Solids Collection Equipment Preselection Package

for

Jordan Valley Water Treatment Plant
JVWTP Solids Collection Equipment Upgrade Project

Volume IV of IV

PREPARED FOR

Jordan Valley Water Conservancy District
8215 S 1300 W
West Jordan, UT 84088

JVWCD Project No. 4277

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

PREPARED BY

Brown and Caldwell
6975 Union Park Center, Suite 490
Salt Lake City, Utah 84047

BC Project No. 157012

REGISTERED PROFESSIONAL ENGINEER
No. 8887408
JACOB C.
HIMEBAUGH
STATE OF UTAH

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Contract/Technical Specifications

for

Jordan Valley Water Treatment Plant
JVWTP Sedimentation Basin Equipment Replacement Project

Solids Handling Equipment Preselection Package

PREPARED FOR

Jordan Valley Water Conservancy District
8215 S 1300 W
West Jordan, UT 84088

JVWCD Project No. 4138

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

REGISTERED PROFESSIONAL ENGINEER
No. 4940719
JEREMY S. WILLIAMS
STATE OF UTAH

PREPARED BY

Brown and Caldwell
6975 Union Park Center, Suite 490
Salt Lake City, Utah 84047

BC Project No. 157012

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No. 8887408
JACOB C. HIMEBAUGH
STATE OF UTAH

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CONTRACT DOCUMENTS FOR

"Solids Handling Equipment Preselection Package"

JVWCD PROJECT #: 4138

July 20, 2021

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
801-565-4300

ENGINEER

Brown and Caldwell
6975 Union Park Center, Suite #490
Midvale, UT 84047
(801) 316-9800

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NOTICE INVITING BIDS

JORDAN VALLEY WATER CONSERVATION DISTRICT
JVWTP SEDIMENTATION EQUIPMENT REPLACEMENT PROJECT
SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

SITE OF WORK: Jordan Valley Water Treatment Plant located at 15305 South 3200 West, Herriman, Utah 84065

DESCRIPTION OF WORK: This project replaces all chain and flight mechanisms in Basins 3, 4, 5, and 6 at the Jordan Valley Water Treatment Plant. Each basin consists of three long mechanisms, three short mechanisms and one cross collector. The successful Bidder shall provide equipment to be installed by a General Contractor (Contractor) that will be selected later this year.

OBTAINING CONTRACT DOCUMENTS: All Contract Documents may be obtained by electronic download from the District's website at www.jvwcd.org on July 20, 2021.

RECEIPT OF BIDS: Sealed bids will be received at the office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, before 1:00 pm, on July 27, 2021. Electronic bids may also be submitted in electronic (.pdf) format to ellisad@jvwcd.org. JVWCD requests that electronic bids be submitted 15 minutes prior to the bid opening deadline.

AWARD OF CONTRACT: An Award of Contract, if awarded, will be made within 60 calendar days of the opening of bids.

NOTICE TO PROCEED: A Notice to Proceed, if issued, will be made within 60 calendar days of the Notice of Award.

PROJECT SCHEDULE: Project schedule for this equipment is critical on this project. The equipment shall be delivered in two milestones: half by February 1, 2022 and the remainder by February 28, 2022 (Milestones 1 and 2, respectively). If the work is not completed within the specified time frame, the bidder herein agrees to accept liquidated damages in the amount of $1000 per day and $2000 per day for Milestones 1 and 2, respectively.

DISTRICT WEB SITE AND PLANHOLDERS LIST
Prospective bidders must register at the District's web site under "Engineering Projects" (https://jvwcd.org/public/projects). Prospective bidders are required to check the District's web site for any addenda prior to submitting a responsive bid. The District's web site will be used to publish updated information relative to the project, including a planholders list.

COVID-19 WORK REQUIREMENTS: This work is expected to be completed under state

NOTICE INVITING BIDS

COVID-19 work restrictions. Bidder is to require that all personnel working on this project be healthy each workday and that those persons which might be ill are not allowed to work at District facilities. Bidder is to take other precautions as required by Salt Lake County Health officials.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check, money order or bid bond in the amount of five percent of the total bid price payable to the Jordan Valley Water Conservancy District as a guarantee that the bidder, if its bid is accepted, will promptly execute the contract, provide evidence of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price and a payment bond in the amount of 100 percent of the total bid price.

ADDRESS AND MARKING OF BID: The envelope enclosing the bid shall be sealed and addressed to the Jordan Valley Water Conservancy District and delivered or mailed to 8215 South 1300 West, West Jordan, Utah 84088. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids. The certified or cashier's check, money order, or bidder's bond shall be enclosed in the same envelope with the bid.

PROJECT ADMINISTRATION: All questions relative to this project prior to the opening of bids shall be directed to the Engineer for the project. It shall be understood, however, that no interpretations of the specifications will be made by telephone, nor will any "or equal" products be considered for approval prior to award of contract.

Engineer
Brown and Caldwell
Project Manager: Jeremy Williams
6975 Union Park Center, Suite #490
Midvale, UT 84047
Telephone: (801) 316-9826
Email: jwilliams1@brwncald.com

OWNER'S RIGHTS RESERVED: The Owner reserves the right to reject any or all bids, to waive any informality in a bid, and to make awards in the interest of the Owner.

Owner
Jordan Valley Water Conservancy District
Project Manager: David McLean, PE
8215 South 1300 West
West Jordan, Utah 84088
Telephone: (801) 565-4300
Email: dmclean@jvwcd.org

INSTRUCTIONS TO BIDDERS

FORM OF BID: The bid shall be made on the bidding schedule(s) bound herein. The bid shall be enclosed in a sealed envelope bearing the name of the bidder and name of the project. In the event there is more than one bidding schedule, the bidder may bid on any individual schedule or on any combination of schedules.

