATE COMPONENTS EXTERNAL TO THE CONTROL PANEL.
- UNFILLED CIRCLES "○" INDICATE TERMINAL STRIP TERMINATIONS SUPPLIED BY AASI.
- UNFILLED SQUARES "□" INDICATE TERMINAL STRIP TERMINATIONS IN JUNCTION BOX SUPPLIED BY AASI.
- FROM # ↑ AND ↓ TO # REPRESENTS CONTINUATION OF WIRING AND/OR COMPONENTS. FROM INDEX POSITION TO INDEX POSITION AS INDICATED. AT THE LEFT EDGE OF EACH COLUMN OF SCHEMATIC.
- GROUND SYMBOL (⏚) INDICATES COMMON GROUND BAR TO CHASSIS.
- GROUND SYMBOL (⏚ ISO) INDICATES ISOLATED GROUND BAR.

C MINIMUM SINGLE CONDUCTOR (COPPER) WIRE GAUGE SIZE
- 18 AWG SHIELDED TWISTED PAIR CABLE = ANALOG CONTROL CIRCUITS
- 16 AWG STRANDED MTW = DIGITAL CONTROL CIRCUITS AND DC POWER
- ≥14 AWG STRANDED MTW = MOTOR POWER

D WHENEVER POSSIBLE LOW VOLTAGE DC WIRING SHOULD CROSS PERPENDICULAR TO HIGHER VOLTAGE AC WIRING. GROUNDS FROM LOW VOLTAGE COMPONENTS AND ANALOG CABLE SHIELDS SHOULD BE TERMINATED ON AN ISOLATED GROUND BAR. THE ISOLATED GROUND BAR SHOULD BE TIED WITH ONE WIRE TO THE MAIN GROUND BAR IN THE ENCLOSURE.

E WIRE COLOR CODE

BLACK	= 230V OR GREATER 3 PHASE
RED	= 115V 1PH
WHITE	= 115V NEUTRAL
BLUE	= (+) 24VDC, INDICATED ON WIRING BY "BLU" ON THE WIRE
WHITE w/BLUE STRIPE	= (-) 24VDC, INDICATED ON WIRING BY "W/B" ON THE WIRE
GREEN w/YELLOW STRIPE	= GROUND, INDICATED ON WIRING BY "G/Y" ON THE WIRE
ORANGE	= POWER FROM REMOTE SOURCE, INDICATED BY "ORG" ON THE WIRE
WHITE w/ORANGE STRIPE	= NEUTRAL FROM REMOTE SOURCE, INDICATED BY "W/O" ON THE WIRE

F WIRE LABEL IDENTIFICATION IS TYPICALLY FOUR OR FIVE DIGITS LONG UTILIZING THE DRAWING AND LINE NUMBER OF THE POINT TO POINT WIRING DIAGRAM.

EXAMPLE: 215 1
- 1 — WIRE NUMBER 1 ON THAT LINE NUMBER
- 215 — REFERENCE NUMBER 215 THE FIRST DIGIT OF THE LINE NUMBER ALSO REPRESENTS SHEET NUMBER OF ELECT SCHEMATIC

WIRE LABELS ARE WHITE VINYL SELF-LAMINATING THERMAL TRANSFER PRINTABLE TYPE. LINE NUMBER OF THE POINT TO POINT WIRING DIAGRAM.

G PILOT LIGHT COLOR KEY
- AM OR A = AMBER (ALARM)
- RE OR R = RED (VALVE CLOSED)
- GN OR G = GREEN (MOTOR ON,VALVE OPEN)
- WH OR W = WHITE (INFORMATION)

H SEE PROJECT SPECIFIC NOTES FOR PANEL CERTIFICATION REQUIREMENTS

J ENGRAVED IDENTIFICATION NAMEPLATE TYPES ARE AS FOLLOWS:
- DOOR MOUNTED OPERATOR DEVICES = STANDARD 30.5 mm RING TYPE NAMEPLATE (WHITE WITH BLACK LETTERS)
- SUB-PANEL MOUNTED COMPONENTS = RECTANGULAR NAMEPLATE (WHITE WITH BLACK LETTERS)

ALL NAMEPLATES TO BE ATTACHED WITH 1/2" 3M SCOTCH ATG ADHESIVE TRANSFER TAPE 926 CLEAR UNLESS OTHERWISE SPECIFIED.

CRITICAL FIELD INSTALLATION NOTES:

AA WHEN ROUTING CONDUIT TO THE CONTROL PANEL, AVOID TOP ENTRY INTO THE ENCLOSURE. TOP CONDUIT ENTRY PROVIDES A POTENTIAL MOISTURE PATH TO ELECTRICAL DEVICES WITHIN THE PANEL. BOTTOM CONDUIT ENTRY IS RECOMMENDED. IF TOP ENTRY CANNOT BE AVOIDED, KEEP AWAY FROM THE AREA DIRECTLY OVER THE PLC OR OTHER ELECTRICAL DEVICES.

BB FOR OUTDOOR INSTALLATIONS,AVOID MOUNTING THE ENCLOSURE WITH DOOR FACING A SOUTHERLY DIRECTION WHEN POSSIBLE.

PROJECT SPECIFIC NOTES:

1 SHORT CIRCUIT CURRENT RATING NAMEPLATE: 5kA RMS SYMMETRICAL @ 120VAC MAXIMUM.

2 CONTROL PANEL TO BE CSA CERTIFIED.

1

AQUA AEROBIC SYSTEMS, INC.
ROCKFORD, IL (815)654-2501
ENCLOSURE RATED TYPE 12
120 VAC 1 PHASE 60 HZ
TOTAL FLA: 20
LARGEST MOTOR: N/A
DRAWING #: 9704419A30700
SHORT CIRCUIT CURRENT RATING:
5 kA rms symmetrical 460v max.

CSA DATA NAMEPLATE TO BE 3x4 GRAVOPLY, WHITE WITH BLACK CORE, ENGRAVED AS INDICATED ABOVE. TAG TO AFFIXED TO INTERIOR OF ENCLOSURE WITH DOUBLE SIDED TAPE.

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

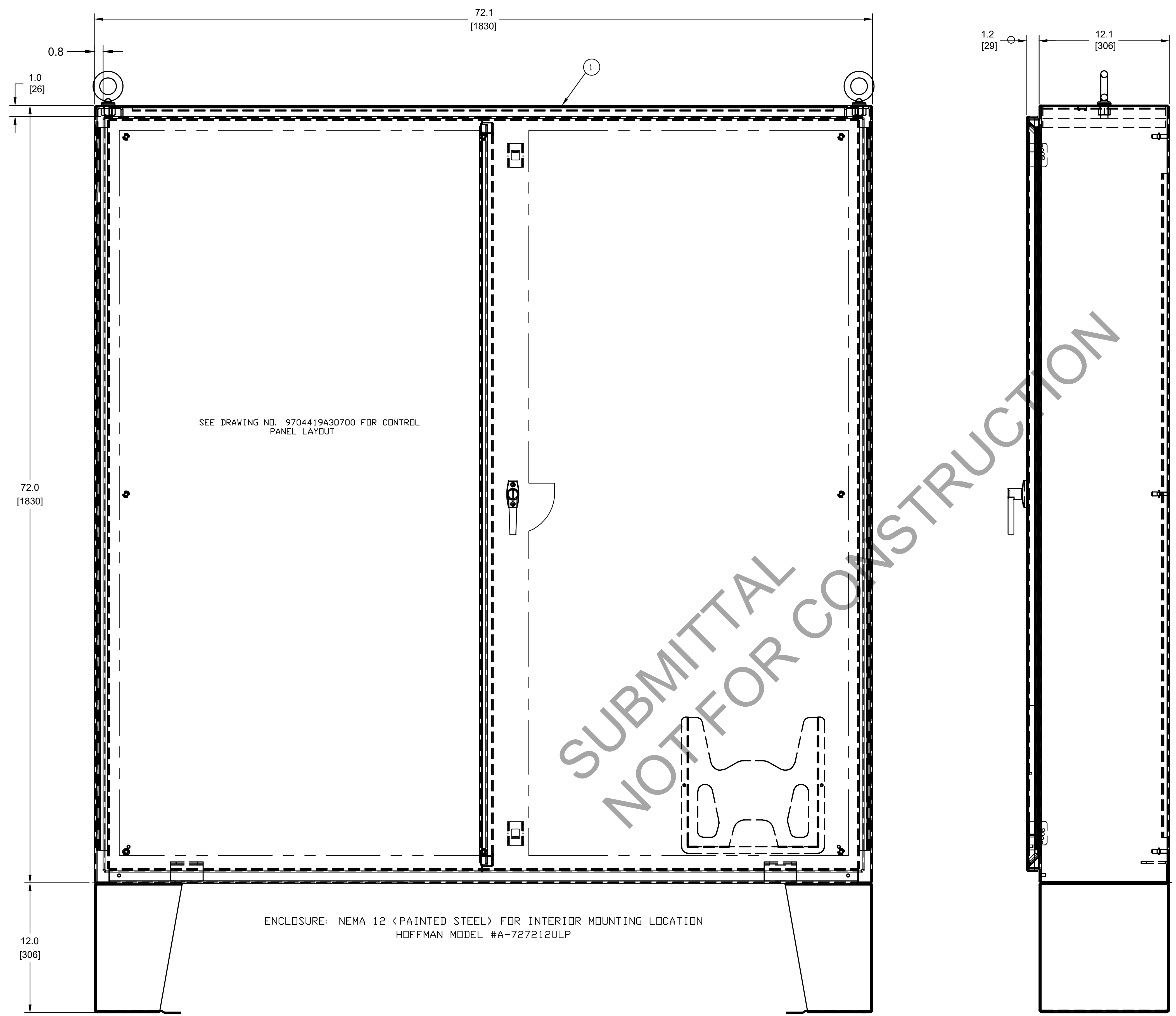
FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

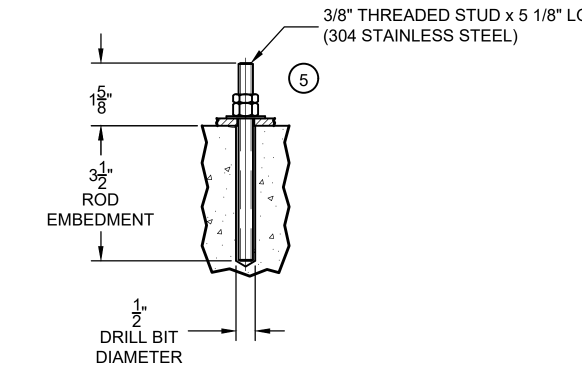
ANSI

TYPE:	3-BASIN AQUANEREDA		
DRAWN BY:	BLP	DATE:	2024-08-08
WEIGHT:	-	SHEET:	1 OF 4

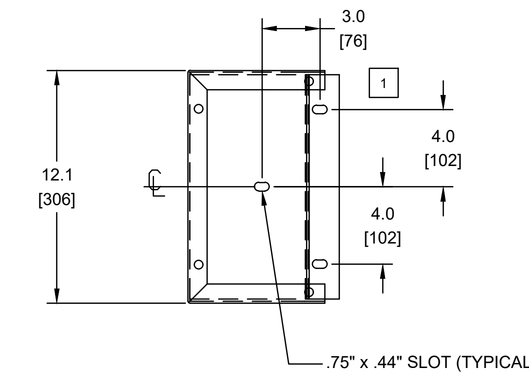
DRAWING NAME: AQUANEREDA CONTROL PANEL INSTALLATION NOTES

DRAWING NUMBER: 9704419A30600 — SCALE: NONE — SIZE: D





ANCHOR BOLT INSTALLATION DETAIL



PANEL MTG. DETAIL

PROJECT SPECIFIC NOTES:

1 MINIMUM DISTANCE FROM ANCHOR TO EDGE OF CONCRETE PAD TO BE 4.5"

5	6	2967161–1	ANCHOR KIT, 3/8"	A
4				D
3	REF	9704419A30910	AGS NETWORK ASSEMBLY	D
2	1	9704419A30800	CONTROL PANEL ELECTRCIAL SCHEMATIC	D
1	1	9704419A30700	CONTROL PANEL ASSEMBLY	D

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

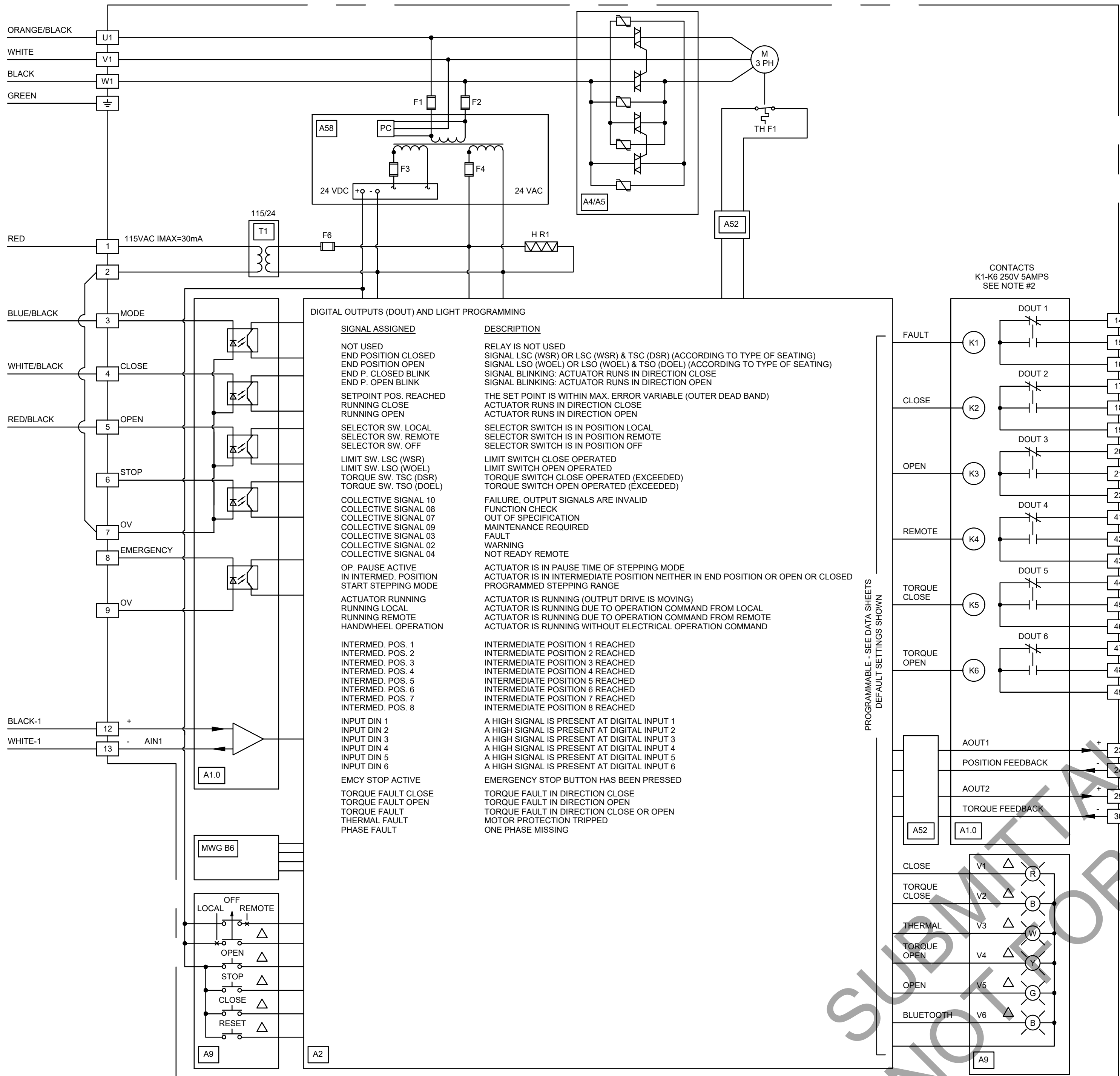
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

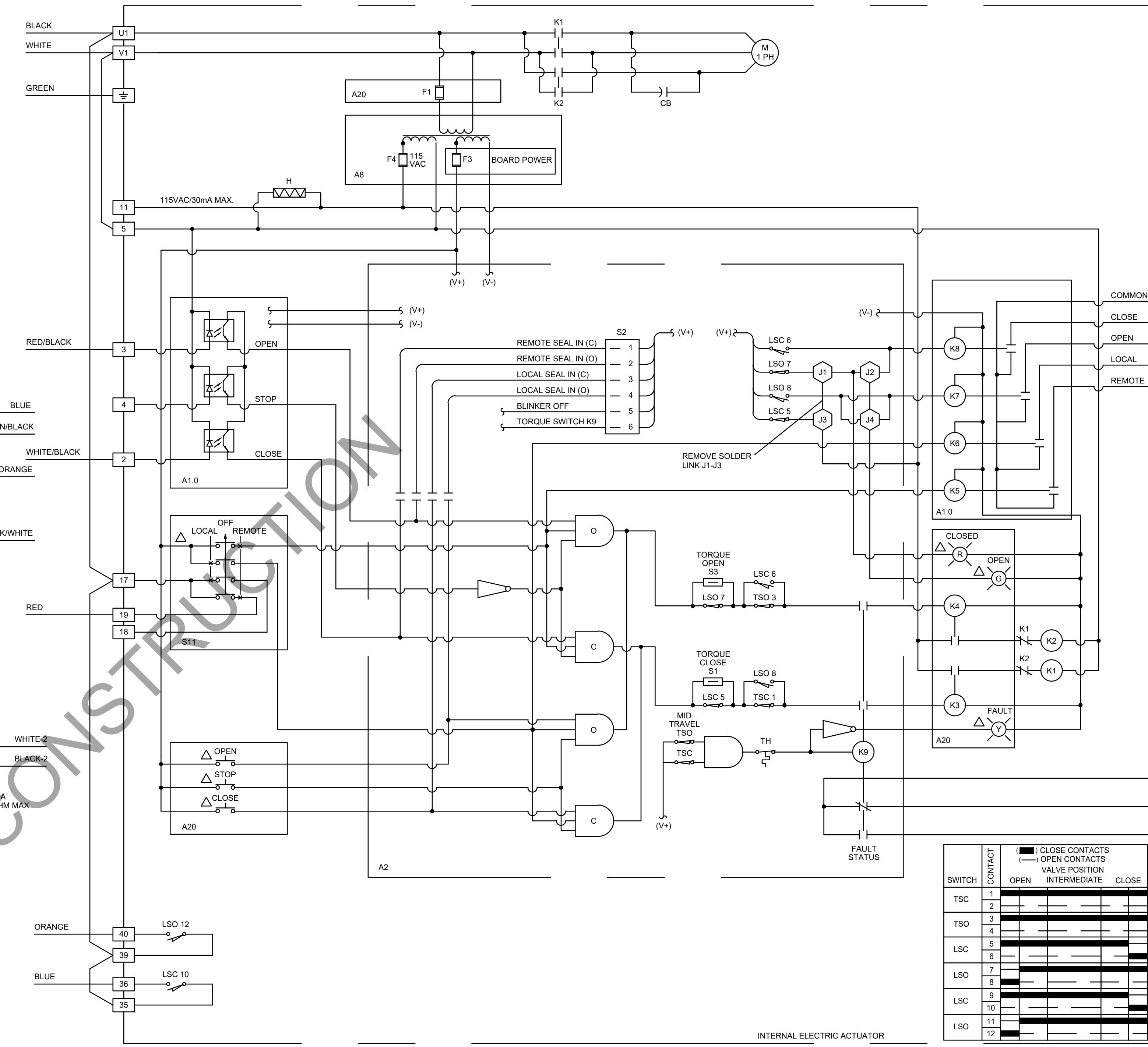
TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 2 OF 4

DRAWING NAME: AQUANEREDA CONTROL PANEL INSTALLATION NOTES
DRAWING NUMBER: 9704419A30600 SCALE: NONE SIZE: D



TYP. AUMA WIRING DIAGRAM

AUMA MODEL:
THREE PHASE FOR SAR/SQR MODULATING
PER AASI WIRING DIAGRAM 2702953



TYP. AUMA WIRING DIAGRAM

AUMA MODEL:
SINGLE PHASE FOR SA/SQ
PER AASI WIRING DIAGRAM 2702997

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

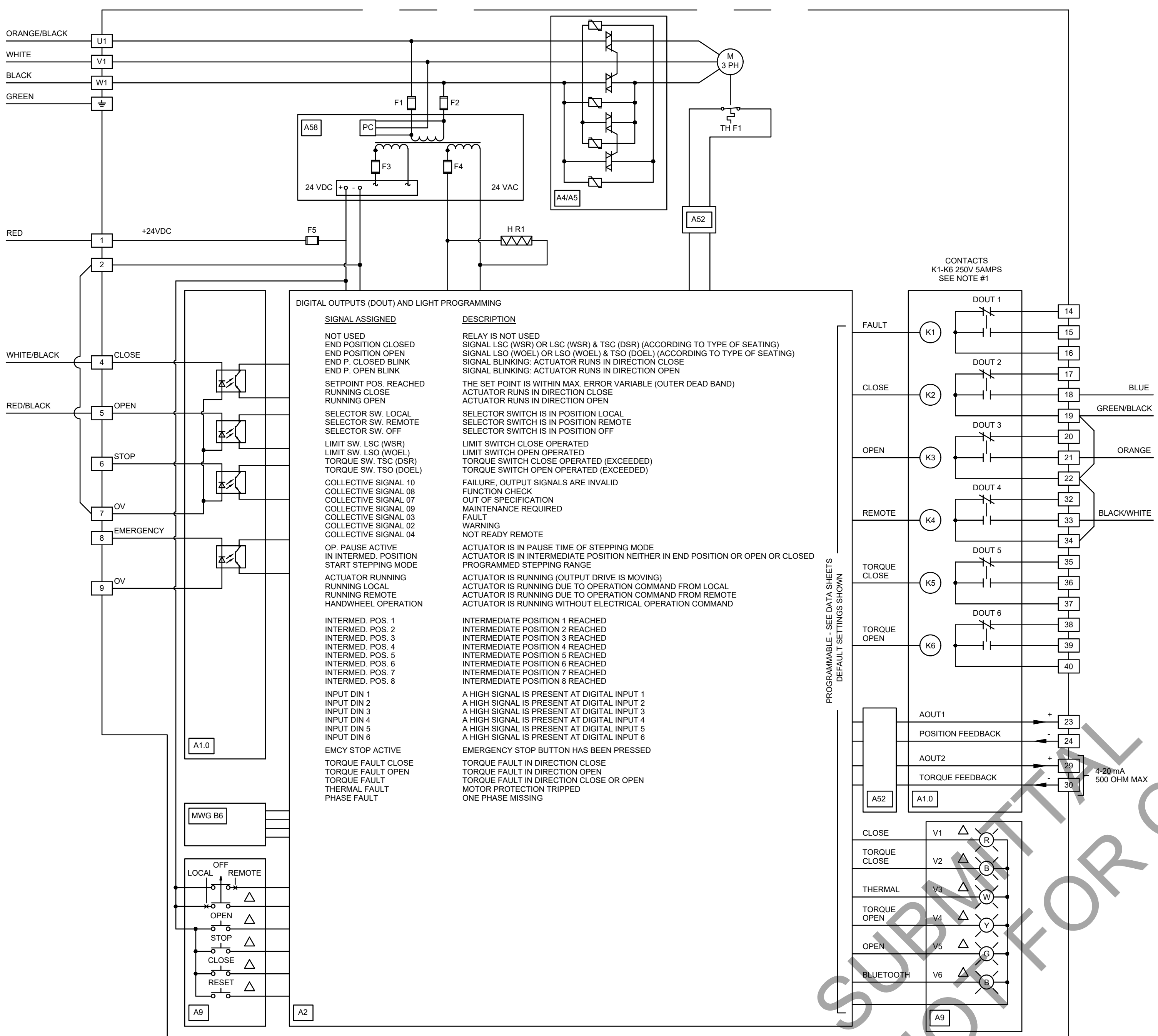
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

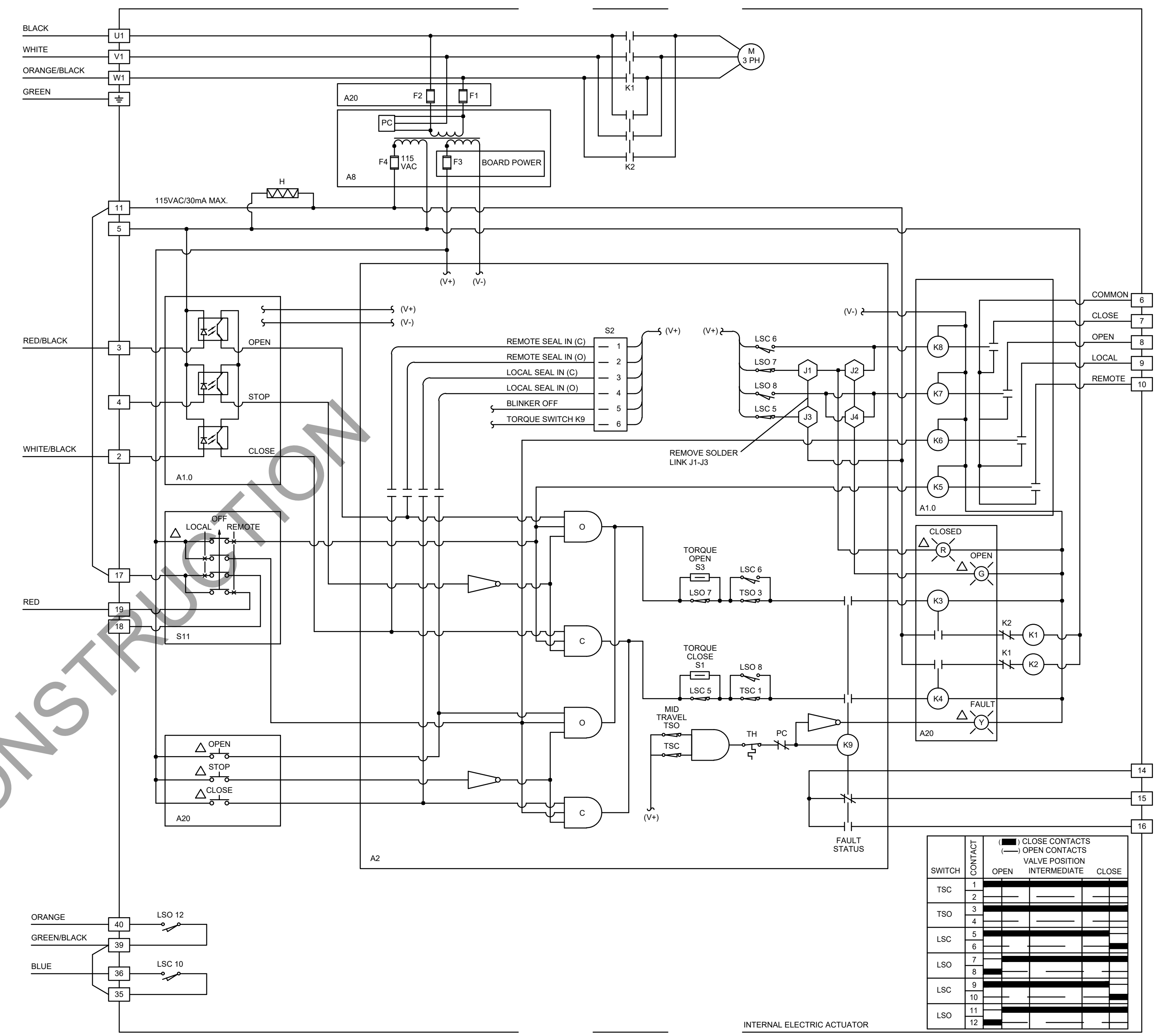
TYPE:	3-BASIN AQUANEREDA
DRAWN BY: BLP	DATE: 2024-08-08
WEIGHT: -	SHEET: 3 OF 4

DRAWING NAME: AQUANEREDA CONTROL PANEL INSTALLATION NOTES
DRAWING NUMBER: 9704419A30600
SCALE: NONE
SIZE: D



TYP. AUMA WIRING DIAGRAM

AUMA MODEL:
THREE PHASE FOR SA/SQ
PER AASI WIRING DIAGRAM XXXXXX



TYP. AUMA WIRING DIAGRAM

AUMA MODEL:
THREE PHASE FOR SA/SQ
PER AASI WIRING DIAGRAM 2702815
(SLUDGE BUFFER INLET)

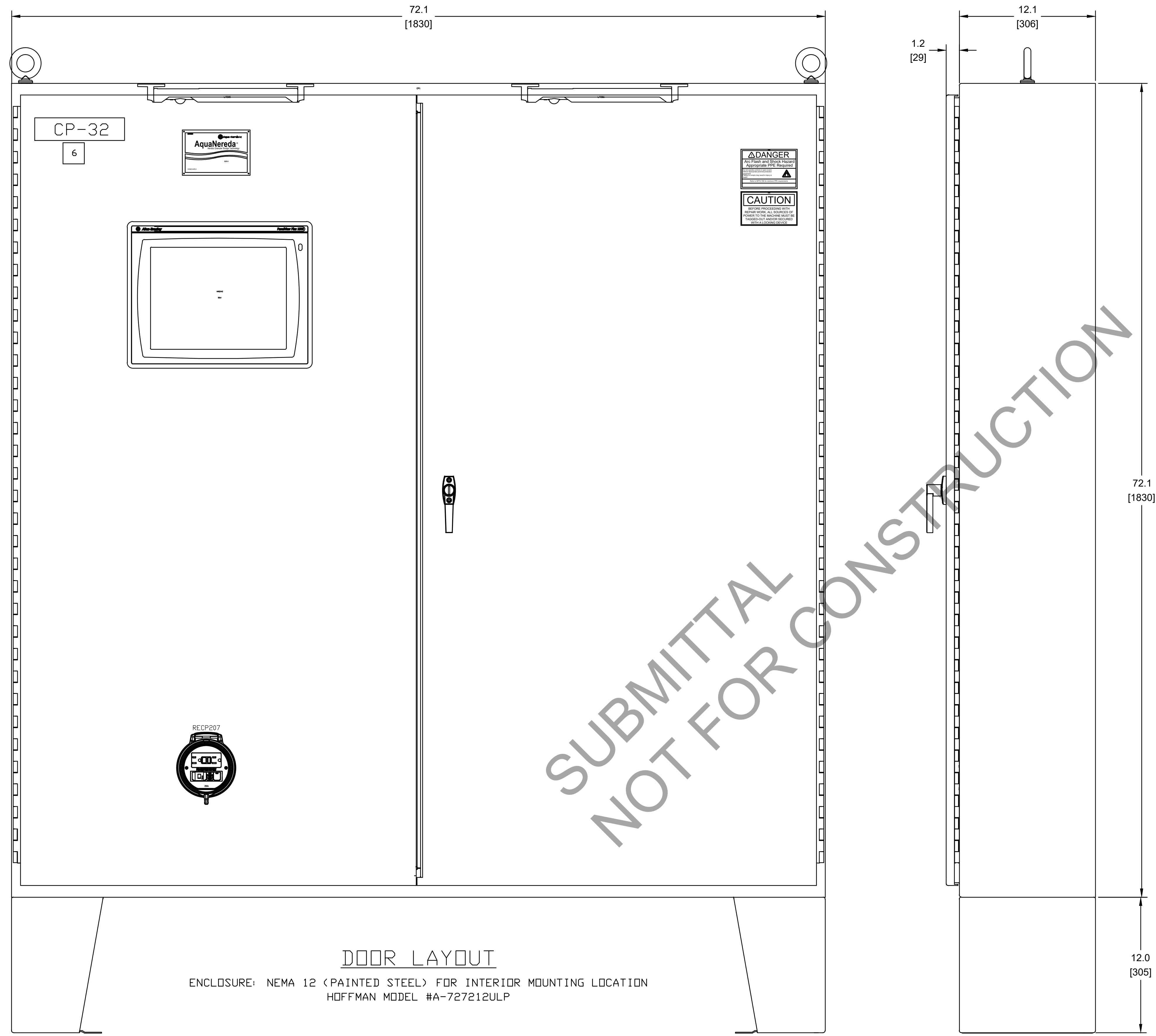
JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: AQUANEREDA CONTROL PANEL INSTALLATION NOTES				

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

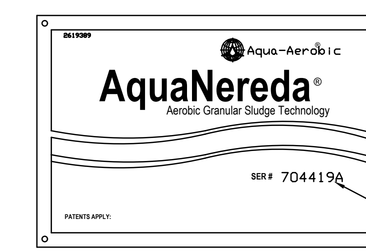
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE: 3-BASIN AQUANEREDA			
DRAWN BY: BLP		DATE: 2024-08-08	
WEIGHT: -		SHEET: 4 OF 4	
DRAWING NUMBER: 9704419A30600		SCALE: NONE	SIZE: D



DOOR LAYOUT

ENCLOSURE: NEMA 12 (PAINTED STEEL) FOR INTERIOR MOUNTING LOCATION
HOFFMAN MODEL #A-727212ULP



INFORMATION TO BE STAMPED INTO PART NUMBER 2619389

APPROXIMATE PANEL WEIGHT: 850 LBS

SHEET SPECIFIC NOTES:

1. STANDARD WIRING NOTES PER INSTALLATION DRAWING 9704419A30600
2. CONTROL PANEL ELEMENTARY PER DRAWING 9704419A30800
3. SYSTEM CONNECTION DIAGRAM PER DRAWING 9704419A30910
4. CONTROL PANEL TO BE CSA LISTED
5. RUN WIRES FOR DOOR MOUNTED DEVICES TO TERMINAL STRIP VIA SPIRAL WRAP. WIRE TO BE RUN IN LENGTHS ADEQUATE ENOUGH TO OPEN CABINET DOOR(S) 180 DEGREES.
6. ENCLOSURE NAMEPLATE TO BE SUPPLIED WITH 1" HIGH BLACK LETTERS ON WHITE BACKGROUND

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

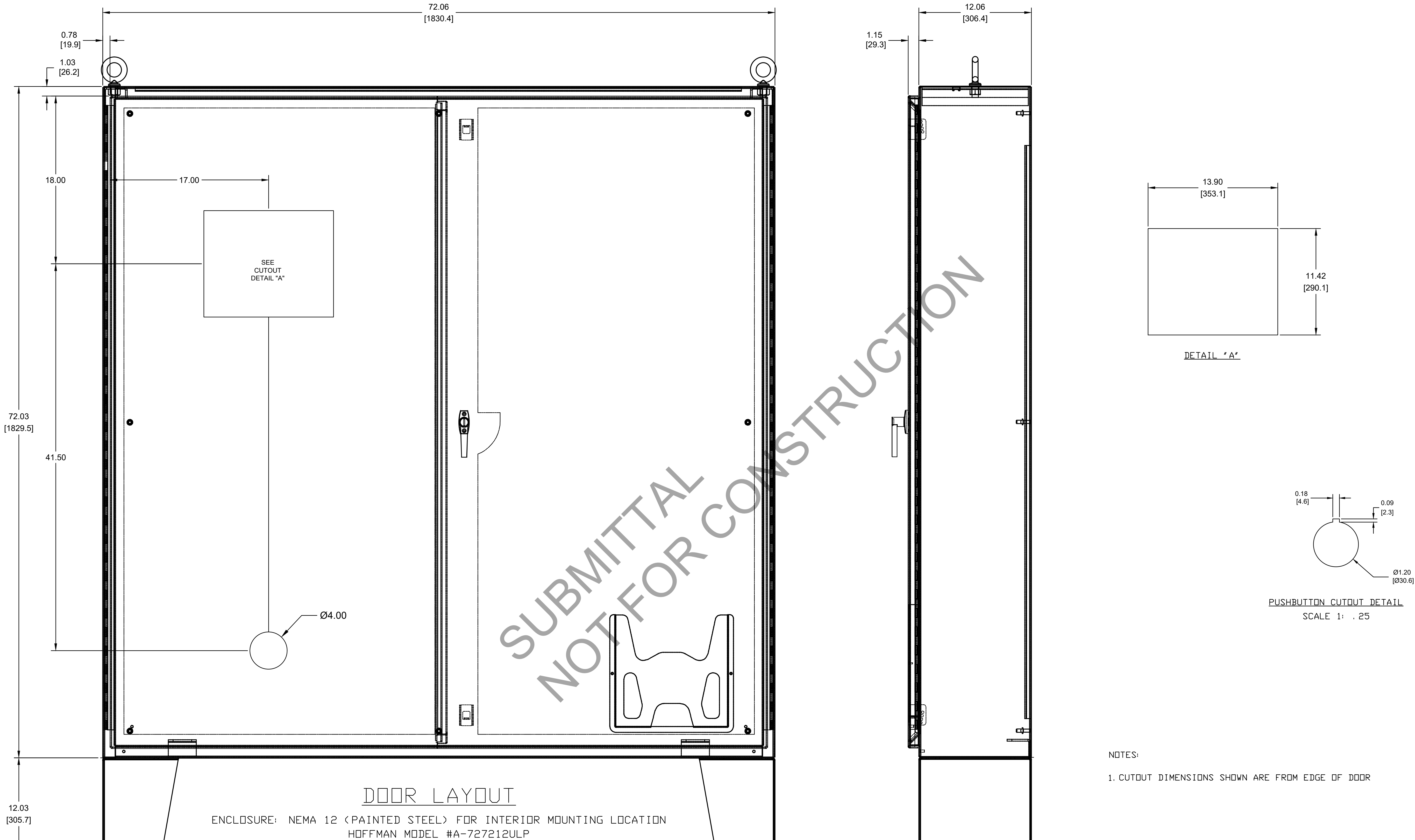
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

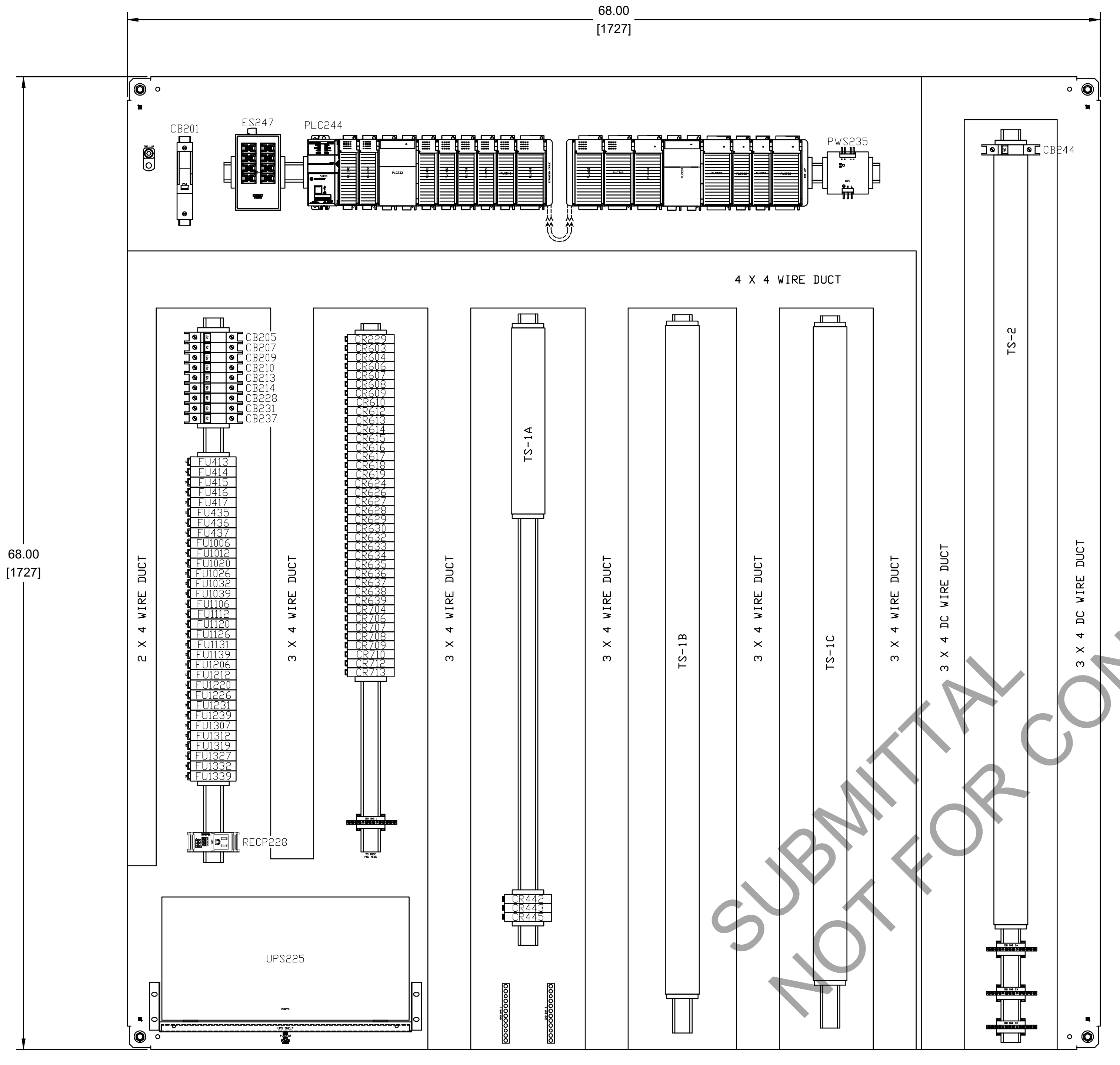
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 1 OF 5

DRAWING NAME: AQUANEREDA CONTROL PANEL ASSEMBLY
DRAWING NUMBER: 9704419A30700
SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP					DO NOT SCALE DRAWING / AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: NAPANEE - ONTARIO, CANADA					
					UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONAL DIMENSIONS +/- 1/16 ALL TWO PLACE DECIMALS +/- 0.010 ALL THREE PLACE DECIMALS +/- 0.005 ALL ANGLES +/- 1/2° ANSI
					TYPE: 3-BASIN AQUANEREDA
A	-	2025-02-13	BLP	SUBMITTAL RELEASE	DRAWN BY: BLP — DATE: 2024-08-08
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: - — SHEET: 2 OF 5
DRAWING NAME: AQUANEREDA CONTROL PANEL ASSEMBLY					DRAWING NUMBER: 9704419A30700 — SCALE: NONE — SIZE: D



SUB-PANEL LAYOUT

SHEET SPECIFIC NOTES:

1. STANDARD WIRING NOTES PER INSTALLATION DRAWING 9704419A30600
2. CONTROL PANEL ELEMENTARY PER DRAWING 9704419A30800
3. NETWORK COMMUNICATION DIAGRAM PER DRAWING 9704419A30910
4. CONTROL PANEL TO BE CSA LISTED
5. RUN WIRES FOR DOOR MOUNTED DEVICES TO TERMINAL STRIP VIA SPIRAL WRAP. WIRE TO BE RUN IN LENGTHS ADEQUATE ENOUGH TO OPEN CABINET DOOR(S) 180 DEGREES.