BID APPURTANCES: Bidders must provide bid appurtenances including Information required of bidder and experience reference projects. Bids not including the required information may be deemed non-responsive.

DELIVERY OF BID: The bid shall be delivered by the time and to the place stipulated in the Notice Inviting Bids. Alternately electronic bids will be accepted in adobe acrobat (.pdf) format. Electronic bids must be sent to ellisad@jvwcd.org. It is the bidder's sole responsibility to see that the respective bid is received in proper time.

WITHDRAWAL OF BIDS: Bids shall be unconditionally accepted without alteration or correction, excepting that bidder may by means of written request, signed by the bidder or his properly authorized representative withdraw his bid. Such written request must be delivered to the place stipulated in the Notice Inviting Bids for receipt of bids prior to the scheduled closing time for receipt of bids.

OPENING OF BIDS: The bids will be publicly opened and read at the time and place stipulated in the Notice Inviting Bids. According to state law, total bid amounts for each bidder will be posted to the District's website within 24 hours following receipt of the bids.

MODIFICATIONS AND ALTERNATIVE BIDS: Unauthorized conditions, limitations, or provisions attached to a bid may render it non-responsive and may cause its rejection. The completed bid forms shall be without interlineations, alterations, or erasures. Alternative bids will not be considered unless called for. Oral, telegraphic, or telephonic bids or modifications will not be considered.

DISCREPANCIES IN BIDS: In the event there is more than one bid item in a bidding schedule, the bidder shall furnish a price for all bid items in the schedule; failure to do so may render the bid non-responsive and subject to rejection. In the event there are unit price bid items in a bidding schedule and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the "amount" will be corrected accordingly, and the Bidder shall be bound by said Correction. In the event there is more than one bid item in a bidding schedule and the total indicated for the schedule does not agree with the sum of the prices bid on the individual items, the prices bid on the individual items shall govern and the total for the schedule will be corrected accordingly, and the Bidder shall be bound by said correction.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check or approved bid bond in the amount stated in the Notice Inviting Bids. Said check or bond shall be made payable to the Owner and shall be given as a guarantee that the bidder, if awarded the work, will enter into a contract within 10 calendar days after receipt of the contract from the Owner, and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond; each of said bonds to be in the amount stated in the Notice Inviting Bids. In case the apparent low bidder refuses or fails to enter into such contract or fails to provide the required insurance and insurance certificates, the check or bid bond, as the case may be, shall be forfeited to the Owner. If the bidder elects to furnish a bid bond as his bid guarantee, he shall use the bid bond bound herein, or one conforming substantially to it in form.

BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE

It is the responsibility of each Bidder before submitting a Bid to:

1. Examine Contract Documents thoroughly.

2. Consider federal, state and local laws and regulations that may affect cost, progress, and performance of furnishing of the work.

3. Study and carefully correlate the Bidder's observations with the Contract Documents.

4. Notify the Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

Reference is made to the Supplemental General Conditions for identification of:

1. Those reports of exploration and tests of subsurface conditions at the site, which have been utilized by the Engineer in the preparation of the Contract Documents.

2. Those drawings of physical conditions in or relating to existing surface and subsurface conditions (except underground utilities as defined in Article 1 of the General Conditions) which are at or contiguous to the site and which were utilized by the Engineer in the preparation of the Contract Documents. Copies of such reports and drawings are available for inspection at the office of the Owner.

Information and data reflected in the Contract Documents with respect to underground facilities at/or contiguous to the site are based upon information and data furnished to the Owner and the Engineer by the owners of such underground facilities or others, and the Owner does not assume any responsibility for the accuracy or completeness thereof including any damages whatsoever that may be incurred by the Bidder through his reliance thereon unless it is expressly provided otherwise in the Supplemental General Conditions and/or the Technical Specifications.

Before submitting a bid, the Bidder shall conduct such examination, investigations, studies and tests as are necessary to satisfy himself as to: the nature and location of the physical conditions (surface, subsurface and underground facilities), the general and local conditions particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, availability of utilities, local weather conditions, the character of equipment and facilities required preliminary to and during the prosecution of the work; any and all other conditions that may in any way affect the cost, progress, performance or furnishing of materials in accordance with the Contract Documents. All such examination, investigation, studies, tests and the like shall be at the Bidder's expense.

Upon reasonable request in advance, the Owner shall provide each Bidder access to the site to conduct such explorations, examination, investigation and tests as each Bidder may determine necessary for the submission of a Bid. The Bidder shall fill all holes, clean and restore the site to its former condition upon the completion of such activities.

The submission of a bid hereunder shall be considered *prima facie* evidence that the Bidder has made such examination as is set forth in the above paragraph and is knowledgeable as to the location and site conditions surrounding the work and the conditions to be encountered in performing the work and as to the requirements, conditions and terms of the Contract and Contract Documents.

The Owner assumes no responsibility for any understanding or representations made by any of its officers or agents during or prior to the execution of this Contract, for information contained in any reports, subsurface studies, or other information which may be made available for the Bidder's information and which are not included as Contract Documents, for any understanding or representations by the Owner or by others which are not expressly stated in the Contract Documents which liability is not expressly assumed by the Owner or its representatives or Engineer in the Contract Documents. Such information shall be deemed to be for the information of the Bidder and the Bidder shall have the obligation of evaluating any such information as to its accuracy and effect the Owner will not be liable or responsible for any such information or any conclusions that may be drawn there from by the Bidder.