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DRAWING NAME: AQUANEREDA CONTROL PANEL ASSEMBLY

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS	+/- 1/16
ALL TWO PLACE DECIMALS	+/- 0.010
ALL THREE PLACE DECIMALS	+/- 0.005
ALL ANGLES	+/- 1/2°

ANSI

TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP		DATE: 2024-08-08	
WEIGHT: -		SHEET: 3 OF 5	
DRAWING NUMBER: 9704419A30700		SCALE: NONE	SIZE: D

TS-1A

2011, 2011, 2011, 2011, 2011, 2011, 2011, 2011, 2011, 2011, –, –, –, –, 2012N

TS-1B

2081, –, 2091, 2091, 2091, 2091, 2091, –, 2101, 2101, 2101, –, 2131, 2141, –, 2301, 2301, 2301, –, 2302N, 2302N, 2302N, –, –, –, –, –, –, –, 3021, 3031, 3041, 3051, 3061, 3071, 3091, 3101, 3111, 3121, 3131, 3141, 3151, 3161, 3171, –, 3221, 3231, 3241, 2351, 3261, 3271, 3291, 3301, 3311, 3321

3331, 3341, 3351, 3361, 3371, –, 4021, 4031, 4041, 4051, 4061, 4071, 4081, 4091, 4101, 4111, 4121, 4131, 4132, 4141, 4142, 4151, 4152, 4161, 4162, 4171, 4172, –, 4221, 4231, 4241, 4251, 4261, 4271, 4281, 4291, 4301, 4311, 4321, 4331, 4341, 4351, 4352, 4361, 4362, 4371, 4372, –, 5021, 5031, 5041, 5051, 5061, 5071, 5081, 5091, 5101, 5111, 5121, 5131, 5141, 5151, 5161, 5171, –, 5221, 5231, 5241, 5251, 5261, 5271, 5281, 5291, 5301, 5311, 5321, 5331, 5341

5351, 5361, 5371, –, 5421, 5431, 5441, 5451, 5461, 5481, 5491, 5501, 5511, 5521, 5531, 5541, 5551, 5561, 5571, –, 6031, 6041, 6051, 6061, 6071, 6081, 6091, 6101, 6121, 6131, 6141, 6151, 6161, 6171, 6181, 6191, –, –, –, –, –, –, –, –

TS-1C

6231, 6241, 6251, 6261, 6271, 6281, 6291, 6301, 6321, 6331, 6341, 6351, 6361, 6371, 6381, 6391, –, 6411, 6412, –, 6431, 6432, –, 6451, 6452, –, 6471, 6472, –, 7031, 7041, 7051, 7061, 7071, 7081, 7091, 7101, 7121, 7131, 7141, 7151, 7161, 7171, 7181, 7191, –, –, –, –, –, –, –, –, –, –, –, –, –, –, –, –, 10031, 10032, 10033, –, 10091, 10092, 10093, 10094, –, 10181, 10182, 10183, –, –, –, 10231

10232, 10233, –, 10291, 10292, 10293, –, 10361, 10362, 10363, –, –, –, –, –, 11031, 11032, 11033, –, 11091, 11092, 11093, 11094, –, 11181, 11182, 11183, –, 11231, 11232, 11233, –, 11291, 11292, 11293, –, 11361, 11362, 11363, –, –, –, –, –, 12031, 12032, 12033, –, 12091, 12092, 12093, 12094, –, 12181, 12182, 12183, –, 12231, 12232, 12233, –, 12291, 12292, 12293, –, 12361, 12362, 12363, –, –, –, –, –, 13041, 13042, 13043

–, 13091, 13092, 13093, –, 13161, 13162, 13163, –, 13241, 13242, 13243, –, 13291, 13292, 13293, –, 13361, 13362, 13363, –

TS-2

FU723: 7241, 2322–, 2321+, SHLD
FU725: 7261, 2322–, 2321+, SHLD
FU727: 7281, 2322–, 2321+, SHLD
FU729: 7301, 2322–, 2321+, SHLD
FU731: 7321, 2322–, 2321+, SHLD
FU733: 7341, 2322–, 2321+, SHLD
FU735: 7361, 2322–, 2321+, SHLD
FU737: 7381, 2322–, 2321+, SHLD
FU803: 8041, 2322–, 2321+, SHLD
FU805: 8061, 2322–, 2321+, SHLD
FU807: 8081, 2322–, 2321+, SHLD
FU809: 8101, 2322–, 2321+, SHLD
FU811: 8121, 2322–, 2321+, SHLD

FU813: 8141, 2322–, 2321+, SHLD
FU815: 8161, 2322–, 2321+, SHLD
FU817: 8181, 2322–, 2321+, SHLD
FU822: 8231, SHLD
FU824: 8251, SHLD
FU826: 8271, SHLD
FU828: 8291, SHLD
FU830: 8311, SHLD
FU832: 8331, SHLD
FU834: 8351, SHLD
FU836: 8371, SHLD
FU902: 9031, SHLD
FU904: 9051, SHLD
FU906: 9071, SHLD
FU908: 9091, SHLD
FU910: 9111, SHLD
FU912: 9131, SHLD
FU914: 9151, SHLD
FU916: 9171

FU923: 9241, 2322–, 2321+, SHLD
FU925: 9261, 2322–, 2321+, SHLD
FU927: 9281, 2322–, 2321+, SHLD
FU929: 9301, 2322–, 2321+, SHLD
FU931: 9321, 2322–, 2321+, SHLD
FU933: 9341, 2322–, 2321+, SHLD
FU935: 9361, 2322–, 2321+, SHLD
FU937: 9381, 2322–, 2321+, SHLD
–, 2321+, 2321+, 2321+, 2321+, 2321+, 2321+, 2321+, 2321+, –, 2322–, 2322–, 2322–, 2322–, 2322–, 2322–, 2322–, 2322–, –, 2441, –, –, 14021, 14031, –, 14111, 14121, –

14221, 14231, –, 14311, 14321, –, –, –, –, –, –, –, –, –, –, 15211, 15221, –, 15281, 15291

SUBMITTAL – NOT FOR CONSTRUCTION

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: AQUANEREDA CONTROL PANEL ASSEMBLY				

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP | DATE: 2024-08-08
WEIGHT: - | SHEET: 4 OF 5
DRAWING NUMBER: 9704419A30700 | SCALE: NONE | SIZE: D

Copyright 2012 Aqua-Aerobic Systems, Inc. All Rights Reserved. This Drawing May Not Be Copied All Or In Part Without The Express Written Permission Of Aqua-Aerobic Systems, Inc.

TAGS	QTY	SUB	USER3	DESCRIPTION
RECP228	1		2751236	RECEPTACLE ASI IMACP01 SINGLE 125VAC NON-GFCI 15 BLACK
RECP207	1	*1	2754532	RECEPTACLE W/ RJ45 PANDUIT DAP4BC-GO-5 DUPLEX 125VAC GFCI 20 IVORY
		*1	*OBSOLETE* 2702606	CORD HUBBELL PCX6GY10 PATCH 300VAC PVC 0 GRAY
CB205	1		2753909	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42102 UL 489 480Y/277V AND 240V 2 C 1
CB244	1		2753912	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42103 UL 489 480Y/277V AND 240V 3 C 1
CB207 CB213 CB214 CB237	4		2753916	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42105 UL 489 480Y/277V AND 240V 5 C 1
CB231	1		2753917	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42106 UL 489 480Y/277V AND 240V 6 C 1
CB209 CB228	2		2753922	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42110 UL 489 480Y/277V AND 240V 10 C 1
CB210	1		2753929	CIRCUIT BREAKER SCHNEIDER ELECTRIC M9F42115 UL 489 480Y/277V AND 240V 15 C 1
CB201	1		2754162	CIRCUIT BREAKER SQUARE D BDL16020 MOLDED CASE 120VAC 20 1
CR442 CR443 CR445	3	*1	2751476	SOCKET ALLEN BRADLEY 700-HN221 RELAY SCREW TERMINAL SPDT 0 0
		*1	2701127	RELAY ALLEN BRADLEY 700-HK36Z24-4 CONTROL 24VDC SPDT 10 1 / FORM C 1
		*1	2752140	SUPPRESSOR ALLEN BRADLEY 700-AR1 R-C SURGE 6-24V AC/DC 0 0
CR603 CR604 CR606 CR607 CR608 CR609 CR610 CR612 CR613 CR614 CR615 CR616 CR617 CR618 CR619 CR624 CR626 CR627 CR628 CR629 CR630 CR632 CR633 CR634 CR635 CR636 CR637 CR638 CR639 CR704 CR706 CR707 CR708 CR709 CR710 CR712 CR713 CR715 CR716 CR717	40	*1	2751476	SOCKET ALLEN BRADLEY 700-HN221 RELAY SCREW TERMINAL SPDT 0 0
		*1	2700940	RELAY ALLEN BRADLEY 700-HK36A1-4 CONTROL 120VAC SPDT 10 1 / FORM C 1
		*1	2750942	SUPPRESSOR ALLEN BRADLEY 700-AR2 R-C SURGE 110-240V AC 0 0
CR229	1	*1	2751643	SOCKET ALLEN BRADLEY 700-HN222 RELAY SCREW TERMINAL DPDT 0 0
		*1	2701130	RELAY ALLEN BRADLEY 700-HK32A1-4 CONTROL 120VAC DPDT 5 2 / FORM C 2
		*1	2750942	SUPPRESSOR ALLEN BRADLEY 700-AR2 R-C SURGE 110-240V AC 0 0
ISO GND 1 ISO GND 2A ISO GND 2B ISO GND 2C	4		2751092	GROUND BAR ABB RAU035610304 ISOLATED BRONZE
PNL MISC	1	*4	2607334	INHIBITOR HOFFMAN AHCI5E CORROSION EMMITER
		*20	2751304	TERMINAL ALLEN BRADLEY 1492-EAJ35 END ANCHOR GRAY GRAY
LT205 LT206	2	*1	2754981	PANEL LIGHT HOFFMAN CEL550M LED 120VAC ALUMINUM
		*1	2754804	POWER CORD HOFFMAN CELC3001PBUL LED LIGHT 24-240VACVDC 3METER
UPS SHELF	1		2752940	SHELF HOFFMAN ESH198 SINGLE-SIDED STEEL
GND BAR 1 GND BAR 2	2		2750028	GROUND BAR ITE GB10 NON-ISOLATED BRONZE
GND LUG	1		2750031	GROUND LUG PENN UNION PNL-1/0 TONGUE BRONZE
FU1032 FU1039 FU1131 FU1139 FU1231 FU1239 FU1312 FU1319 FU1332 FU1339	10	*1	2751333	BLOCK ALLEN BRADLEY 1492-FB1M30 FUSE 600 VAC/VDC MIDGET 30 1
		*1	2608763	FUSE LITTELFUSE FLM5 TIME DELAY 250VAC/VDC SUPPLEMENTAL 5
FU1006 FU1012 FU1020 FU1026 FU1106 FU1112 FU1120 FU1126 FU1206 FU1212 FU1220 FU1226 FU1307 FU1327 FU413 FU414 FU415 FU416 FU417 FU435 FU436 FU437	22	*1	2751333	BLOCK ALLEN BRADLEY 1492-FB1M30 FUSE 600 VAC/VDC MIDGET 30 1
		*1	2608762	FUSE LITTELFUSE FLM1 TIME DELAY 250VAC/VDC SUPPLEMENTAL 1
CP1 TAG1	1		2619389	NAMEPLATE AQUA-AEROBIC 2619389 3.5" x 5.5" 316 SS BLACK BLUE AQUA NEREDA
CP1 TAG2	1		2751337	NAME PLATE BRADY 101951 3.5" x 5" PRESS-ON BLACK/WHITE WHITE/RED DANGER ARC-FLASH
CP1 TAG3	1		2603103	NAME PLATE SAFETY SIGN COMPANY 9395288 3" x 5" PRESS-ON BLACK YELLOW CAUTION
EXPANSION CABLE	1		2702336	CABLE ALLEN BRADLEY 1769-CRL1 EXPANSION ACCESSORY COMPACTLOGIX
END CAP	1		2701823	END CAP ALLEN BRADLEY 1769-ECR RIGHT COMPACTLOGIX
PLC302 PLC322 PLC402 PLC422 PLC502 PLC522 PLC542	7		2701824	INPUT MODULE ALLEN BRADLEY 1769-IA16 DIGITAL 132VAC 79VAC COMPACTLOGIX 16
PLC723 PLC803 PLC923	3		2701835	INPUT MODULE ALLEN BRADLEY 1769-IF8 ANALOG 4-20mA 0-10VDC COMPACTLOGIX 8
PLC244	1	*1	2754692	PROCESSOR ALLEN BRADLEY 1769-L38ERM PLC 5 MBYTES COMPACTLOGIX
		*1	2702605	CORD HUBBELL PCX6GY03 PATCH 300VAC PVC 0 GRAY
PLC822 PLC902	2		2702282	OUTPUT MODULE ALLEN BRADLEY 1769-OF8C ANALOG 4-20mA 0-10VDC COMPACTLOGIX 8
PLC602 PLC622 PLC702	3		2701834	OUTPUT MODULE ALLEN BRADLEY 1769-OW16 RELAY 265VAC 5VAC COMPACTLOGIX 16
PLC233 PLC237	2		2701833	POWER SUPPLY ALLEN BRADLEY 1769-PA4 PLC 230 VAC 120VAC COMPACTLOGIX
PWS235	1		2751312	POWER SUPPLY ALLEN BRADLEY 1606-XLP100E 100Watts 28VDC 24VDC 4.2 100VAC 240VAC
TS1 TS2	9		2751304	TERMINAL ALLEN BRADLEY 1492-EAJ35 END ANCHOR GRAY GRAY
TS1 TS2	4		2751303	TERMINAL ALLEN BRADLEY 1492-EBJ16 END BARRIER GRAY GRAY
TS1 TS2	625		2751299	TERMINAL ALLEN BRADLEY 1492-J4 BLOCK 600VAC/600VDC FEED THROUGH 35 GRAY
FU723 FU725 FU727 FU729 FU731 FU733 FU735 FU737 FU803 FU805 FU807 FU809 FU811 FU813 FU815 FU817 FU822 FU824 FU826 FU828 FU830 FU832 FU834 FU836 FU902 FU904 FU906 FU908 FU910 FU912 FU914 FU916 FU923 FU925 FU927 FU929 FU931 FU933 FU935 FU937	40	*1	2750034	BLOCK ALLEN BRADLEY 1492-WFB4 FUSE 300 VAC/VDC AXIAL LEAD 15 1
		*1	2751144	FUSE LITTELFUSE 217.05 FAST ACTING - 50mA 250VAC/VDC SUPPLEMENTAL 0.05
HMI242	1	*1	2753561	PANELVIEW PLUS 7 1500 ALLEN BRADLEY 2711P-T15C22D9P OPER INTER 32VDC 18VDC 50Watts COLOR ACTIVE MATRIX TOUCHSCREEN
		*1	*OBSOLETE* 2702606	CORD HUBBELL PCX6GY10 PATCH 300VAC PVC 0 GRAY
UPS225	1	*1	2754116	UPS APC SMT1500C 1500 1000 120VAC 120VAC
		*1	2754115	SMARTSLOT CARD APC AP9613 DRY CONTACT RELAY 24VDC
		*1	2615838	POWER CORD MCMASTER 70355K35 NEMA 5-15 PLUG 14 AWG THREE CONDUCTOR SJEOOW 6'
ES247	1		2754546	SWITCH ALLEN BRADLEY 1783-US16T ETHERNET 24VDC UNMANAGED 250MA
TS MISC	1	*2	2609910	DIN RAIL ALLEN BRADLEY 1492-DR5 IEC STYLE ALUMINUM STANDARD 35 mm x 7.5 mm, 1.0 m LENGTH
		*6	2750086	DIN RAIL ALLEN BRADLEY 1492-DR6 IEC STYLE ALUMINUM STANDARD 35 mm x 7.5 mm, RAISED 57.4 mm, 1.0 m LENGTH
		*7	2751199	TERMINAL ALLEN BRADLEY 1492-M6X12 MARKER WHITE
		*6	2751329	TERMINAL ALLEN BRADLEY 1492-CJLJ6-10 JUMPER CENTER 10
		*1	2751309	TERMINAL ALLEN BRADLEY 1492-M7X12 MARKER WHITE
		*4	2751307	TERMINAL ALLEN BRADLEY 1492-CJJ12-10 JUMPER CENTER 10
CP1	1	*1	2750136	ENCLOSURE HOFFMAN A727212ULP FLOOR MOUNT 12 MILD STEEL MULTI-DOOR
		*1	2750137	SUB-PANEL HOFFMAN A72P72 ENCLOSURE MILD STEEL WHITE PAINT

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA

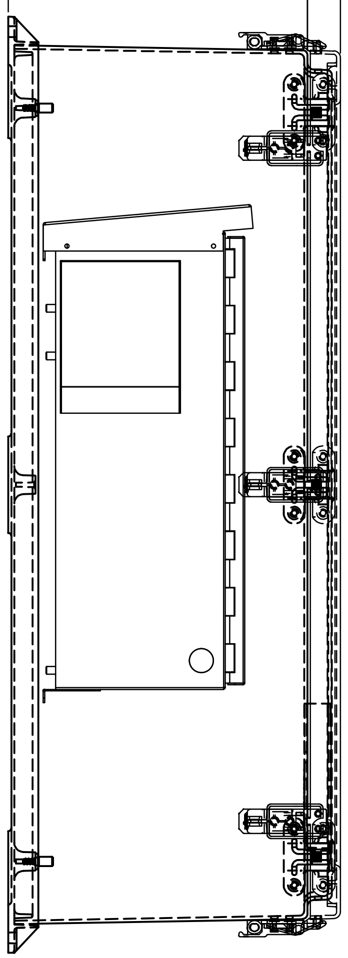
DO NOT SCALE DRAWING

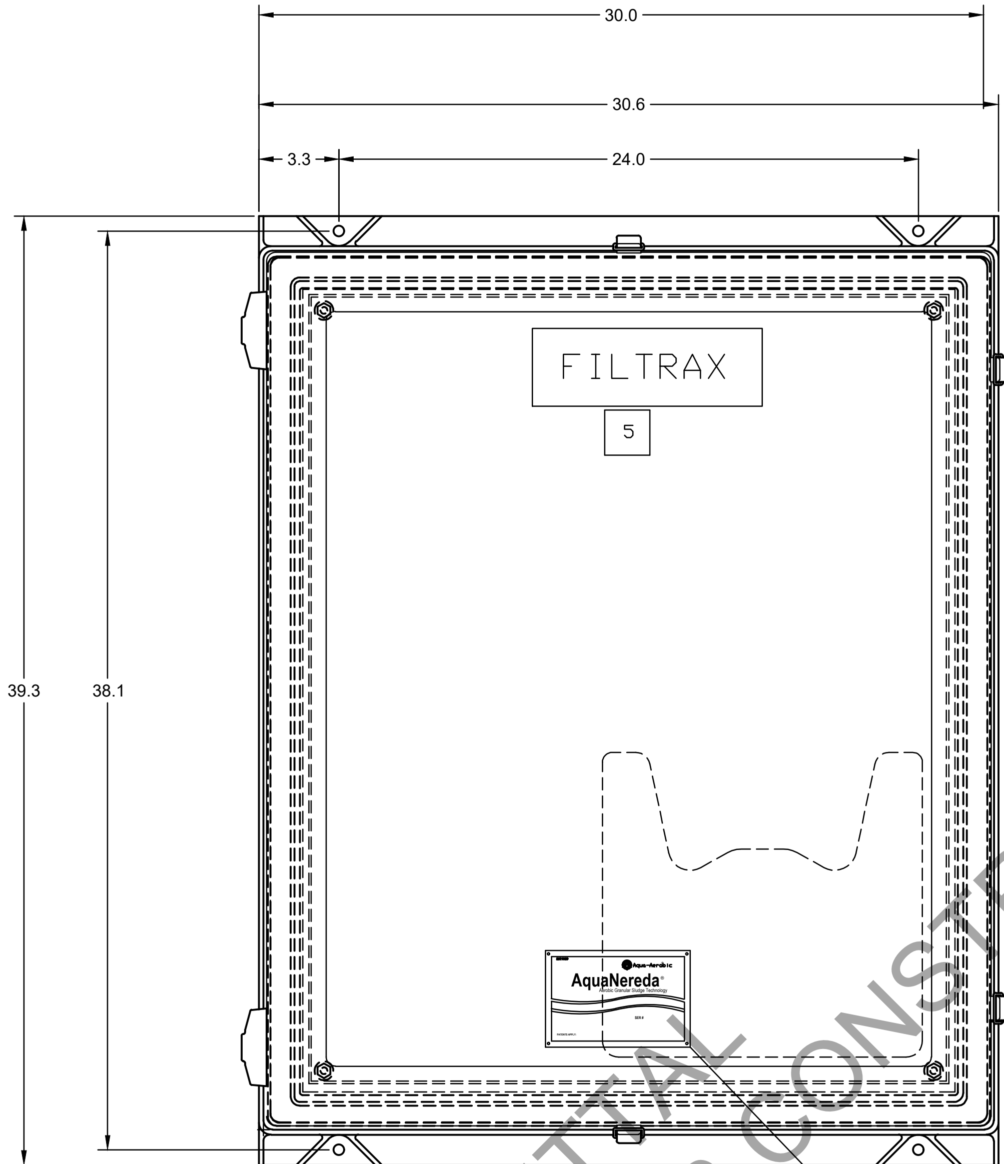
AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

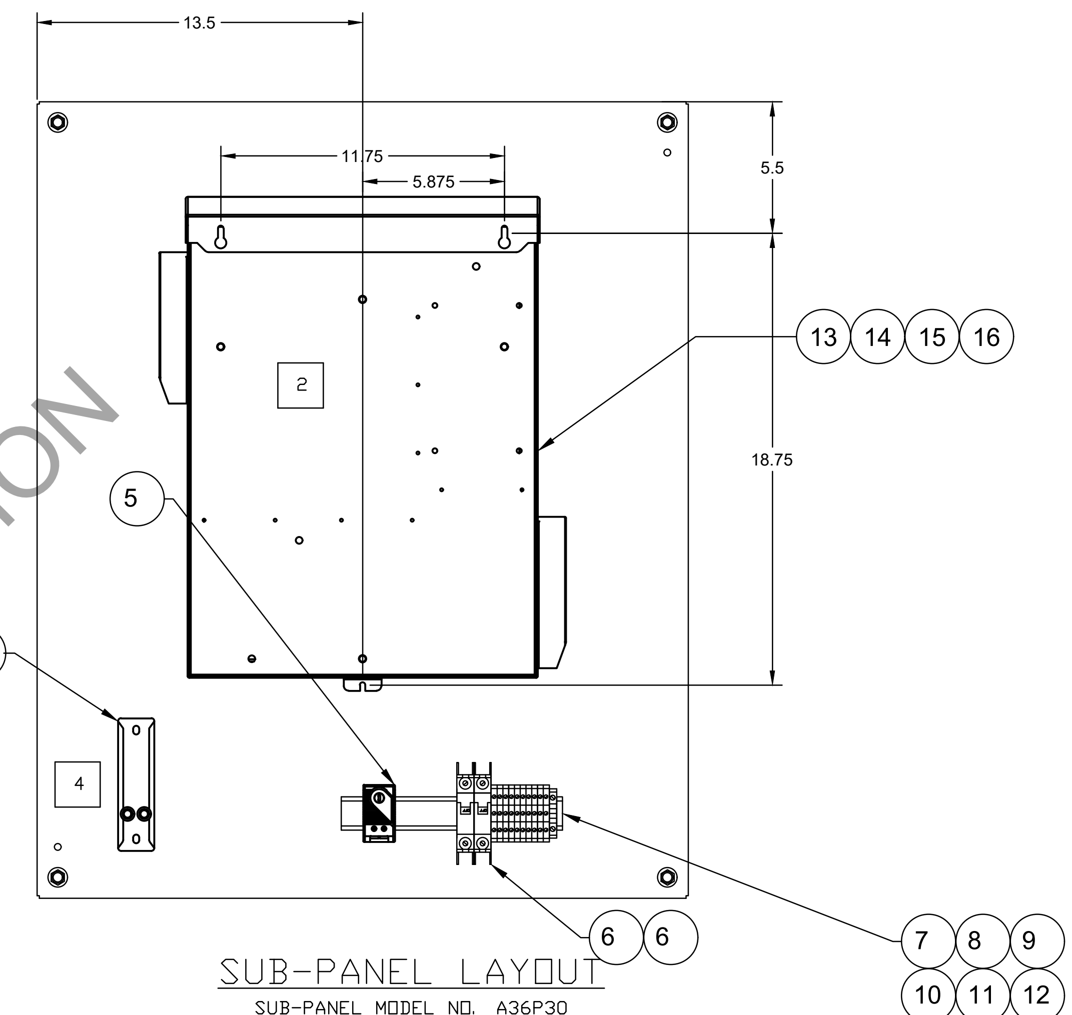
TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 5 OF 5
DRAWING NAME: AQUANEREDA CONTROL PANEL ASSEMBLY
DRAWING NUMBER: 9704419A30700 SCALE: NONE SIZE: D





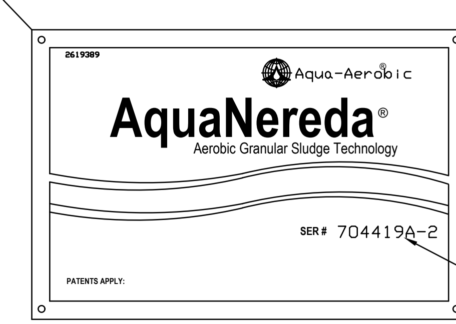
DOOR LAYOUT

ENCLOSURE: NEMA 4X FIBERGLASS
HOFFMAN MODEL A36H3020GQRLP

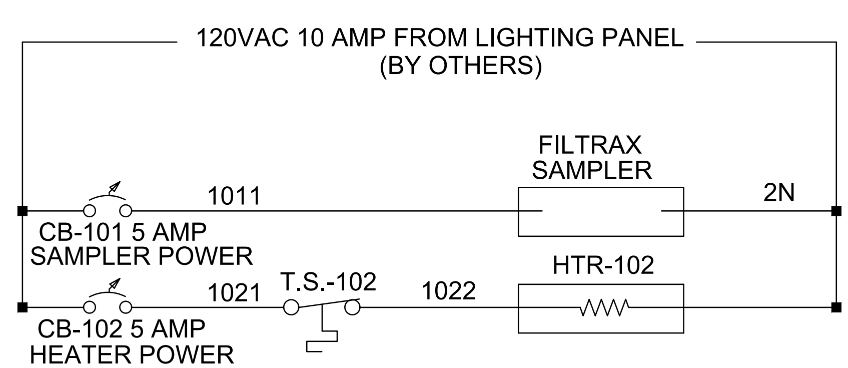


SUB-PANEL LAYOUT

SUB-PANEL MODEL NO. A36P30



INFORMATION TO BE STAMPED INTO PART NUMBER 2619389



SHEET SPECIFIC NOTES:

1. STANDARD WIRING NOTES PER INSTALLATION DRAWING 9704419A30600
2. FILTRAX UNIT SHOWN ON INSTRUMENTATION DRAWING 9704419A30030
3. TUBING CONNECTIONS TO BE INSTALLED IN THE FIELD. CABINET ENTRY HOLES TO BE SUPPLIED AS NEEDED
4. CHROMALOX STRIP HEATER TO BE MOUNTED ON 4" STAND-OFF TO ALLOW FOR HEAT DISSIPATION
5. ENCLOSURE NAMEPLATE TO BE SUPPLIED WITH 1" HIGH BLACK LETTERS ON WHITE BACKGROUND

17	1	2619389	NAMEPLATE, AQUANEREDA		-
16	8	2600224	WASHER, FLAT 1/4"		-
15	4	2603600	NUT, NYLOCK 1/4'		-
14	4	2614556	HEXHEAD CAPSCREW 1/2-20X1.5LG		-
13	1	2620523	HACH FILTRAX ANALYZER		-
12	1	2609910	ALLEN BRADLEY DIN RAIL		-
11	2	2751304	ALLEN BRADLEY END ANCHOR		-
10	1	2751302	ALLEN BRADLEY END TERMINAL		-
9	10	2751299	ALLEN BRADLEY TERMINAL BLOCK		-
8	1	2751199	ALLEN BRADLEY TERMINAL MARKER		-
7	1	2751329	ALLEN BRADLEY 10-POLE TERMINAL JUMPER		-
6	2	2753916	SQ-D 5 AMP U.L. 489 BREAKER		-
5	1	2751744	HOFFMAN N.C. TEMP SWITCH		-
4	1	2702503	PROTECTIVE COVER CHROMALOX PT-AC-1	SS	-
3	1	2702502	STRIP HEATER CHROMALOX PT-502	STEEL	-
2	1	2750060	HOFFMAN ENCLOSURE SUB PANEL	PAINTED STEEL	-
1	1	2750521	HOFFMAN ENCLOSURE A36H3012GQRLP	FIBERGLASS	-

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

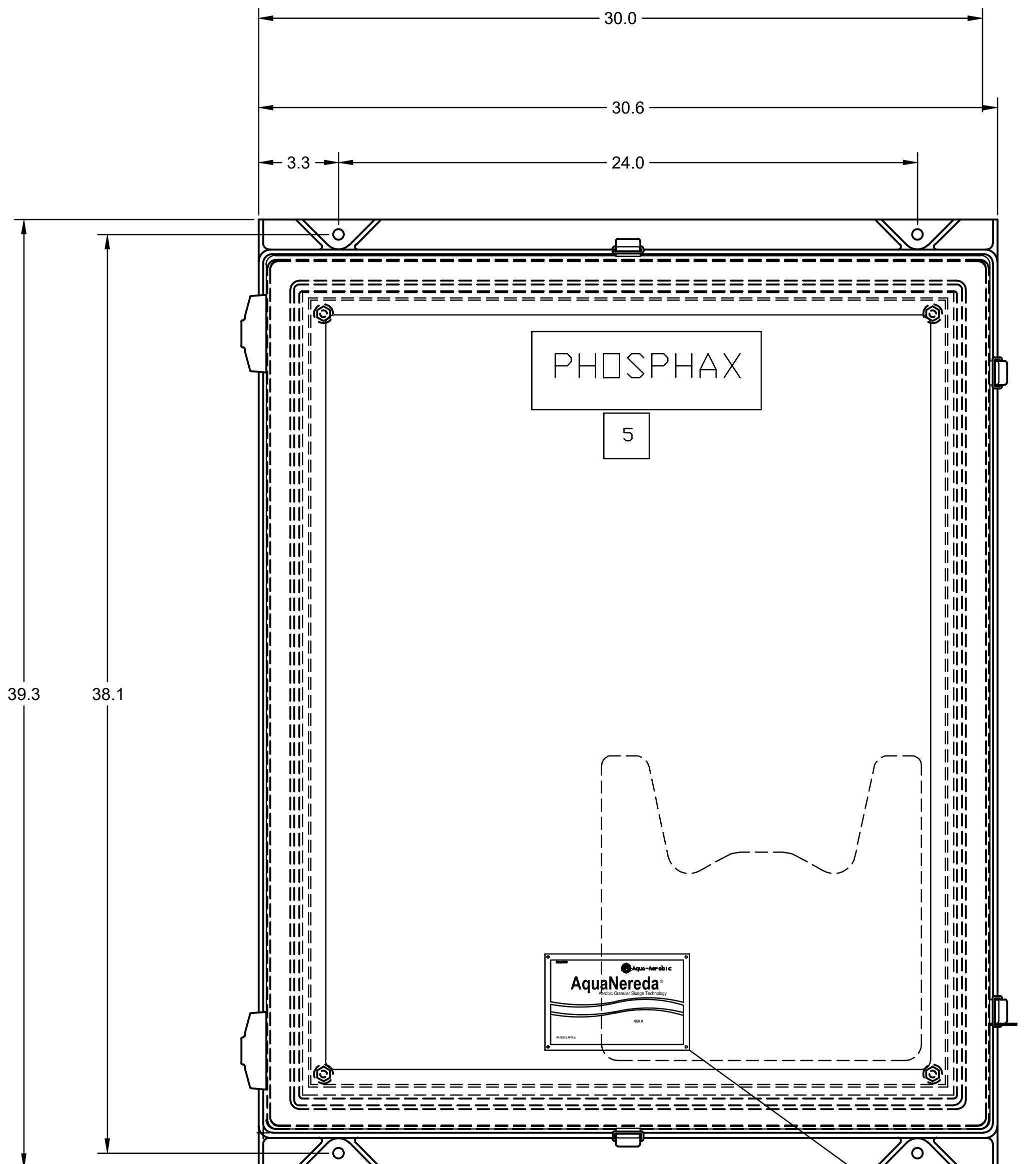
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

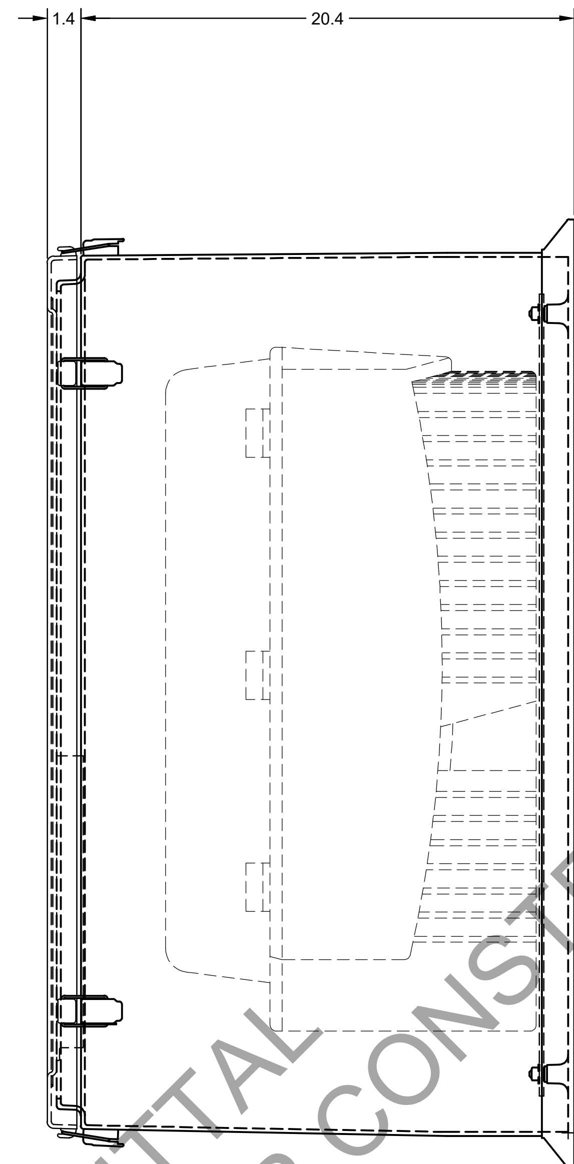
TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 1 OF 1

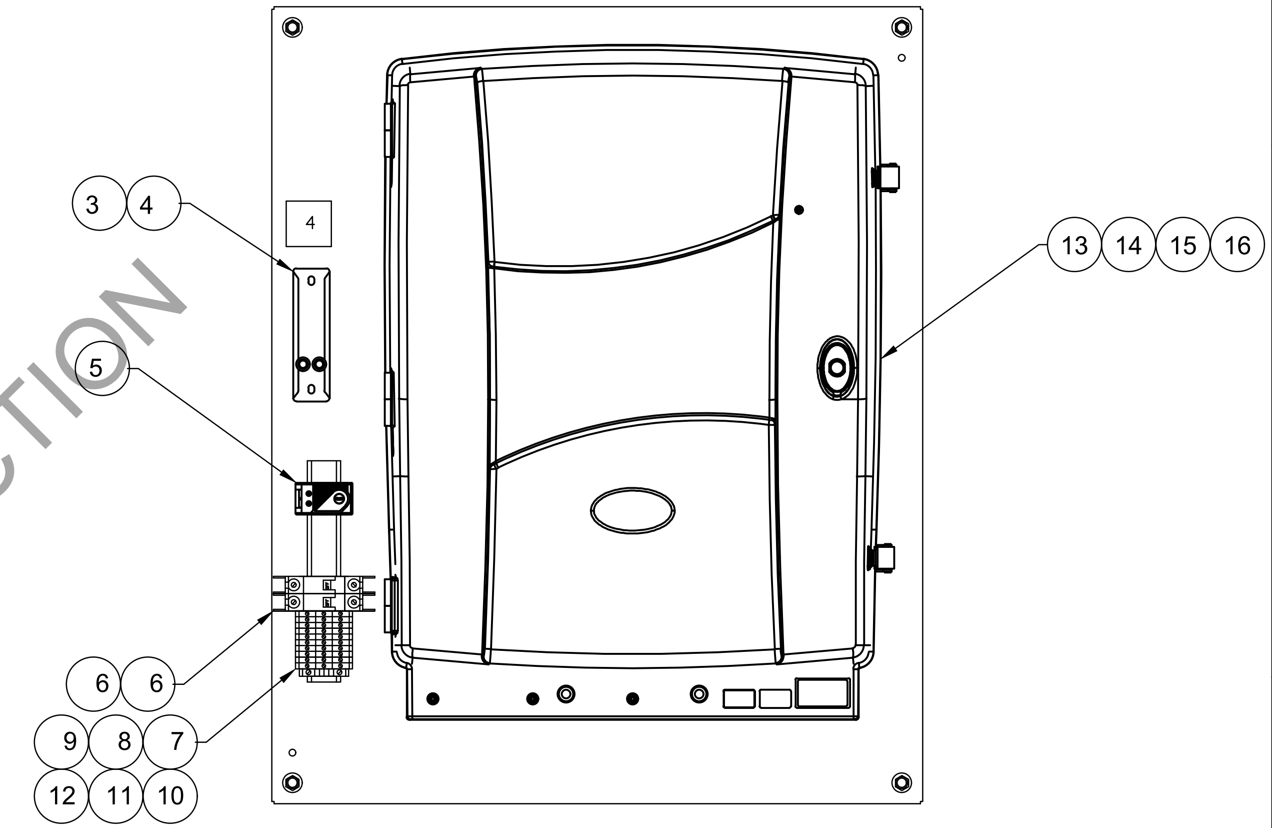
DRAWING NAME: FILTRAX HOUSING CONTROL PANEL ASSEMBLY
DRAWING NUMBER: 9704419A30702 SCALE: NONE SIZE: D