The lands upon which the work is to be performed, right-of-ways and easements for access thereto together with other lands designated for use by the Bidder in performing the work are identified in the Contract Documents. All additional lands and access thereto that are required for temporary construction facilities or storage of materials and equipment are to be provided by the Bidder. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the Owner unless otherwise provided in the Contract Documents.

The submission of a Bid shall constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, and that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents in compliance with such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that such means, methods, techniques, sequences or procedures described in the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the work.

QUANTITIES OF WORK

The quantities of work or material stated in the Bid Schedule are supplied only to give an indication of the general scope of the work; the Owner does not expressly or by implication agree that the actual amount of work or material will correspond therewith. The Owner reserves the right after award of the Contract to increase or decrease the quantities of any unit price item of the work by an amount up to and including 25 percent of the quantity of any bid item, or to omit portions of such work as may be deemed necessary or expedient by the Engineer or Owner, without a change in the unit price. Such right to revise and omit shall include the right to delete any bid item in its entirety, or to add additional bid items in quantities up to and including an aggregate total amount not to exceed 25 percent of the total amount of the Contract.

The Bidders nor the ultimate Contractor on the Project shall at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit price items of the Bid.

COMPETENCY OF BIDDERS: In selecting the lowest responsible Bidder, consideration will be given to the general competency of the Bidder for the performance of the work covered by the Bid. To this end, each bid shall be supported by a statement of the bidder's experience as of recent date on the form entitled "Information Required of Bidder," bound herein.

DISQUALIFICATION OF BIDDERS: More than one bid from an individual, firm partnership, corporation, or association under the same or different names will not be considered. Reasonable grounds for believing that any bidder is interested in more than one bid for the work contemplated will cause the rejection of all bids in which such bidder is interested. If there is reason for believing that collusion exists among the bidders, all bids will be rejected.

INSTRUCTIONS TO BIDDERS

RETURN OF BID GUARANTEE: Within 10 calendar days after award of the contract, the Owner will return the bid guarantees accompanying such of the bids as are not considered in making the award. All other bid guarantees will be held until a Notice to Proceed has been issued and accepted. They will then be returned to the respective bidders whose bids they accompany.

AWARD OF CONTRACT: Award of the Contract, if it be awarded, will be based primarily on the lowest overall cost to the Owner, and will be made to a responsive and responsible bidder whose bid complies with all the requirements prescribed. Any such award will be made by written notice and within 60 calendar days after opening of the bids, unless a different waiting period is expressly allowed in the Notice Inviting Bids. Unless otherwise indicated, an award will not be made for less than all the bid items in an individual bidding schedule. In the event the entire work is contained in more than one bidding schedule, the Owner may award schedules individually or in combination. In the case of two bidding schedules which are alternate to each other, only one of such alternate schedules will be awarded.

EXECUTION OF CONTRACT: The Bidder to whom the award is made shall secure all insurance and shall furnish all certificates and bonds required by the specifications within ten calendar days after receipt of the Notice of Award from the Owner. The Bidder to whom the award is made shall execute a written contract with the Owner on the form of agreement provided within ten calendar days after receipt of the Agreement from the Owner. Failure or refusal to enter into a contract as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the bid guarantee. If the successful bidder refuses or fails to execute the contract, the Owner may award the contract to the second lowest responsible bidder, or reject all bids and re-advertise the project for rebidding. If the second lowest responsible bidder refuses or fails to execute the contract, the Owner may award the contract to the third lowest responsible bidder. On the failure or refusal of such second or third lowest bidder to execute the contract, each such bidder's guarantees shall be likewise forfeited to the Owner.

ISSUANCE OF NOTICE TO PROCEED: The Owner intends to execute the Agreement and issue the Notice to Proceed specifying the Project start date within ten calendar days after its receipt of the executed Agreement, Purchase Order Assignment(s), (if applicable), bonds and insurance certificates from the successful bidder. If the Contract Time is expressed as a specific completion date in the Notice Inviting Bids and paragraph 3.1 of the Agreement rather than a specific number of successive days following the start date identified in the Notice to Proceed, then any delay by the Owner beyond the ten days in issuing the Notice to Proceed shall extend the completion date by the number of days of the delay.

INSTRUCTIONS TO BIDDERS

SALES AND USE TAXES: Utah state sales and use taxes on materials and equipment will be paid by the Contractor to whom the contract will be assigned and shall not be incorporated in the Project. Said taxes shall be EXCLUDED from this Bid.

CONTRACT TO BE ASSIGNED: The Owner is executing an Agreement with a Bidder for early selection of the preferred Supplier for the Solids Handling Equipment to be used in the Work. Said Agreement, along with the firm price, shall be assigned by the Owner to the Contractor.

Bidder will be required to accept assignment of said Agreement from the Owner, whereupon the Contractor will be wholly responsible under the construction contract for administration of the Bidder’s Agreement, including payment therefor and all expediting and delivery. The Supplier’s capital cost proposal shall include all costs of the Agreement Work plus all field services and Special Services required of the Bidder (per all specification requirements herein) until final acceptance is granted by the Owner to the respective Contractor.

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled "Solids Handling Equipment Preselection Package" drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda are only delivered by e-mail and through the internet via download.