DOOR LAYOUT

ENCLOSURE: NEMA 4X FIBERGLASS
HOFFMAN MODEL A36H3020GQRLP





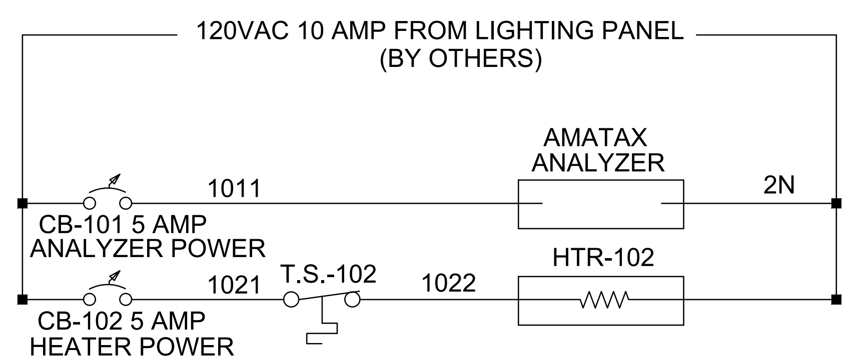
SUB-PANEL LAYOUT

SUB-PANEL MODEL NO. A36P30

INFORMATION TO BE
STAMPED INTO
PART NUMBER 2619389

SHEET SPECIFIC NOTES:

1. STANDARD WIRING NOTES PER INSTALLATION DRAWING 9704419A30600
2. PHOSPHAX UNIT SHOWN ON INSTRUMENTATION DRAWING 9704419A30030
3. TUBING CONNECTIONS TO BE INSTALLED IN THE FIELD. CABINET ENTRY HOLES TO BE SUPPLIED AS NEEDED
4. CHROMALOX STRIP HEATER TO BE MOUNTED ON 4" STAND-OFF TO ALLOW FOR HEAT DISSIPATION
5. ENCLOSURE NAMEPLATE TO BE SUPPLIED WITH 1" HIGH BLACK LETTERS ON WHITE BACKGROUND



17	1	2619389	NAMEPLATE, AQUANEREDA		-
16	8	2600224	WASHER, FLAT 1/4"		-
15	4	2603600	NUT, NYLOCK 1/4'		-
14	4	2614556	HEXHEAD CAPSCREW 1/2-20X1.5LG		-
13	1	2620680	HACH PHOSPHAX ANALYZER		-
12	1	2609910	ALLEN BRADLEY DIN RAIL		-
11	2	2751304	ALLEN BRADLEY END ANCHOR		-
10	1	2751302	ALLEN BRADLEY END TERMINAL		-
9	10	2751299	ALLEN BRADLEY TERMINAL BLOCK		-
8	1	2751199	ALLEN BRADLEY TERMINAL MARKER		-
7	1	2751329	ALLEN BRADLEY 10-POLE TERMINAL JUMPER		-
6	2	2753916	SQ-D 5 AMP U.L. 489 BREAKER		-
5	1	2751744	HOFFMAN N.C. TEMP SWITCH		-
4	1	2702503	PROTECTIVE COVER CHROMALOX PT-AC-1	SS	-
3	1	2702502	STRIP HEATER CHROMALOX PT-502	STEEL	-
2	1	2750060	HOFFMAN ENCLOSURE SUB PANEL	PAINTED STEEL	-
1	1	2754545	HOFFMAN ENCLOSURE A36H3020GQRLP	FIBERGLASS	-

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA

DO NOT SCALE DRAWING

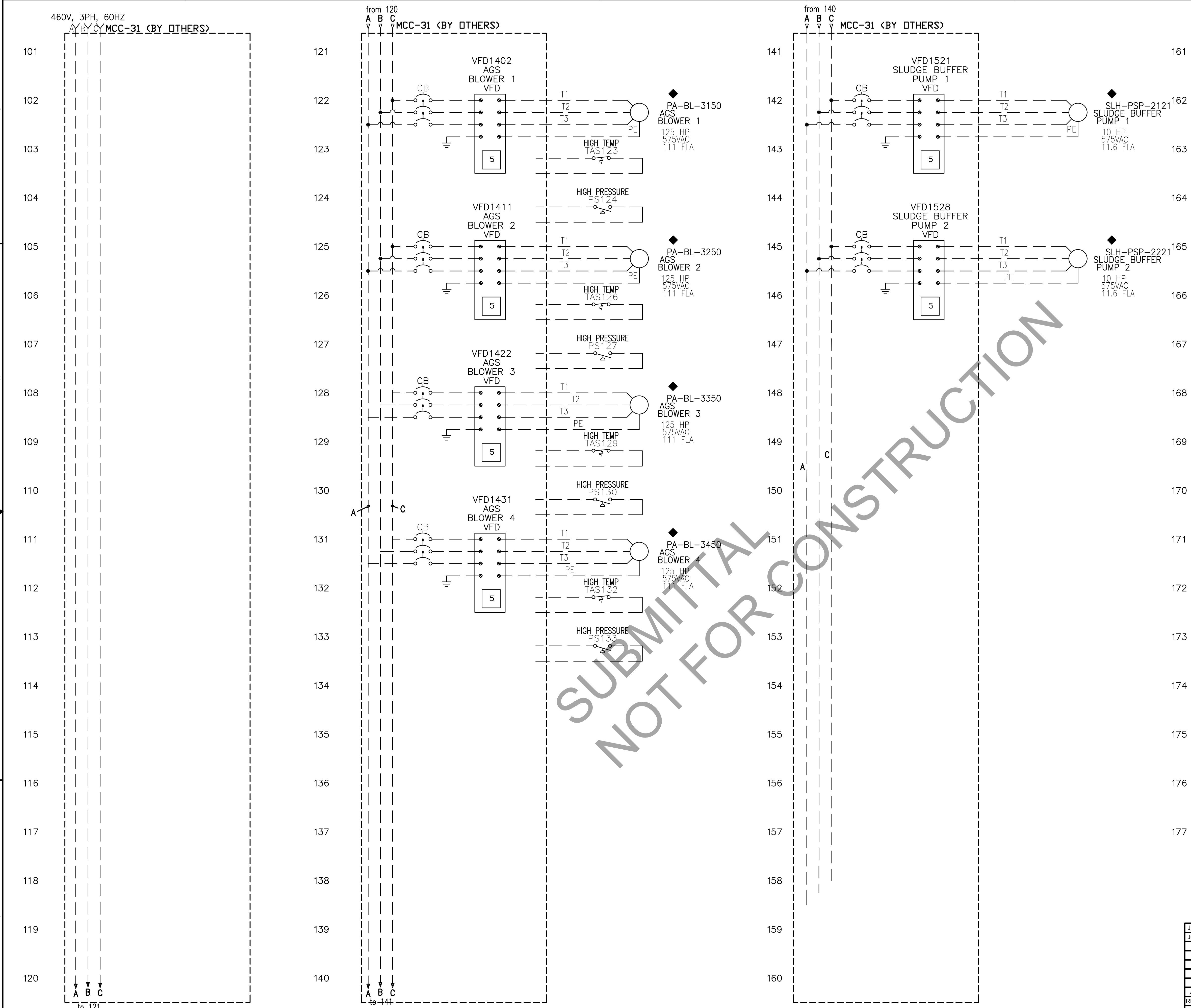
AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 1 OF 1

DRAWING NAME: PHOSPHAX HOUSING CONTROL PANEL ASSEMBLY
DRAWING NUMBER: 9704419A30703 SCALE: NONE SIZE: D



SHEET SPECIFIC NOTES:

1. STANDARD WIRING NOTES PER INSTALLATION DRAWING 9704419A30600
2. CONTROL PANEL ASSEMBLY PER DRAWING 9704419A30700
3. NETWORK COMMUNICATION DIAGRAM PER DRAWING 9704419A30910
4. CONTROL PANEL TO BE CSA LISTED
5. SEE VFD WIRING DETAILS (BY OTHERS)

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2°

ANSI

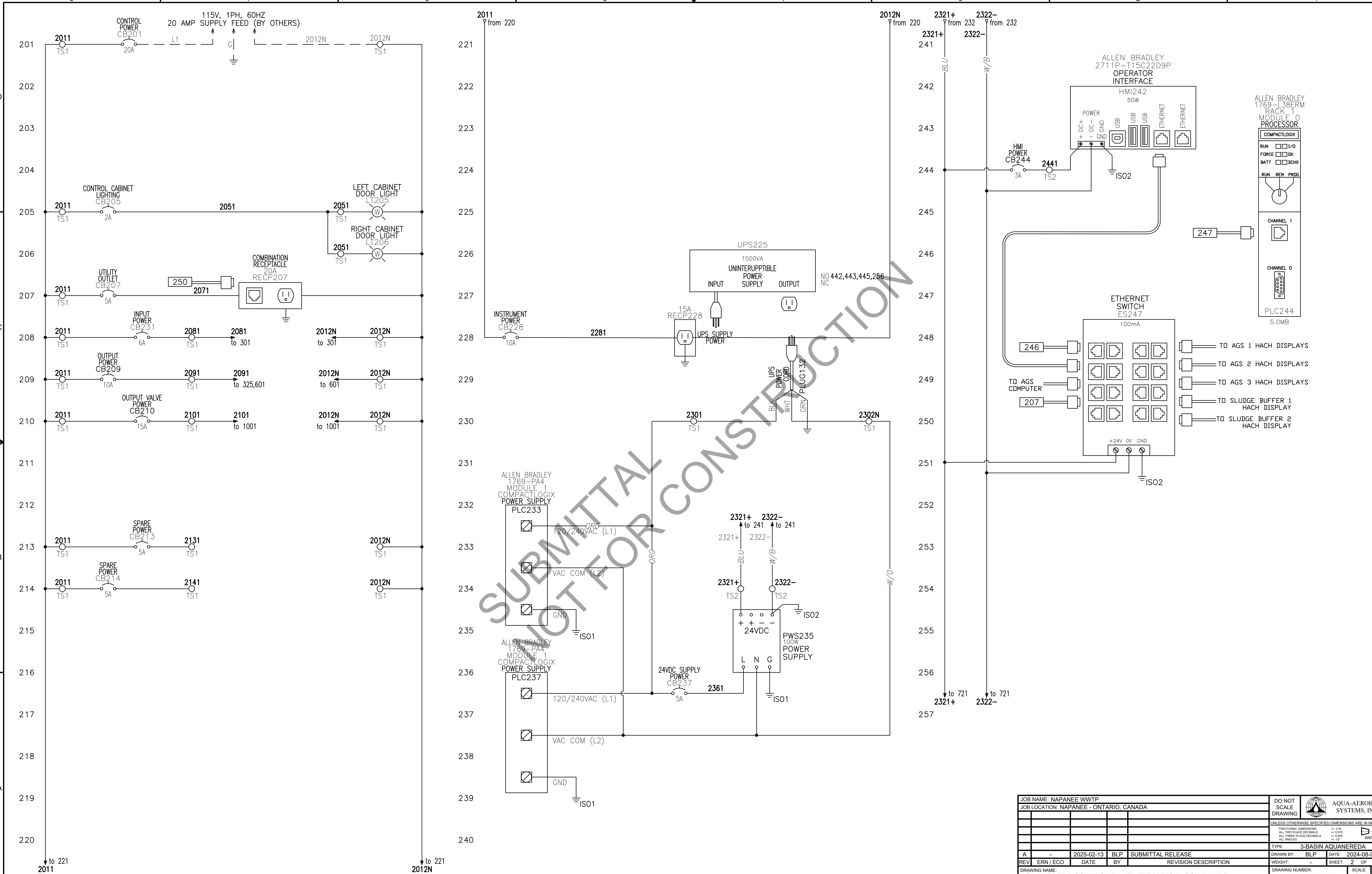
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP | DATE: 2024-08-08

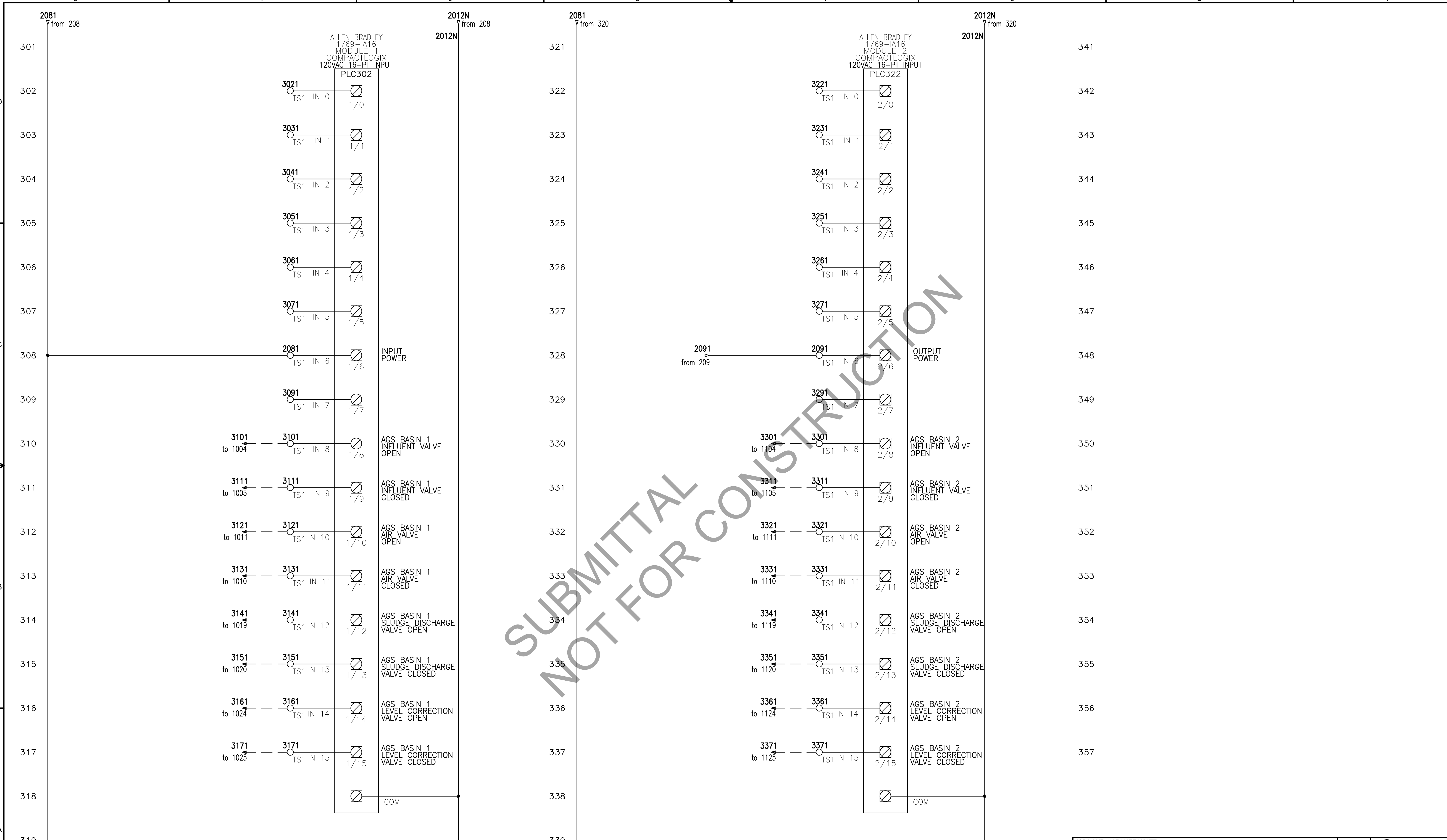
WEIGHT: - | SHEET: 1 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 | SCALE: NONE | SIZE: D



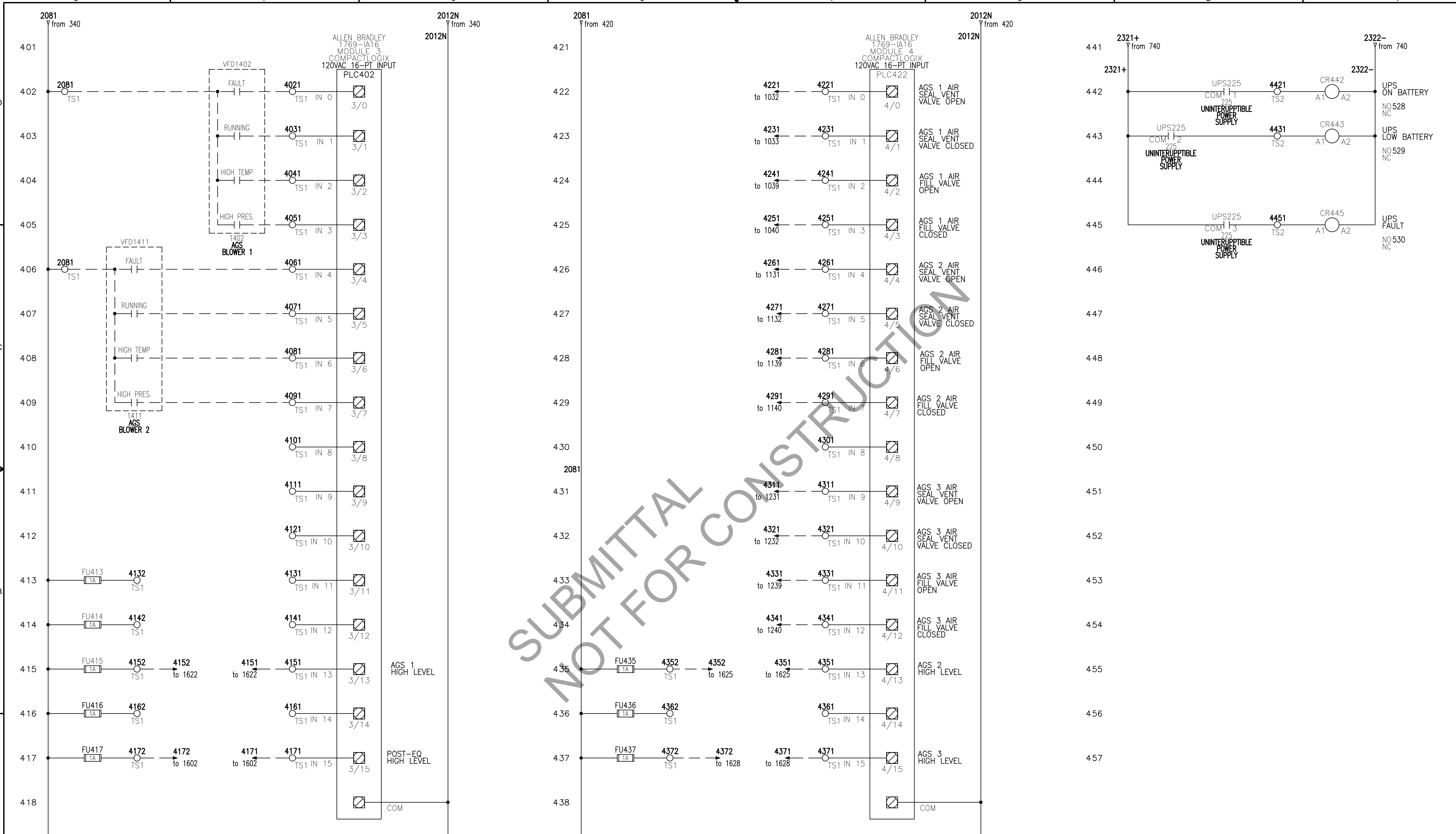
115V, 1PH, 60HZ
20 AMP SUPPLY FEED (BY OTHERS)
CONTROL POWER CB201 20A
CONTROL CABINET LIGHTING CB205 2A
LEFT CABINET DOOR LIGHT LT205
RIGHT CABINET DOOR LIGHT LT206
UTILITY OUTLET CB207 5A
COMBINATION RECEPTACLE 20A RECP207
INPUT POWER CB231 6A
OUTPUT POWER CB209 10A
OUTPUT VALVE POWER CB210 15A
SPARE POWER CB213 5A
SPARE POWER CB214 5A
INSTRUMENT POWER CB228 10A
15A RECP228
UPS SUPPLY POWER
UPS225
1500VA
UNINTERUPPTIBLE POWER SUPPLY
INPUT OUTPUT
NO 442,443,445,256
NC
UPS POWER CORD
PLUG132
ALLEN BRADLEY 1769-PA4 MODULE 1 COMPACTLOGIX POWER SUPPLY PLC233
120/240VAC (L1)
VAC COM (L2)
GND
ALLEN BRADLEY 1769-PA4 MODULE 1 COMPACTLOGIX POWER SUPPLY PLC237
24VDC SUPPLY POWER CB237 5A
24VDC
PWS235 100W POWER SUPPLY
ISO1
ISO2
ALLEN BRADLEY 2711P-T15C22D9P OPERATOR INTERFACE
HMI242 50W
HMI POWER CB244 3A
ALLEN BRADLEY 1769-L38ERM RACK 1 MODULE 0 PROCESSOR
COMPACTLOGIX
PLC244 5.0MB
CHANNEL 1
CHANNEL 0
ETHERNET SWITCH ES247 100mA
TO AGS 1 HACH DISPLAYS
TO AGS 2 HACH DISPLAYS
TO AGS 3 HACH DISPLAYS
TO AGS COMPUTER
TO SLUDGE BUFFER 1 HACH DISPLAY
TO SLUDGE BUFFER 2 HACH DISPLAY
SUBMITTAL
NOT FOR CONSTRUCTION
JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA
DO NOT SCALE DRAWING
AQUA-AEROBIC SYSTEMS, INC.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TYPE: 3-BASIN AQUANEREDA
A - 2025-02-13 BLP SUBMITTAL RELEASE
REV ERN / ECO DATE BY REVISION DESCRIPTION
DRAWN BY: BLP DATE: 2024-08-08
SHEET: 2 OF 16
DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800
SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA
DO NOT SCALE DRAWING
AQUA-AEROBIC SYSTEMS, INC.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 3 OF 16
DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800
SCALE: NONE SIZE: D

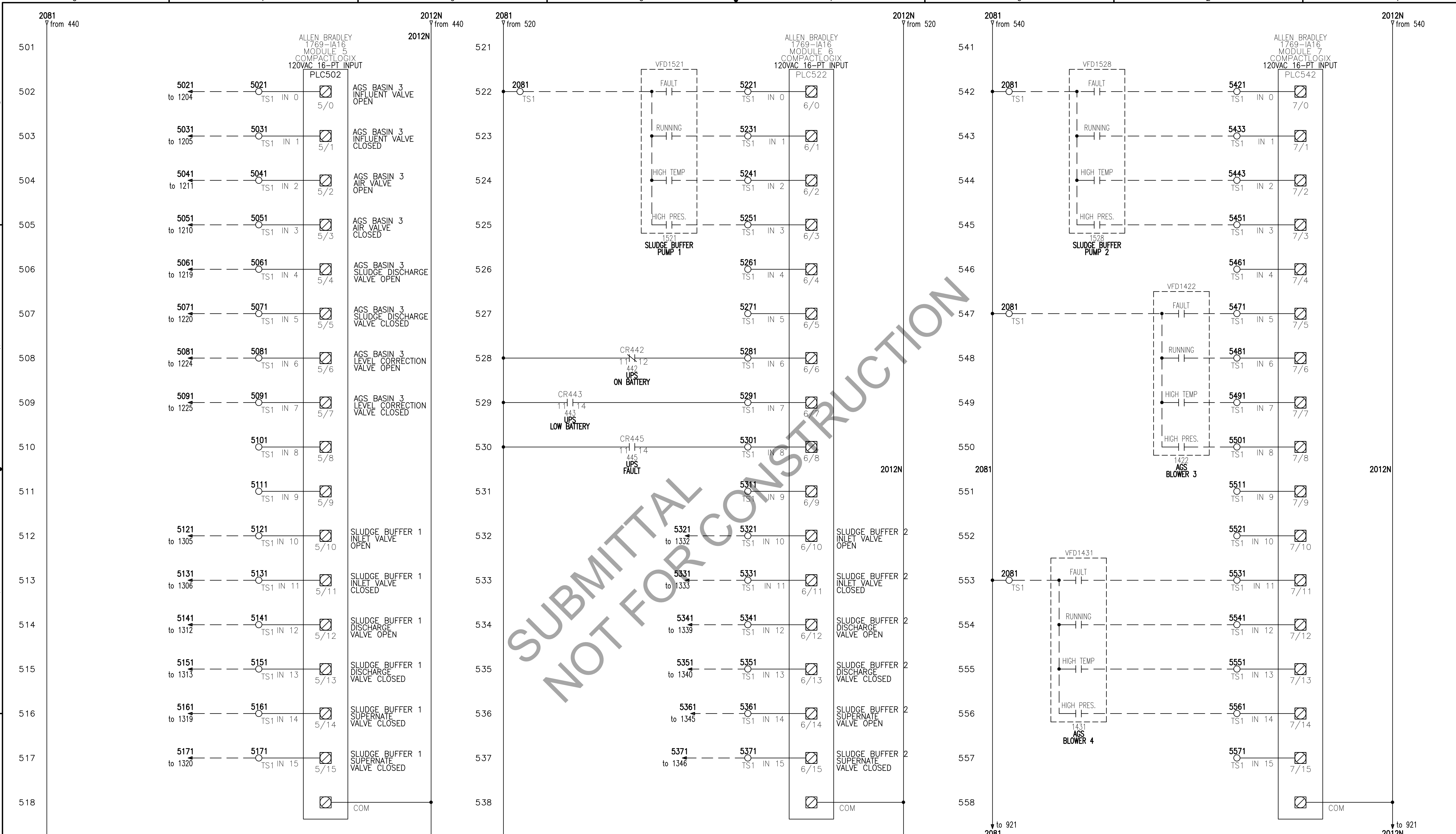


JOB NAME: NAPANEE WWTP				DO NOT SCALE DRAWING
JOB LOCATION: NAPANEE - ONTARIO, CANADA				AQUA-AEROBIC SYSTEMS, INC.
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
WEIGHT: - SHEET: 4 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

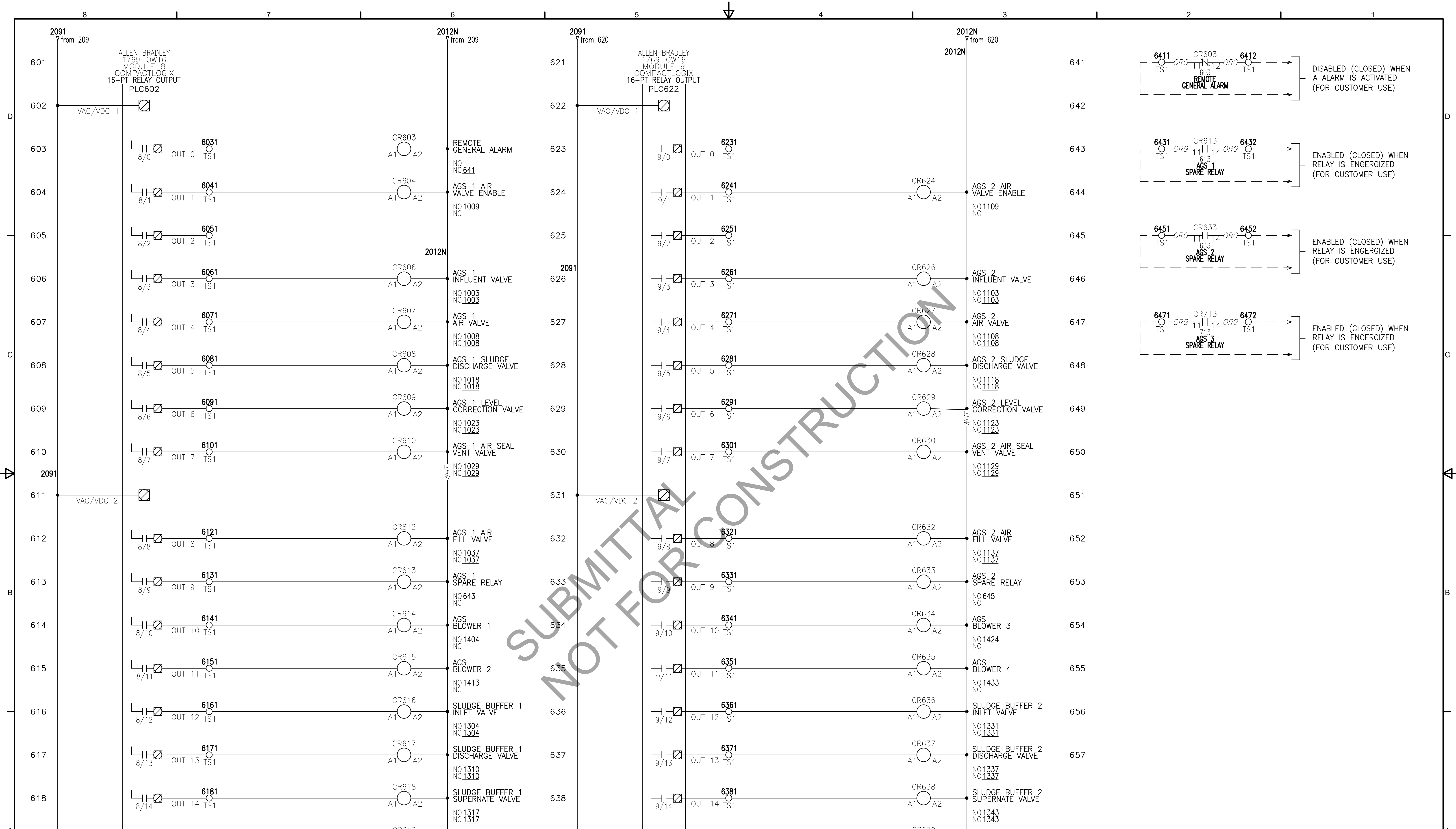
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP DATE: 2024-08-08

WEIGHT: - SHEET: 5 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

ANSI

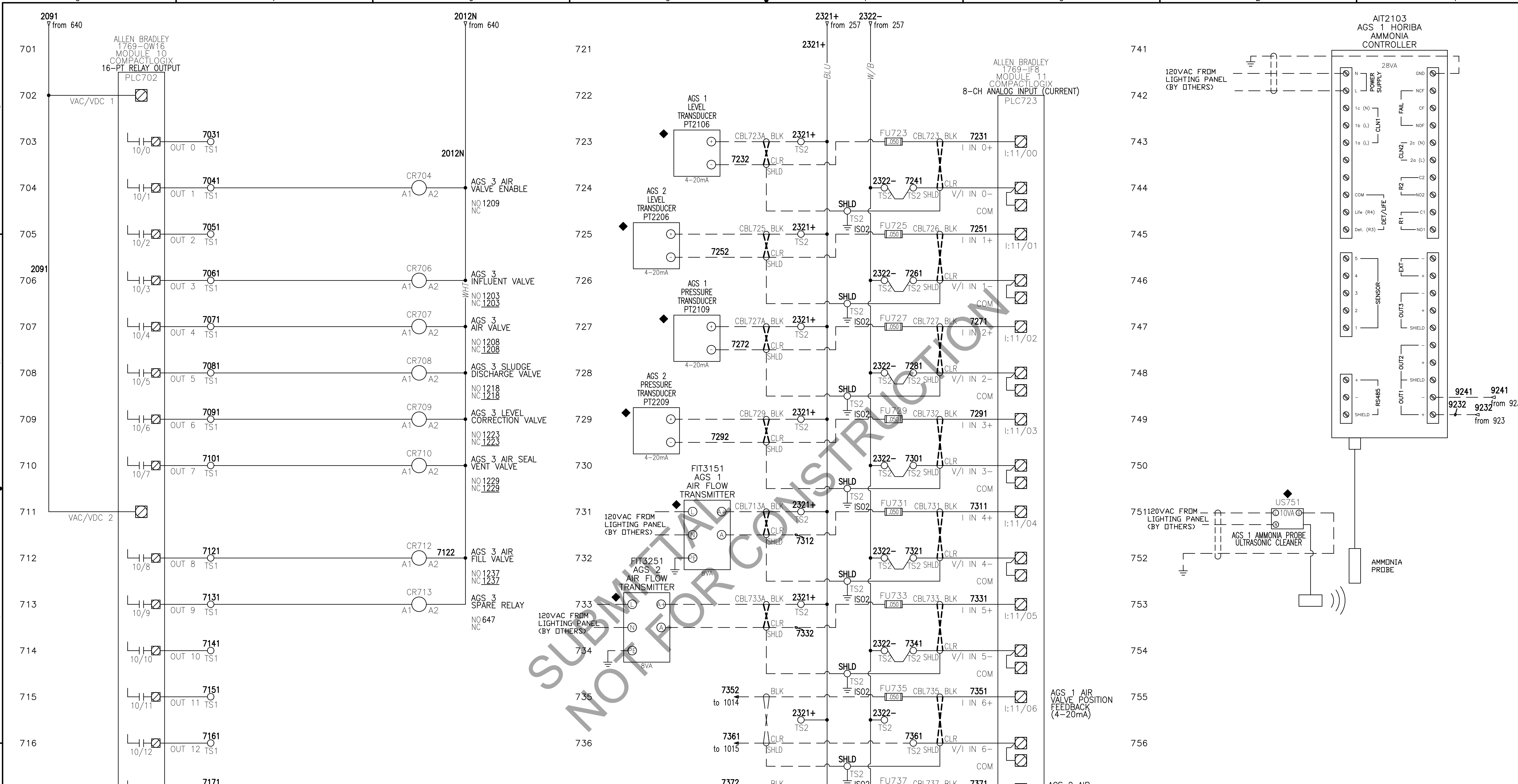
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP DATE: 2024-08-08

WEIGHT: - SHEET: 6 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



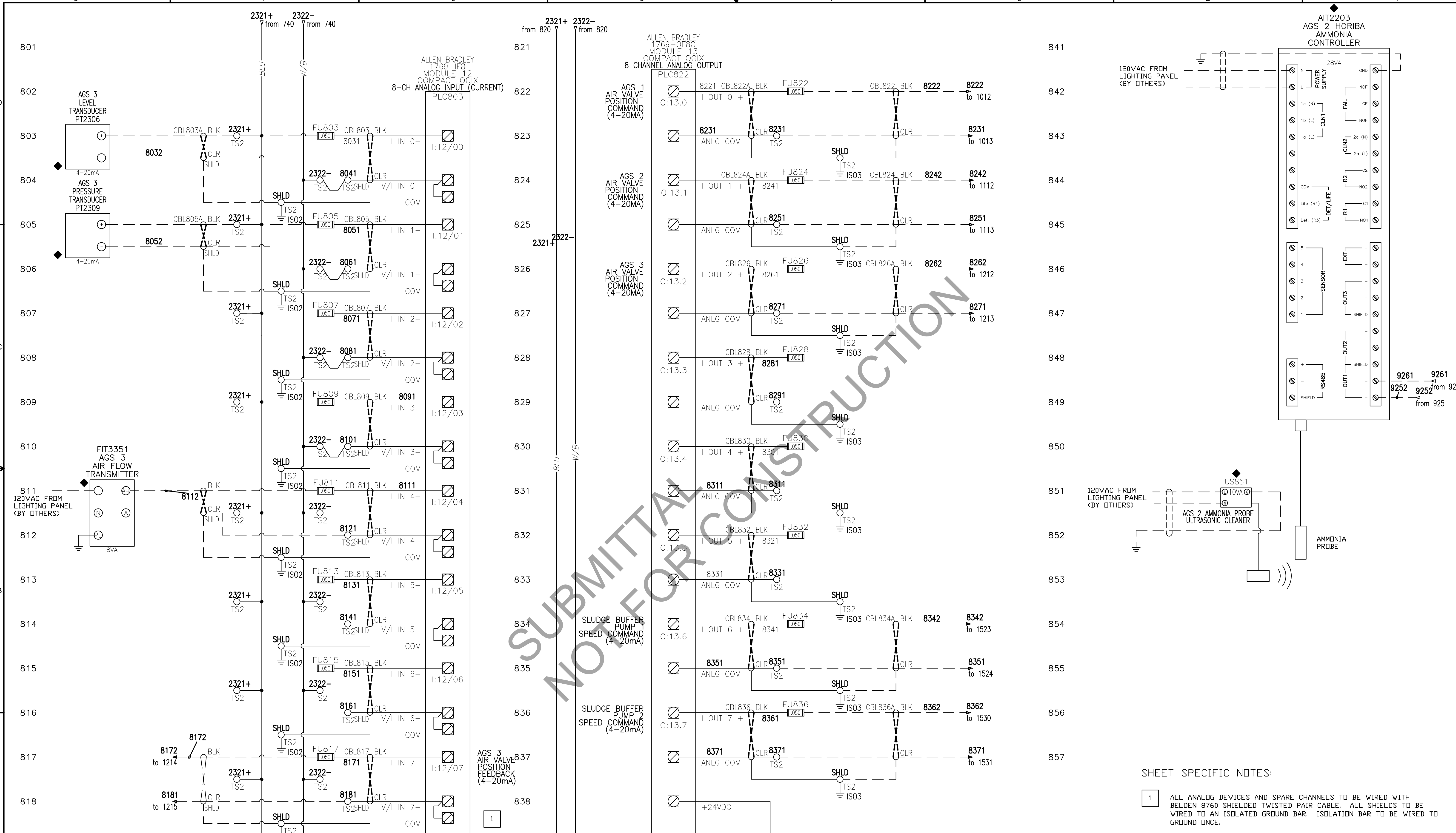
SHEET SPECIFIC NOTES:

1. ALL ANALOG DEVICES AND SPARE CHANNELS TO BE WIRED WITH BELDEN 8760 SHIELDED TWISTED PAIR CABLE. ALL SHIELDS TO BE WIRED TO AN ISOLATED GROUND BAR. ISOLATION BAR TO BE WIRED TO GROUND ONCE.

JOB NAME:	NAPANEE WWTP
JOB LOCATION:	NAPANEE - ONTARIO, CANADA
DO NOT SCALE DRAWING	AQUA-AEROBIC SYSTEMS, INC.
TYPE:	3-BASIN AQUANEREDA
DRAWN BY:	BLP
DATE:	2024-08-08
WEIGHT:	-
SHEET:	7 OF 16
DRAWING NAME:	AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER:	9704419A30800
SCALE:	NONE
SIZE:	D

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

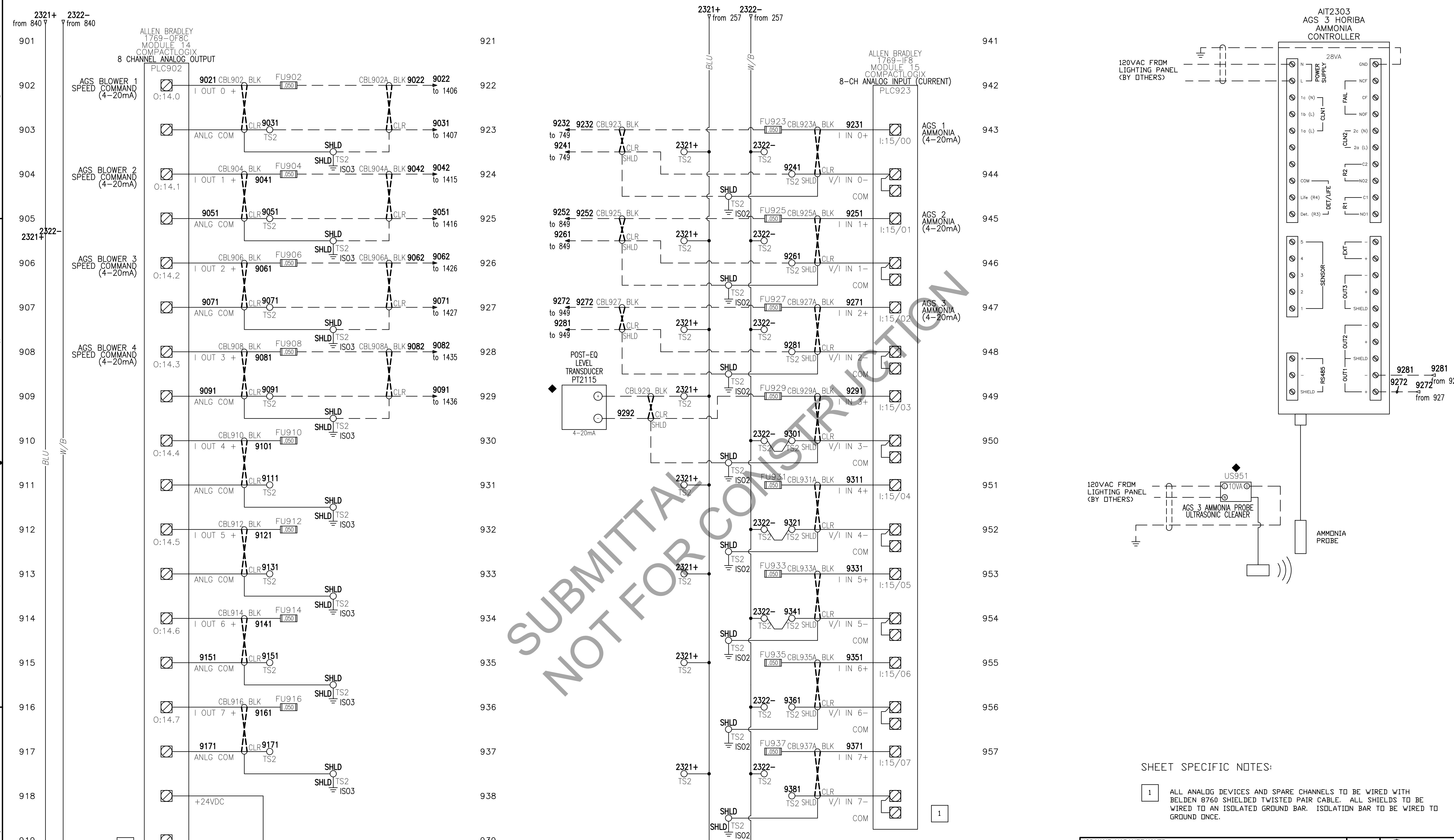


SHEET SPECIFIC NOTES:

1. ALL ANALOG DEVICES AND SPARE CHANNELS TO BE WIRED WITH BELDEN 8760 SHIELDED TWISTED PAIR CABLE. ALL SHIELDS TO BE WIRED TO AN ISOLATED GROUND BAR. ISOLATION BAR TO BE WIRED TO GROUND ONCE.