The undersigned bidder acknowledges receipt of the following addenda:

No.	Date Received	No.	Date Received

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: ______________________

Bidder: __________________________________

By: __________________________________
(Signature)

Title: __________________________________

Bidder further agrees to complete all work required within the time stipulated in the Contract Documents, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

BID

BID SCHEDULE(S)

BASE BID:

Item	No. Units	Unit	Unit Price ($ numerals)	Total Price ($ numerals)
Special Services to prepare complete shop drawings and related submittals, and coordinate with Owner and Engineer during design. The Contract Price for the Special Engineering Services shall not exceed 5% of the total Contract Price.	1	LS		
Goods: Replace Chain and Flight Equipment in Basins 3, 4 ,5 and 6 as specified including all parts and appurtenances required for a complete and functional system.[1]	1	LS		
			Total ($ numerals)	

[1] Price to include all related costs including any bonds, insurance, shipping, lading at point of fabrication and Point of Destination, O&M Manuals, and start up field services as described in the Contract Documents. Excludes sales tax, to be paid by the Contractor.

BID ALTERNATE 1:

Item	No. Units	Unit	Unit Price ($ numerals)	Total Price ($ numerals)
Additive: 4-Axle System: For the three (3) long mechanisms in each basin (4 basins, 12 mechanisms total), provide a 4th shaft and all required parts to function as a return shaft at the east end of each basin.	12	EA		
Deductive: 4-Axle System: For the three (3) long mechanisms in each basin (4 basins, 12 mechanisms total), deduct the return track wall supports. The return rail will be hung from above by elevated supports (future tube-settler supports); the elevated supports will be provided by the Contractor.	12	EA		
			Total ($ numerals)	

BID

BID ALTERNATE 2:

Item	No. Units	Unit	Total Price ($ numerals)
Upgraded Chain: In place of the specified chain, provide an upgraded chain (first named manufacturer's model HS730, or equal)	1	LS	

BID ALTERNATE 3:

Item	No. Units	Unit	Total Price ($ numerals)
Upgraded Flight: In place of the specified flight, provide an upgraded flight (first named manufacturer's model Diamond, or equal)	1	LS	

The Bid may be awarded using the Base Bid or a combination of the Base Bid and any/all Bid Alternate(s).

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That ____, as Bidder,

and____, as Surety,

are held and firmly bound unto the Jordan Valley Water Conservancy District (hereinafter called "Owner") in the sum of $_____________________________________dollars (not less than five percent of the total amount of the bid) for the payment of which sum, will and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Bidder has submitted a bid to Owner to perform all work required under the bidding Schedule of the Owner's Contract Documents entitled “Solids Handling Equipment Preselection Package”, (hereafter called the “Project”).

NOW THEREFORE, if Bidder is awarded Contract by Owner for the Construction of the Project and, within the time and in the manner required under the heading "Instructions to Bidders" enters into the written contract entitled "Agreement" bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond within 10 calendar days after receipt of such contract from Owner, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by Owner and judgment is recovered, Surety shall pay all costs incurred by Owner in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this _____day of _______________, 20__.

_________________________________	_________________________________
By: ____________________________	By: ____________________________
Its: ____________________________	Its: ____________________________
(SEAL)	(SEAL)

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. **Bidder information:**

   Bidder's name: ____

   Bidder's address: ____

   ____

   ____

   Bidder's Primary Contact: ________________________________

   Email address of Bidder's primary contact: _____________________

   Bidder's telephone number: _______________________________

2. **Bidder must be qualified and meet the minimum requirements described in 46 43 11, Part 1.05 A.**

NOTICE OF AWARD

To:

Re: Solids Equipment Preselection Package

You are hereby notified that the OWNER has accepted your bid for the above referenced project in the amount of $____.

Furnish the required Bidder's Performance Bond, Payment Bond, and Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: David McLean, PE

When the Agreement is provided, sign and return it within ten calendar days from receipt of the agreement.

Dated this _____ day of _________________, 20__.

____
Alan E. Packard, PE
Assistant General Manager & Chief Engineer

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:

____

This _____day of _________________________, 20__.

Signature: ____

Printed Name: ____

Title: ____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

NOTICE TO PROCEED

To:

Re: Solids Handling Equipment Preselection Package

You are hereby notified to commence work in accordance with the Agreement dated ___________________________, on _____________________________, and you are to complete the work by, _________________________________.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, attention:_____________________________________.

Dated this _____day of ________________________, 20___.

____
Shane K Swensen, P.E.
Engineering Department Manager

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

____

This _____day of _________________________, 20__.

Signature: ____

Printed Name: ____

Title: ____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

PURCHASE ORDER ASSIGNMENT

The Jordan Valley Water Conservancy District, a water conservancy district organized under the laws of the State of Utah (Assignor), hereby assigns, transfers and sets over to ________________________, a ____________________corporation qualified to do business and doing business in the State of Utah (Assignee), all of Assignor's right, title and interest in and to the following described Purchase Order (a copy of which is attached and incorporated by reference as though fully set forth), subject to all the terms and conditions thereof:

Purchase Order No.______, dated____________.

This Assignment is made pursuant to and in accordance with the terms of the Contract Documents and Specifications entered into by and between Assignor and Assignee for the Solids Handling Equipment Preselection Package dated ____________.

Assignor hereby delegates to Assignee, and Assignee hereby expressly assumes, upon execution of this document, all of the obligations and duties to be performed by Assignor under the Purchase Order in accordance with the terms thereof and as provided in the Contract Documents and Specifications.

Assignor

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

Dated:____________, 20__ By: ____________________________
Barton Forsyth
Its General Manager

JORDAN VALLEY WATER CONSERVANCY DISTRICT

______________________________, Assignee, on this ________day of ______________, 20__,

hereby accepts the assignment of the above-described Purchase Order, subject to the terms and conditions thereof and in accordance with the terms of this Assignment.