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A	-	2025-02-13	BLP	SUBMITTAL RELEASE

JOB NAME: NAPANEE WWTP
JOB LOCATION: NAPANEE - ONTARIO, CANADA
DO NOT SCALE DRAWING
AQUA-AEROBIC SYSTEMS, INC.
TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP DATE: 2024-08-08
SHEET: 8 OF 16
DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800
SCALE: NONE SIZE: D



SHEET SPECIFIC NOTES:

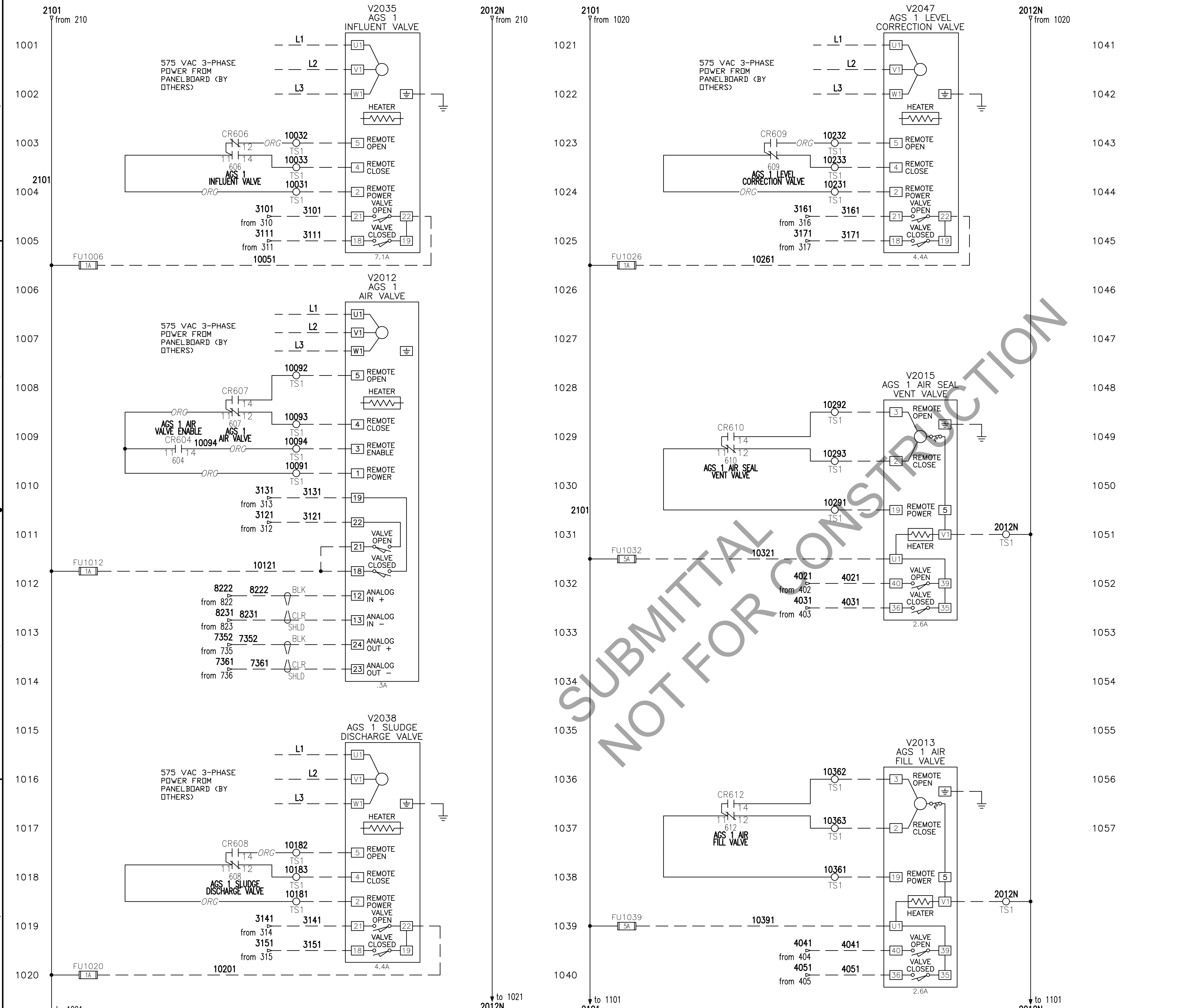
1. ALL ANALOG DEVICES AND SPARE CHANNELS TO BE WIRED WITH BELDEN 8760 SHIELDED TWISTED PAIR CABLE. ALL SHIELDS TO BE WIRED TO AN ISOLATED GROUND BAR. ISOLATION BAR TO BE WIRED TO GROUND ONCE.

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP — DATE: 2024-08-08
WEIGHT: - — SHEET: 9 OF 16
DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800 — SCALE: NONE — SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

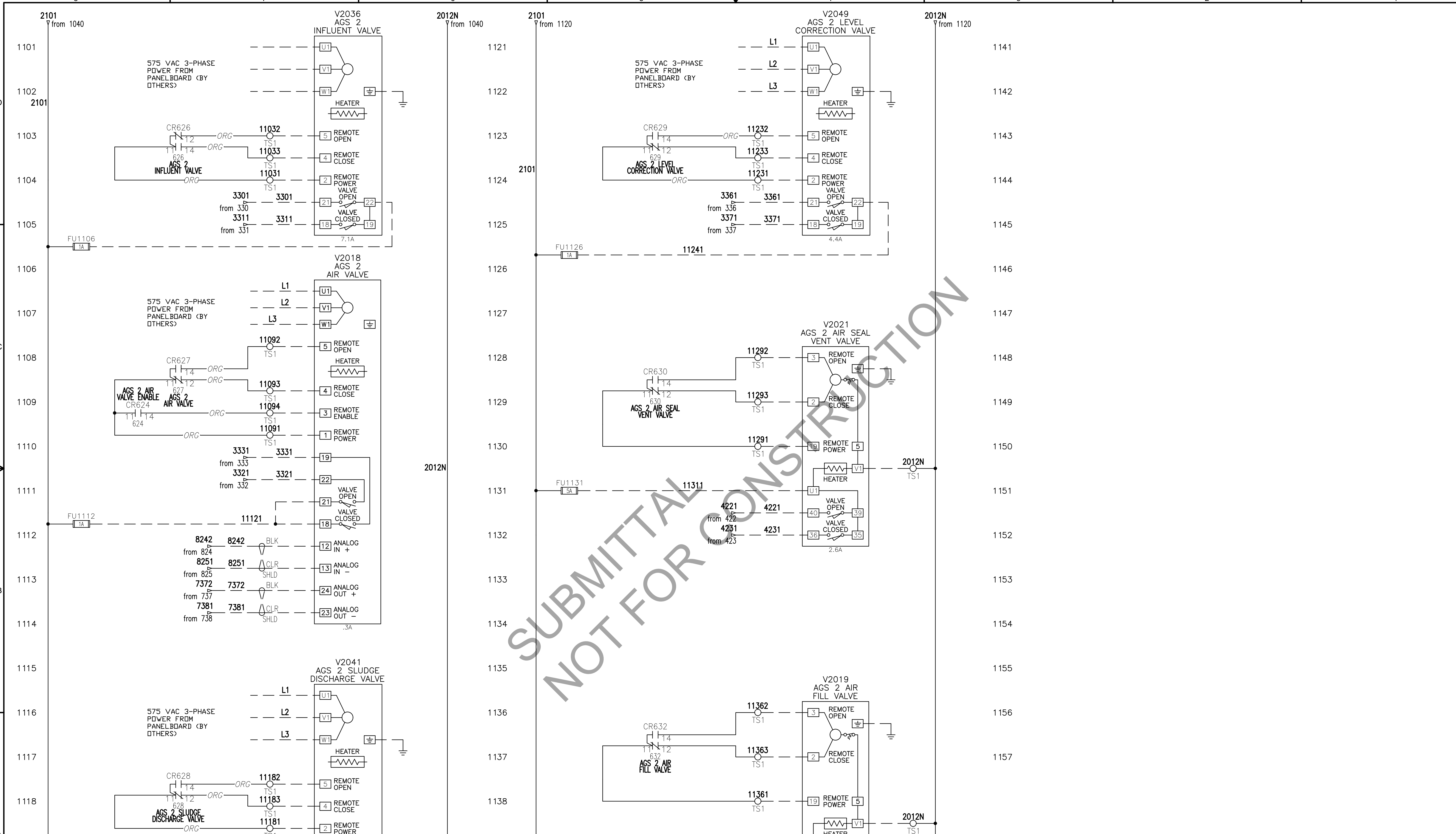
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP DATE: 2024-08-08

WEIGHT: - SHEET: 10 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

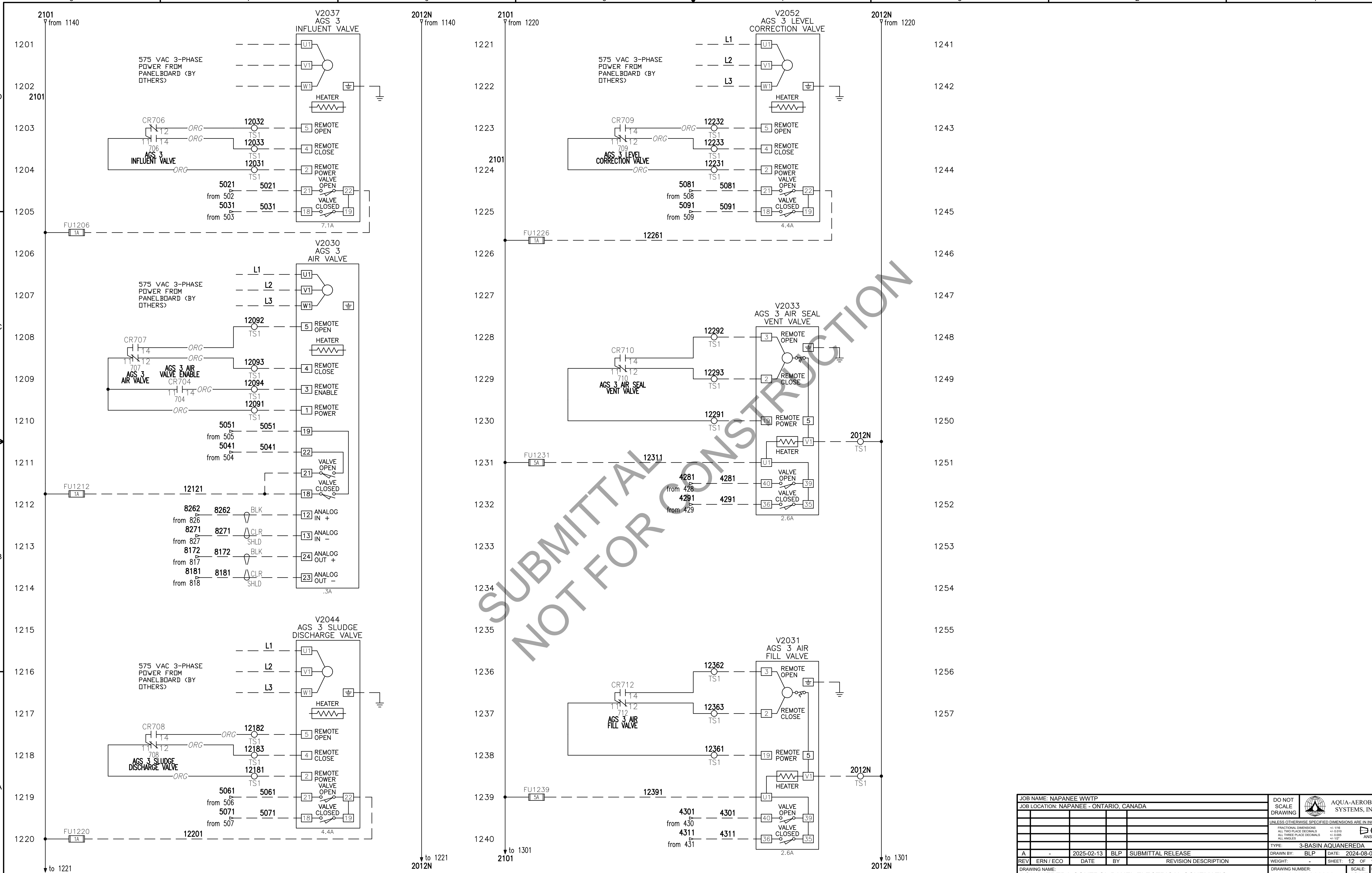
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP DATE: 2024-08-08

WEIGHT: - SHEET: 11 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

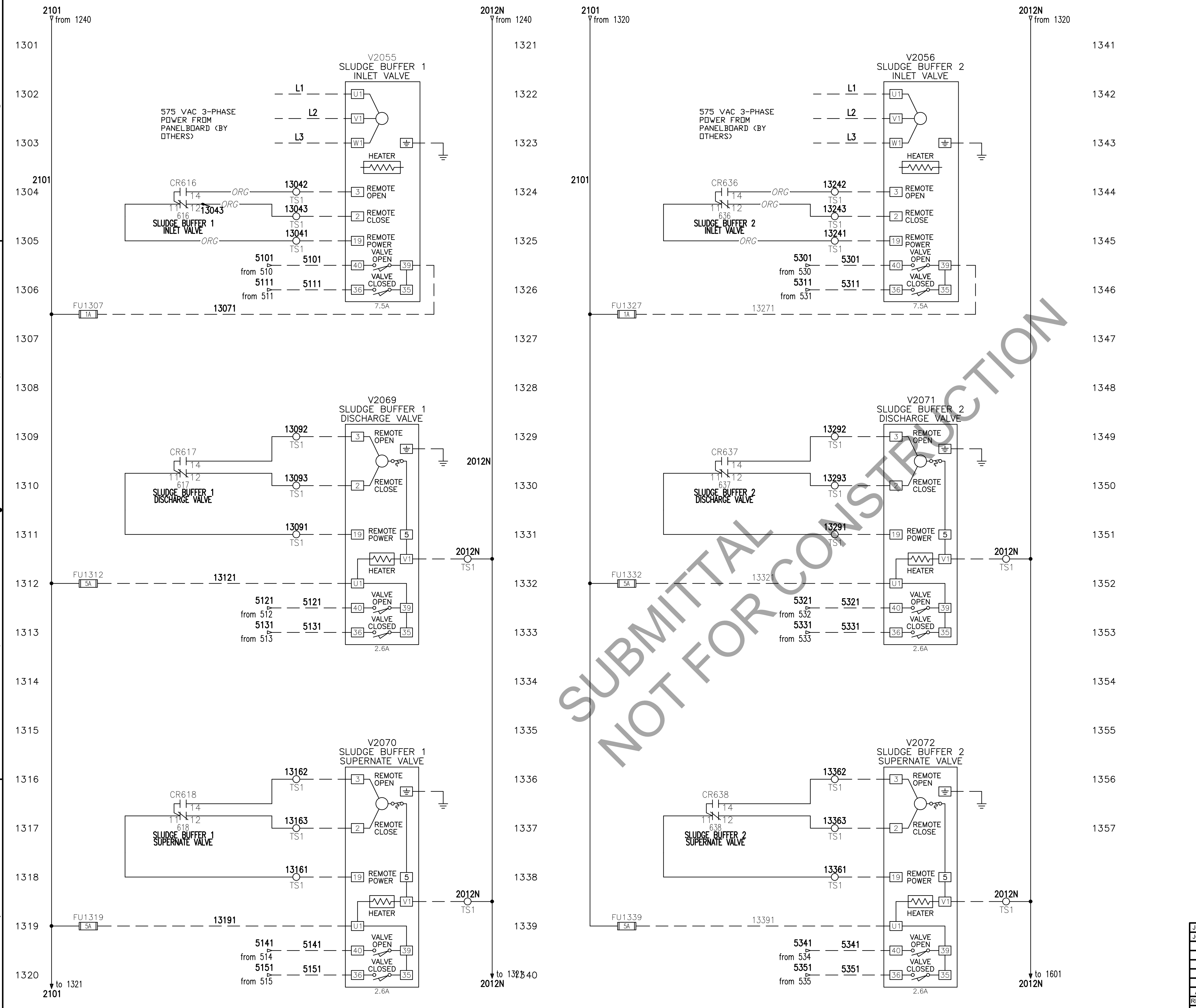
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP DATE: 2024-08-08

WEIGHT: - SHEET: 12 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 SCALE: NONE SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

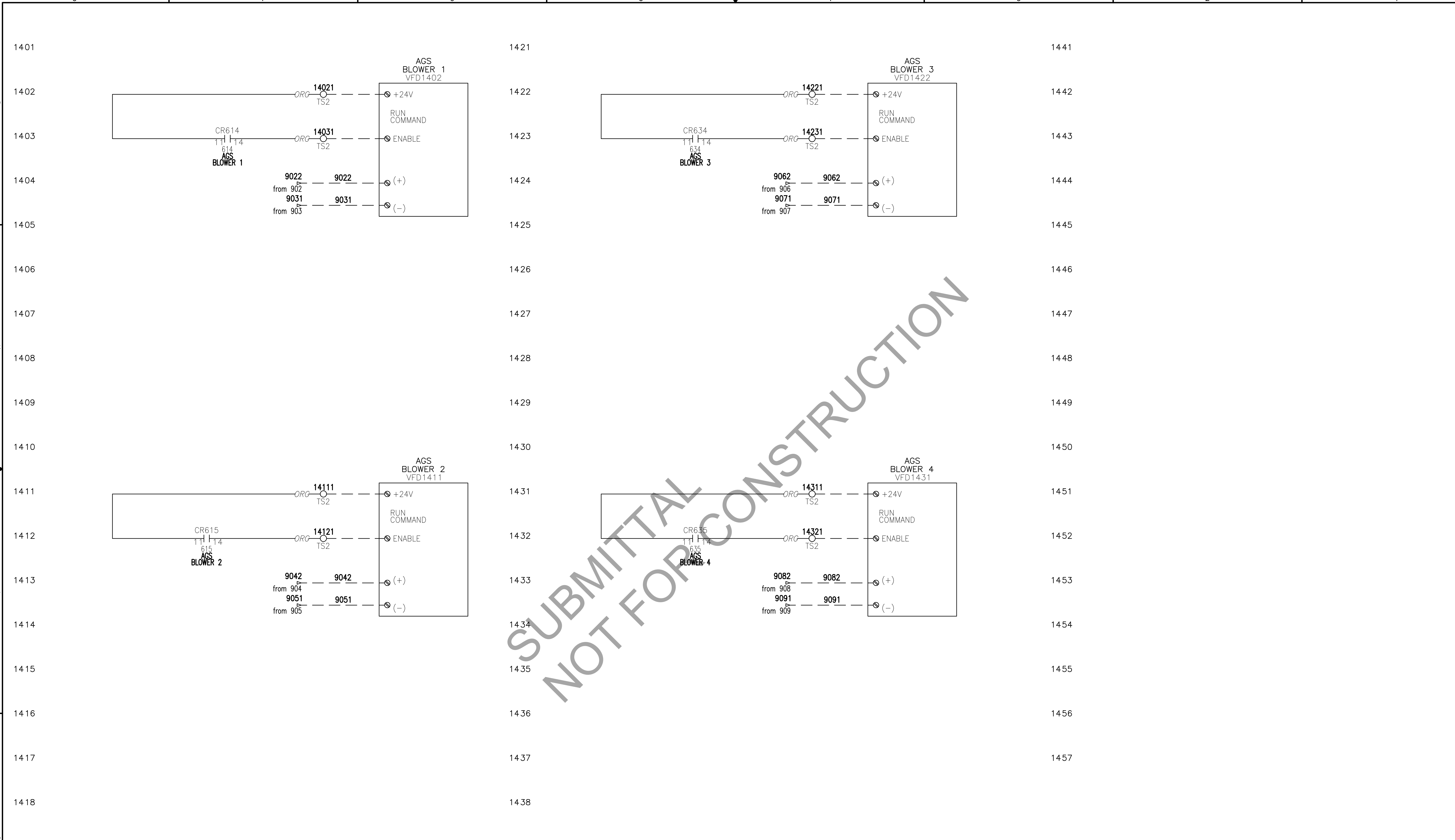
TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP | DATE: 2024-08-08

WEIGHT: - | SHEET: 13 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 | SCALE: NONE | SIZE: D



JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TYPE: 3-BASIN AQUANEREDA

DRAWN BY: BLP | DATE: 2024-08-08

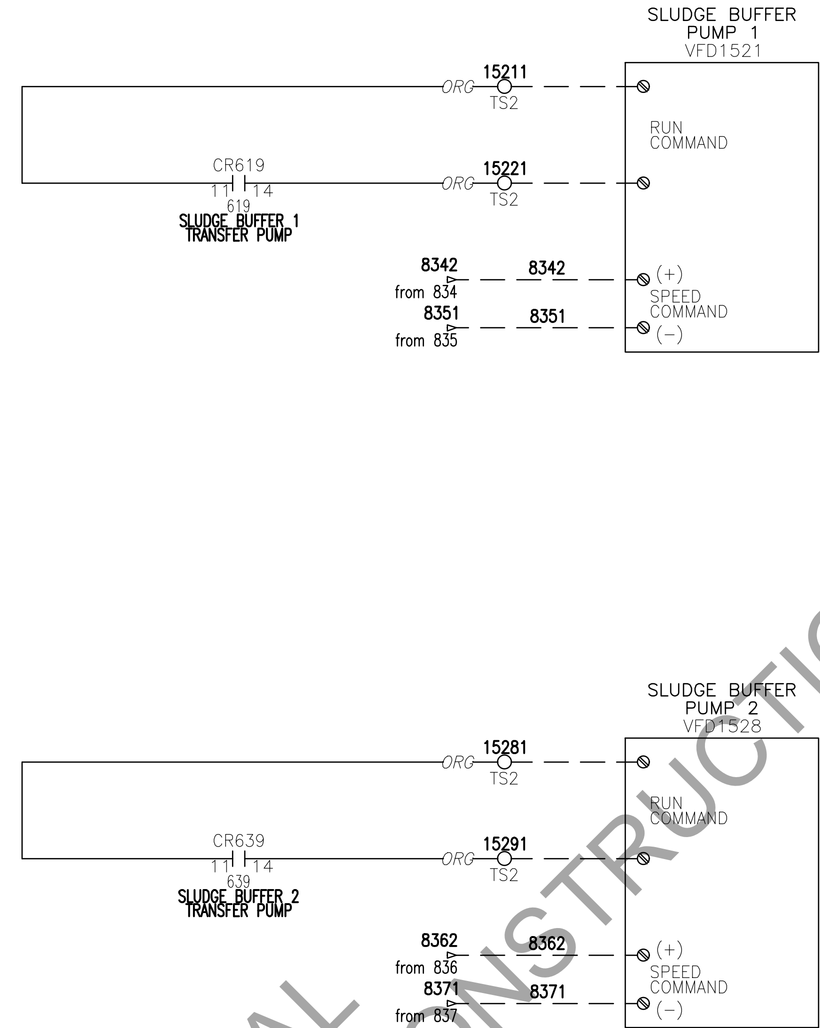
WEIGHT: - | SHEET: 14 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWING NUMBER: 9704419A30800 | SCALE: NONE | SIZE: D

1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520

1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540



1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

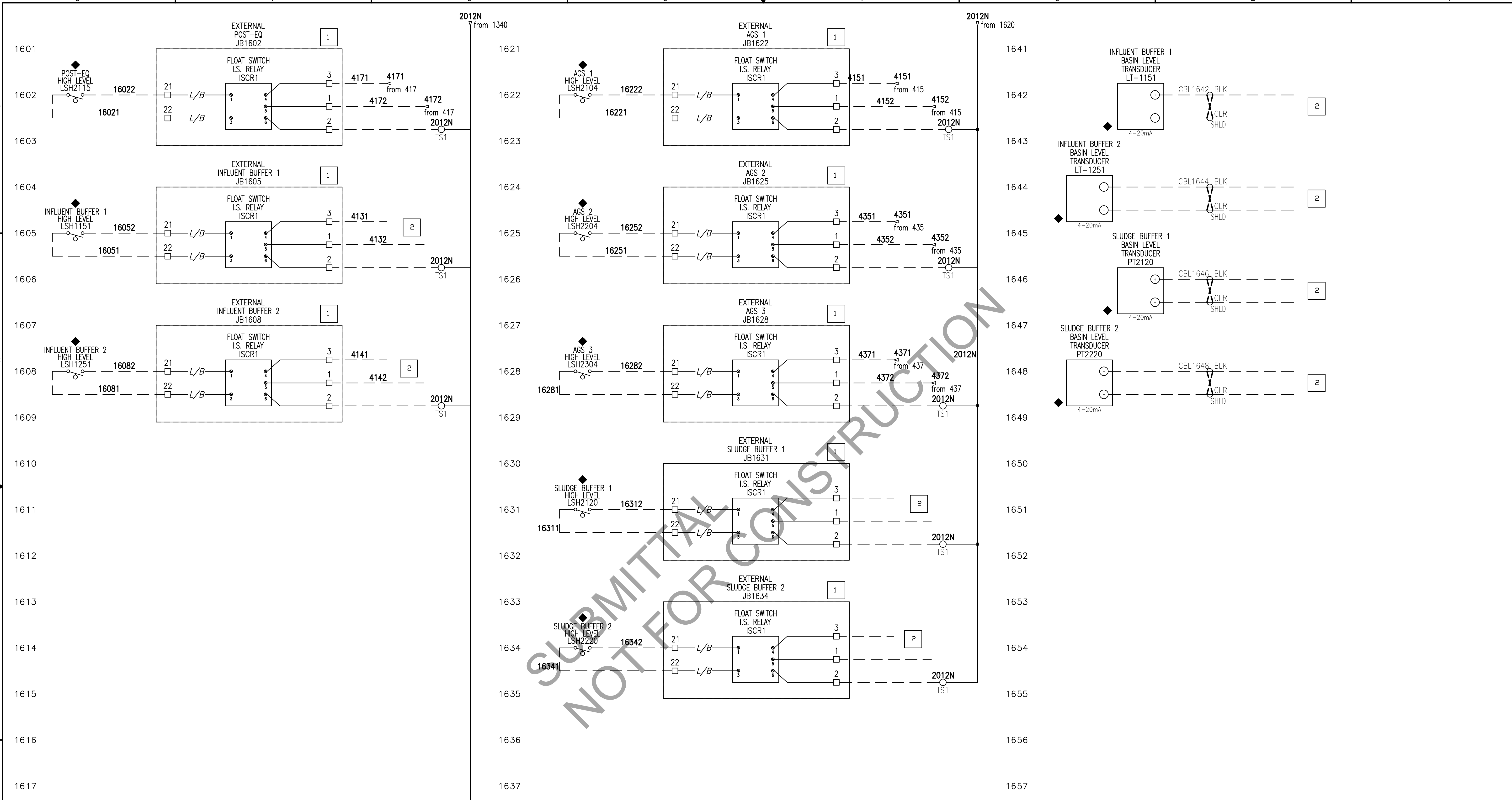
DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE:	3-BASIN AQUANEREDA		
DRAWN BY:	BLP	DATE:	2024-08-08
WEIGHT:	-	SHEET:	15 OF 16

DRAWING NAME: AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER: 9704419A30800
SCALE: NONE
SIZE: D



1. J-BOXES ORDERED BY MECHANICAL SECTION PER DRAWING 2969295

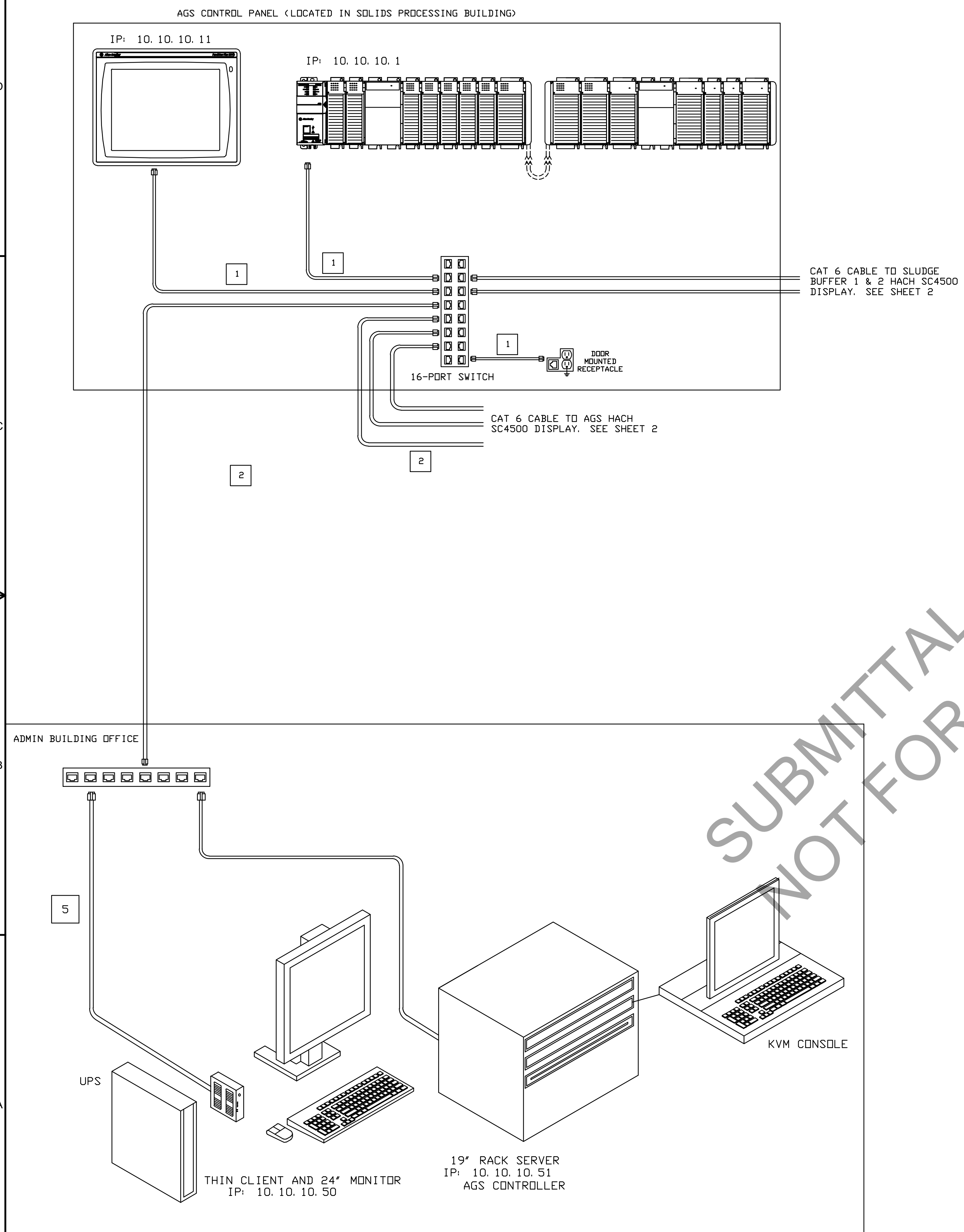
2. HIGH LEVEL SIGNAL AND TRANSDUCER WIRED TO LCP-100 (BY OTHERS)

JOB NAME:	NAPANEE WWTP
JOB LOCATION:	NAPANEE - ONTARIO, CANADA
TYPE:	3-BASIN AQUANEREDA
DRAWN BY:	BLP
DATE:	2024-08-08
WEIGHT:	-
SHEET:	16 OF 16
DRAWING NAME:	AQUANEREDA CONTROL PANEL ELECTRICAL SCHEMATIC
DRAWING NUMBER:	9704419A30800
SCALE:	NONE
SIZE:	D

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES



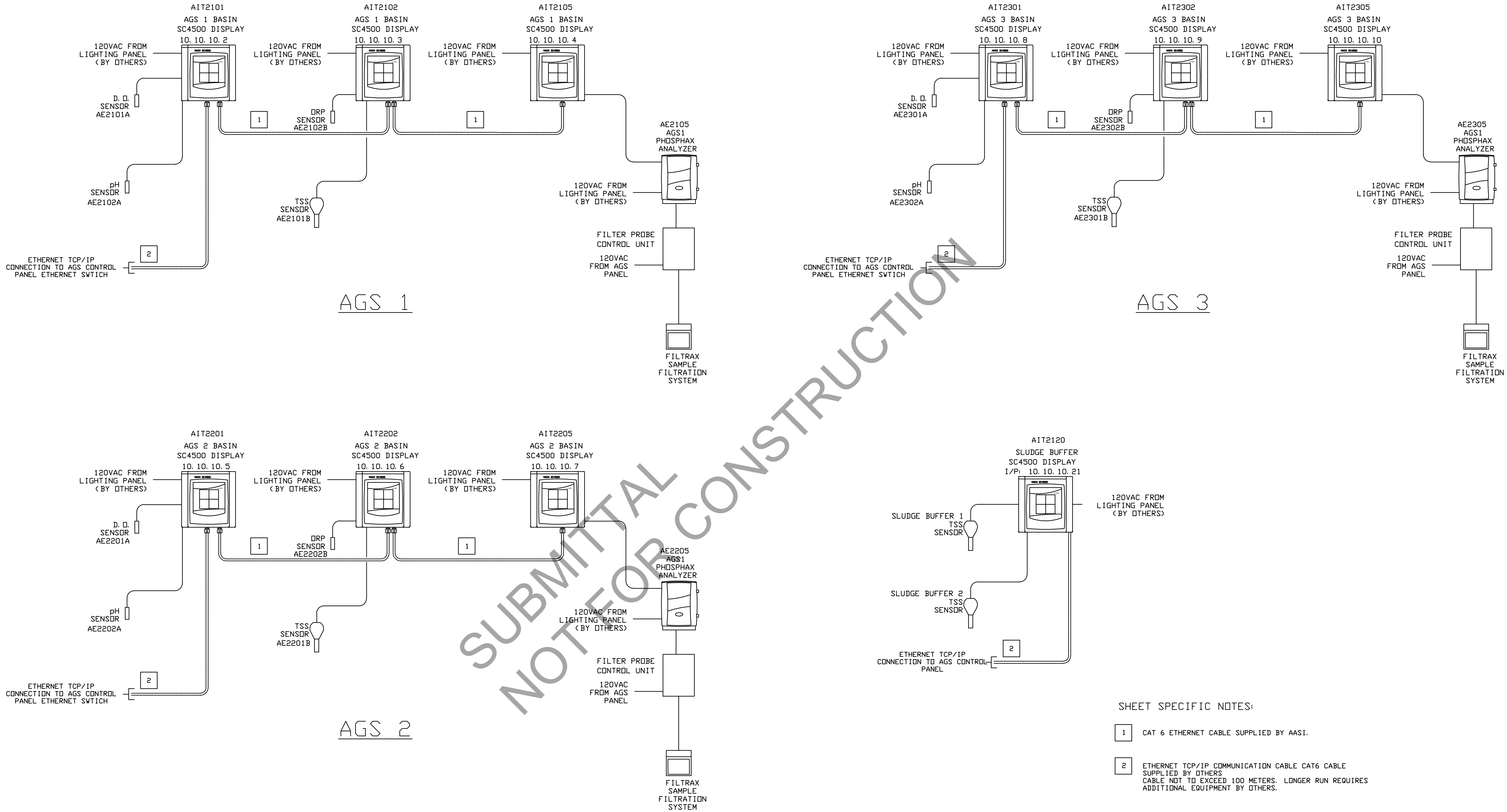
BOM / COMPONENT LISTING					
DEVICE	AQUA PART #	MANUFACTURER PART #	TYPE	QTY	DESCRIPTION
AQUANEREDA THIN CLIENT	2703177	7072q-8800	P	1	10ZiG 7000q SERIES THIN CLIENT, LINUX
					8GB RAM, 8GB SATA STORAGE
					COMMS PORTS: (1) RJ45 ETHERNET, (4) USB 2.0, (2) USB 3.2, (1) USB C
					AV PORTS: (2) DISPLAYPORT, (1) 3.5mm TRRS HEADSET JACK
AQUANEREDA OPERATOR EQUIPMENT	9104265C30910-2	DELL QUOTE # 3000172203045.1	P	1	24" ULTRASHARP MONITOR
	2754822-001	MS116-BK	P	1	DELL OPTICAL 3-BUTTON WIRED USB MOUSE - BLACK
	2754823-001	KB216-BK	P	1	DELL USB KEYBOARD - BLACK
AQUANEREDA SERVER	2754817-002	R250	P	1	DELL - POWER EDGE R250 SERVER Intel® Xeon® W-2334 (16 MB cache, 8 cores,16 threads, 2.6 GHz
					(3) HARD DRIVE 1TB, (1) HARD DRIVE 2TB
	2755035	RKCONS17HD	P	1	STARTECH RACK MOUNT KVM CONSOLE
	2754819-001	SMT1500RM2UC	P	1	APC SMART UPS 1500VA
	2754820-001	AP9562	P	1	APC BASIC RACK MOUNT POWER DIST. STRIP
	2754821-001	RK1233BKM	P	1	STARTECH 12U SERVER RACK CABINET
	2754826-001		P	5	MICROSOFT CSP - PERPETUAL LICENSE WINDOWS SERVER 2022
	2754827-001		P	1	MICROSOFT CSP - PERPETURAL LICENSE 16 CORE PACK
	2752205	GS-308	P	1	NETGEAR ETHERNET SWITCH
SOFTWARE	2751620	9701M-VWSTNMRT10M	P	1	ROCKWELL AUTOMATION, FACTORYTALK VIEW STUDIO ME
	2754399	9324M-RLDT10M	P	1	ROCKWELL AUTOMATION, RSLOGIX 5000 STUDIO LITE EDITION
	2753031		P	1	MICROSOFT OFFICE HOME LATEST VERSION
	2754040	OECP-A-120-NA-STD	P	3	CYLANCE MALWARE SOFTWARE
	2621818	B-8SRVS-IPP24-00	P	1	MACRIUM BACK-UP SERVER IMAGING SOFTWARE
	2751980	KWP-ABSTEO-PRD	P	1	KEPWARE OPC SERVE A-B SUITE
UPS	2753095	BR1500MS2	P	1	APC 1500VA UNINTERRUPTIBLE POWER SUPPLY

SHEET SPECIFIC NOTES:

1 CAT6 ETHERNET CABLE SUPPLIED BY AASI

2 CAT6 ETHERNET CABLE SUPPLIED BY ELECTRICAL CONTRACTOR.

JOB NAME: NAPANEE WWTP					DO NOT SCALE DRAWING	AQUA-AEROBIC SYSTEMS, INC. A Metawater Company
JOB LOCATION: NAPANEE - ONTARIO, CANADA						
					UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
					FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2°	ANSI
					TYPE: 3-BASIN AQUANEREDA	
A	-	2025-02-13	BLP	SUBMITTAL RELEASE	DRAWN BY: BLP	DATE: 2024-08-08
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: -	SHEET: 1 OF 2
DRAWING NAME: AGS NETWORK COMPUTER ASSEMBLY					DRAWING NUMBER: 9704419A30910	SCALE: NONE; SIZE: D



SHEET SPECIFIC NOTES:

1. CAT 6 ETHERNET CABLE SUPPLIED BY AASI.
2. ETHERNET TCP/IP COMMUNICATION CABLE CAT6 CABLE SUPPLIED BY OTHERS
CABLE NOT TO EXCEED 100 METERS. LONGER RUN REQUIRES ADDITIONAL EQUIPMENT BY OTHERS.

JOB NAME: NAPANEE WWTP				
JOB LOCATION: NAPANEE - ONTARIO, CANADA				
A	-	2025-02-13	BLP	SUBMITTAL RELEASE
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
DRAWING NAME: AGS NETWORK COMPUTER ASSEMBLY				

DO NOT SCALE DRAWING

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

TYPE: 3-BASIN AQUANEREDA
DRAWN BY: BLP | DATE: 2024-08-08
WEIGHT: - | SHEET: 2 OF 2
DRAWING NUMBER: 9704419A30910 | SCALE: NONE | SIZE: D