Assignee

(NAME OF ASSIGNEE)

Dated:____________, 20__ By: ____________________________

Its President

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated:

Addenda - Written or graphic instruments issued prior to the opening of Bids which make additions, deletions, or revisions to the Contract Documents.

Agreement - The written contract between the OWNER and the CONTRACTOR for the performance of the WORK pursuant to the Contract Documents. Documents incorporated into the contract by reference become part of the contract and of the Agreement.

Application for Payment - The form furnished by the ENGINEER and completed by the CONTRACTOR to request progress or final payment including supporting documentation to substantiate the amounts for which payment is requested.

Bonds - Performance, and Payment Bonds and other instruments which protect against loss due to inability or refusal of the CONTRACTOR to perform pursuant to the Contract Documents.

Change Order - A document recommended by the ENGINEER, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion, or revision in the WORK, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents - Information and Instructions, forms (including the Schedule of Prices and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, Technical Specifications, Drawings and all Addenda and Change Orders executed pursuant to the provisions of the Contract Documents.

Contract Price - The total monies payable by the OWNER to the CONTRACTOR under the terms and conditions of the Contract Documents.

Contract Time - The number of successive Days stated in the Contract Documents for the completion of the WORK. The Contract Time begins to run on the date specified in the Notice to Proceed.

CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

Cost Proposal - The offer or proposal of the pipeline installation subcontractor to the CONTRACTOR to provide the work required under these Contract Documents.

Day - A calendar day of 24 hours measured from midnight to the next midnight.

Defective Work - Work that: is unsatisfactory, faulty, or deficient; does not conform to the Contract Documents; does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; has been damaged prior to the ENGINEERS's recommendation of final payment.

Drawings - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the WORK.

Effective date of the Agreement - The date indicated in the Agreement on which it was executed, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER - The person, firm, or corporation named as such in the Contract Documents.

Field Order - A written order issued by the ENGINEER which may or may not involve a change in the WORK.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes, and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

Notice of Award - The OWNER's written notice to the apparent successful Bidder stating that upon compliance with the conditions precedent enumerated therein by the apparent successful Bidder within the time specified, the OWNER will enter into the Agreement.

Notice to Proceed - The OWNER's written notice to the CONTRACTOR authorizing the CONTRACTOR to proceed with the work and establishing the date of commencement of the Contract Time.

OWNER - The Jordan Valley Water Conservancy District.

Partial Utilization - Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of the WORK.

Project - A unit of total construction of which the WORK to be provided under the Contract Documents, may be the whole, or a part thereof.

Project Representative - The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

Proposer - Any person, firm or corporation submitting a proposal for the work.

Schedule of Prices - The offer or proposal of the CONTRACTOR setting forth the price or prices for the work to be performed.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of WORK and all illustrations, brochures, standard schedules, performance charts, instruction, and diagrams to illustrate material or equipment for some portion of the WORK.

Specifications - (Same definition as for Technical Specifications hereinafter).

Subcontractor - An individual, firm, or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the WORK at the site.

Substantial Completion - That state of construction when the WORK has progressed to the point where, in the opinion of the ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the WORK can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to substantial completion thereof.

Supplementary General Conditions - The part of the Contract Documents which make additions, deletions, or revisions to these General Conditions.

Supplier - A manufacturer, fabricator, supplier, distributor, materialman, or vendor.

Technical Data - The factual information contained in reports describing physical conditions, including exploration method, plans, logs, laboratory test methods and factual data. Technical Data does not include conclusions, interpretations, interpolations, extrapolations or opinions contained in reports or reached by the CONTRACTOR.

Technical Specifications - Those portions of the Contact Documents consisting of the written technical descriptions of products and execution of the WORK.

Underground Utilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and any encasements containing such facilities which have been installed under ground to furnish any of the following services or materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

WORK - The entire construction required to be furnished under the Contract Documents. WORK is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

GENERAL CONDITIONS

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

A. The CONTRACTOR shall deliver to the OWNER the Agreement, Bonds, Insurance Policies and Certificates required by the Contract Documents within ten (10) days after receiving the Notice of Award from the OWNER.

2.02 COPIES OF DOCUMENTS

A. The OWNER shall furnish the CONTRACTOR 5 copies of the Contract Documents, together with 5 sets of full-scale Drawings. Additional quantities of the Contract Documents will be furnished at reproduction cost.

2.03 STARTING THE PROJECT

A. The CONTRACTOR shall begin construction of the WORK within 10 days after the commencement date stated in the Notice to Proceed, but shall not commence construction prior to the commencement date.

2.04 BEFORE STARTING CONSTRUCTION

A. Before undertaking each part of the WORK, the CONTRACTOR shall carefully study and compare the Contract Documents to check and verify pertinent figures and dimensions shown thereon with all applicable field measurements. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.

B. The CONTRACTOR shall submit to the ENGINEER for review those documents called for in each section of the Technical Specifications.

2.05 PRECONSTRUCTION CONFERENCE

A. The CONTRACTOR shall attend a preconstruction conference with the OWNER, the ENGINEER and others as appropriate to discuss the construction of the WORK in accordance with the Contract Documents.

2.06 FINALIZING SCHEDULES

A. At least 7 days before the CONTRACTOR's submittal of its first Application for Payment, the CONTRACTOR, the ENGINEER, and others as appropriate will meet to finalize the schedules submitted in accordance with the Technical Specifications.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT

A. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK. The Contract Documents are complementary, what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

B. It is the intent of the Contract Documents to describe the WORK, functionally complete, to be constructed in accordance with the Contract Documents. All work, materials, or equipment that may be reasonably inferred from the Contract Documents as being required to produce the completed work shall be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials, or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals, or codes or any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR, or the ENGINEER or any of their consultants, agents, or employees from those set forth in the Contract Documents.

C. If, during the performance of the WORK, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall immediately report it to the ENGINEER in writing and before proceeding with the work affected thereby. The ENGINEER shall then make a written interpretation, clarification, or correction from the ENGINEER.

3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

A. In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:

1. Change Orders
2. Agreement
3. Addenda
4. Contractor's Bid (Bid Form)
5. Supplemental General Conditions
6. Notice Inviting Bids
7. Instructions to Bidders
8. General Conditions
9. Technical Specifications
10. Referenced Standard Specifications
11. Drawings

B. With reference to the Drawings the order of precedence is as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda/change order drawings govern over general drawings
4. Contract Drawings govern over standard drawings

3.03 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

A. The Contract Documents may be amended by a Change Order (pursuant to Article 10) to provide for additions, deletions or revisions in the WORK or to modify terms and conditions.

3.04 REUSE OF DOCUMENTS

A. Neither the CONTRACTOR, Subcontractor, Supplier, nor any other person or organization performing any of the WORK under a contract with the OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents used on the WORK, and they shall not reuse any of them on the extensions of the Project or any other project without written consent.

GENERAL CONDITIONS

ARTICLE 4 - AVAILABILITY OF LANDS; PHYSICAL CONDITIONS: REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

A. The OWNER shall furnish the lands, rights-of-way and easements upon which the WORK is to be performed and for access thereto, together with other lands designated for the use of the CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing major facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or rights-of-way provided. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. The CONTRACTOR shall not enter upon nor use any property not under the control of the OWNER until a written temporary construction easement agreement has been executed by the CONTRACTOR and the property owner, and a copy of the easement furnished to the ENGINEER prior to its use. Neither the OWNER nor the ENGINEER shall be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any properties.

4.02 PHYSICAL CONDITIONS - SUBSURFACE AND EXISTING STRUCTURES

A. <u>Explorations and Reports</u>: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies exploration reports and subsurface conditions tests at the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the Technical Data contained in these reports. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

B. <u>Existing Structures</u>: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies the drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Paragraph 4.04 herein) which are at or contiguous to the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

4.03 DIFFERING SITE CONDITIONS

A. The CONTRACTOR shall notify the ENGINEER upon encountering any of the following unforeseen conditions, hereinafter called "differing site conditions," during the prosecution of the WORK. The CONTRACTOR's notice to the ENGINEER shall be in writing and delivered before the differing site conditions are disturbed, but in no event later than 14 days after their discovery.

1. Subsurface or latent physical conditions at the site of the WORK differing materially from those indicated, described, or delineated in the Contract Documents including those reports and documents discussed in Paragraph 4.02; and

2. Physical conditions at the site of the WORK of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents including those reports and documents discussed in Paragraph 4.02.

B. The ENGINEER will review the alleged differing site conditions, determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent and advise the OWNER in writing of the ENGINEER's findings and conclusions.

C. If the OWNER concludes that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the differing site conditions.

D. In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to the differing site conditions. If the OWNER and the CONTRACTOR are unable to agree as to the amount or length of the Change Order, a claim may be made as provided in Articles 11 and 12.

E. The CONTRACTOR's failure to give written notice of differing site conditions within 14 days of their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

4.04 PHYSICAL CONDITIONS - UNDERGROUND UTILITIES

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Utilities at or contiguous to the site are based on information and data furnished to the OWNER or the ENGINEER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section entitled "Protection and Restoration of Existing Facilities" of the Technical Specifications, the OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any Underground Utilities information or data. The CONTRACTOR's responsibility relating to underground utilities are: review and check all information and data, locate all Underground Utilities shown or indicated in the Contract Documents, coordinate the WORK with the owners of Underground Utilities during construction, the safeguard and protect the of Underground Utilities, and repair any damage to Underground Utilities resulting from the WORK. The cost of all these activities will be considered as having been included in the Contact Price.

B. Not Shown or Indicated: If an Underground Utility not shown or indicated in the Contract Documents is uncovered or revealed at or contiguous to the site and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall give written notice to the OWNER of that utility and the ENGINEER, specifying the location of the utility in question.

4.05 REFERENCE POINTS

A. The ENGINEER will provide one bench mark, near or on the site of the WORK, and will provide two points near or on the site to establish a base line for use by the ENGINEER for alignment control. Unless otherwise specified in the Technical Specifications, the CONTRACTOR shall furnish all other lines, grades, and bench marks required for proper execution of the WORK.

B. The CONTRACTOR shall preserve all bench marks, stakes, and other survey marks. In case of their removal or destruction by its own employees or by its subcontractor's employees, the CONTRACTOR shall be responsible for the accurate replacement of reference points by professionally qualified personnel at no additional cost to the OWNER.

ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount set forth in the Supplementary General Conditions as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury’s Circular 570, with an acceptable underwriting limitation limit. The Performance Bond shall remain in effect at least until one year after the date of Notice of Completion, except as otherwise provided by Law or Regulation or by the Contract Documents. After the ENGINEER issues the Notice of Completion, the amount of the Performance Bond may be reduced to 10 percent of the Contract Price, or $1,000, whichever is greater. The CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary General Conditions.

B. If the surety on any Bond furnished by the CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the WORK is located, the CONTRACTOR shall within 7 days after written approval by the OWNER of a substitute Bond and Surety substitute the approved Bond and Surety.

5.02 INSURANCE

A. The CONTRACTOR shall purchase and maintain the insurance required under this paragraph. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury’s Circular 570, with an acceptable underwriting limitation limit. This insurance shall include the specific coverages set out herein and be written for not less than the limits of liability and coverages provided in the Supplementary General Conditions, or required by law, whichever is greater. The CONTRACTOR's liabilities under the Agreement shall not be deemed limited in any way to the insurance coverage required.

B. The CONTRACTOR shall furnish the OWNER and ENGINEER with certificates indicating the type, amount, class of operations covered, effective dates and expiration dates of all policies. All insurance policies purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 30 days' prior written notice has been given to the OWNER by certified mail. All insurance shall remain in effect until the ENGINEER issues the Notice of Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.06 or completing punch list items required by the Notice of Completion. In addition, the insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the OWNER, the ENGINEER, and their officers, agents, and employees as "additional insured" under the policies.

1. Workers' Compensation and Employer's Liability: This insurance shall protect the CONTRACTOR against all claims under applicable state workers' compensation laws. The CONTRACTOR shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" endorsement. The CONTRACTOR shall require each subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in the WORK unless its employees are covered by the protection afforded by the CONTRACTOR's Workers' Compensation Insurance. In the event a class of employees is not protected under the Workers' Compensation Statute, the CONTRACTOR or Subcontractor, as the case may be, shall provide adequate employer's liability insurance for the protection of its employees not protected under the statute.

2. Comprehensive General Liability: This insurance shall be written in comprehensive form and shall protect the CONTRACTOR against all claims arising from injuries to persons other than its employees and damage to property of the OWNER or others arising out of any act or omission of the CONTRACTOR or its agents, employees or subcontractors. The policy shall include the following endorsements: (1) Protective Liability endorsement to insure the contractual liability assumed by the CONTRACTOR under the indemnification provisions in these General Conditions; (2) Broad Form Property Damage endorsement; (3) Personal Injury endorsement to cover personal injury liability for intangible harm. The Comprehensive General Liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground structures.

3. Comprehensive Automobile Liability: This insurance shall be written in comprehensive form. The policy shall protect the CONTRACTOR against all claims for injuries to employees, members of the public and

damage to property of others arising from the use of CONTRACTOR's motor vehicles, whether they are owned, non-owned, or hired, and whether used or operated on or off the site. The motor vehicle insurance required under this paragraph shall include: (a) motor vehicle liability coverage; (b) personal injury protection coverage and benefits; and (c) uninsured motor vehicle coverage.

4. Subcontractor's Insurance: The CONTRACTOR shall require each of its subcontractors to procure and to maintain Comprehensive General Liability Insurance and Comprehensive Automobile Liability Insurance of the type and in the amounts specified in the Supplementary General Conditions or insure the activities of its subcontractors in the CONTRACTOR's own policy, in like amount.

5. Builder's Risk: This insurance shall be of the "all risk" type, shall be written in completed value form, and shall protect the CONTRACTOR, the OWNER, and the ENGINEER against damage to buildings, structures, materials and equipment. The amount of this insurance shall not be less than the insurable value of the WORK at completion. Builder's risk insurance shall provide for losses to be payable to the CONTRACTOR, the OWNER, and the ENGINEER as their interests may appear. The policy shall contain a provision that in the event of payment for any loss under the coverage provided, the insurance company shall have no rights of recovery against the CONTRACTOR, the OWNER, and the ENGINEER. The Builder's Risk policy shall insure against all risks of direct physical loss or damage to property from any external cause including flood and earthquake. Allowable exclusions, if any, shall be as specified in the Supplementary General Conditions.

GENERAL CONDITIONS

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

A. The CONTRACTOR shall supervise and direct the WORK competently and efficiently, devoting the attention and applying the skills and expertise necessary to perform the WORK in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The CONTRACTOR shall be responsible to see that the finished WORK complies accurately with the Contract Documents.

B. The CONTRACTOR shall employ the Superintendent named in "Information Required of Bidder" on the work site at all times during the progress of the WORK. The superintendent shall not be replaced without the OWNER's written consent. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR. The CONTRACTOR shall issue all its communications to the OWNER through the ENGINEER.

C. The CONTRACTOR's superintendent shall be present at the site of the WORK at all times while work is in progress. Failure to observe this requirement shall be considered suspension of the WORK by the CONTRACTOR until the superintendent is again present at the site.

6.02 LABOR, MATERIALS, AND EQUIPMENT

A. The CONTRACTOR shall provide skilled, competent and suitably qualified personnel to survey and lay out the WORK and perform construction as required by the Contract Documents. When required in writing by the OWNER or ENGINEER, the CONTRACTOR or any subcontractor shall discharge any person who is, in the opinion of the OWNER or ENGINEER, incompetent, disorderly, or otherwise unsatisfactory and shall not again employ the discharged person on the WORK without the consent of the OWNER or ENGINEER. The CONTRACTOR shall at all times maintain good discipline and order at the site.

B. Except in connection with the safety or protection of persons the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice to the ENGINEER. Except as otherwise provided in this Paragraph, the CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of 8 hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the ENGINEER and the Change Order specifically authorizes the use of overtime work, but only to the extent that the CONTRACTOR pays overtime wages on a regular basis being paid by for overtime work of a similar nature in the same locality.

C. All costs of inspection and testing performed during overtime work approved solely for the convenience of the CONTRACTOR shall be borne by the CONTRACTOR. The OWNER shall have the authority to deduct the costs of all inspection and testing from any partial payments otherwise due to the CONTRACTOR.

D. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall furnish, erect, maintain and remove the construction plant, and temporary works and assume full responsibility for all materials, equipment, labor, transportation, construction equipment, machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities and all other facilities and incidentals necessary for the furnishing, performance testing, start-up and completion of the WORK.

E. All materials and equipment incorporated into the WORK shall be of new and good quality, except as otherwise provided in the Contract Documents. If required by the ENGINEER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. The CONTRACTOR shall apply, install, connect, erect, use, clean, and condition all material and equipment in accordance with the instructions of the manufacturer and Supplier except as otherwise provided in the Contract Documents.

6.03 ADJUSTING PROGRESS SCHEDULE

A. The CONTRACTOR shall submit any adjustments in the progress schedule to the ENGINEER for acceptance in accordance with the provisions for "Contractor Submittals" in the Technical Specifications.

6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below:

1. “Or-Equal” Items: If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an “or-equal” item, in which case review and approval of the proposed item may, in ENGINEER’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.04.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

   a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is a least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

   b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Document.

2. Substitute Items

   a. If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an “or-equal” item under paragraph 6.04.A.1, it will be considered a proposed substitute item.

   b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

c. The procedure for review by ENGINEER will be as set forth in paragraph 6.04.A.2.d, as supplemented in the Technical Specifications and as ENGINEER may decide is appropriate under the circumstances.

d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute item is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in

ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.04.A.2.

C. Engineer's Evaluation: ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.04.A and 6.04.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. Special Guarantee: OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. ENGINEER's Cost Reimbursement: ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.04.A.2 and 6.04.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluation each such proposed substitute.

F. CONTRACTOR's EXPENSE: CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.05 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

A. The CONTRACTOR shall be responsible to the OWNER and the ENGINEER for the acts and omissions of its subcontractors and their employees to the same extent as the CONTRACTOR is responsible for the acts and omissions of its own employees. Nothing contained in this paragraph shall create any contractual relationship between any subcontractor and the OWNER or the ENGINEER nor relieve the CONTRACTOR of any liability or obligation under the Agreement.

6.06 PERMITS

A. Unless otherwise provided in the Supplementary General Conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including furnishing the insurance and bonds required by such agencies. The costs incurred by the CONTRACTOR in compliance with this paragraph shall not be made the basis for claims for additional compensation. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the WORK, which are applicable at the time of opening of Bids, including all utility connection charges for utilities required by the WORK.

B. The CONTRACTOR shall pay all license fees and royalties and assume all costs when any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others when issued in the construction of the WORK or incorporated into the WORK. If a particular invention, design, process, product, or device is specified in the Contract Documents for incorporation into or use in the construction of the WORK and if to the actual knowledge of the OWNER or the ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of these rights shall be disclosed by the OWNER in the Contract Documents. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER and the ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the WORK or resulting from the incorporation in the WORK of any invention, design, process, product, or device not specified in the Contract Documents.

6.07 LAWS AND REGULATIONS

A. The CONTRACTOR shall observe and comply with all federal, state, and local laws, ordinances, codes, orders, and regulations which in any manner affect those engaged or employed on the WORK, the materials used in the WORK, or the conduct of the WORK. If any discrepancy or inconsistency should be discovered in the Contract Documents in relation to any law, ordinance, code, order, or regulations, the CONTRACTOR shall report the same in writing to the ENGINEER. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims and from violation of any law, ordinance, code, order, or regulation, whether by CONTRACTOR or by its employees or subcontractors. Any particular law or regulation specified or referred to elsewhere in the Contract Documents shall not in any way limit the obligation of the CONTRACTOR to comply with all other provisions of federal, state, and local laws and regulations. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provision of said State act shall control.

6.08 EQUAL OPPORTUNITY

A. The Contractor agrees to abide by: the provisions of Title VII of the Civil Rights Act of 1964 (42USC § § 2000e et seq.), which prohibits discrimination against any employee or applicant for employment on the basis of race, religion, color, or national origin; Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90, which prohibits discrimination on the basis of age; Section 504 of the Rehabilitation Act of 1973, (42 USC § 794), which prohibits discrimination on the basis of handicap; Utah Executive Order dated June 30, 1989, which prohibits sexual harassment in the workplace; and the Americans with Disabilities Act (42 USC § § 12111 et seq.), which prohibits discrimination against qualified employees and applicants with a disability.

6.09 TAXES

A. The CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by the CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the WORK.

6.10 USE OF PREMISES

A. The CONTRACTOR shall confine construction equipment, stored materials and equipment, and other operations of workers to (1) the Project site, (2) the land and areas identified for the CONTRACTOR's use in the Contract Documents, and (3) other lands whose use is acquired by Laws and Regulations, rights-of-way, permits, and easements. The CONTRACTOR shall be fully responsible to the owner and occupant of such lands for any damage to the lands or areas contiguous thereto, resulting from the performance of the WORK or otherwise. Should any claim be made against the OWNER or the ENGINEER by owner or occupant of lands because of the performance of the WORK, the CONTRACTOR shall promptly settle the claim by agreement, or resolve the claim through litigation. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend, and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals and court costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any owner or occupant of land against the OWNER or the ENGINEER to the extent the claim is based or arises out of the CONTRACTOR's performance of the WORK.

6.11 SAFETY AND PROTECTION

A. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the WORK and other persons and organizations who may be affected thereby.

2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. The CONTRACTOR shall comply with all applicable Laws and Regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Unless the CONTRACTOR otherwise designates in writing a different individual as the responsible individual, the CONTRACTOR's superintendent shall be CONTRACTOR's representative at the site whose duty shall be the prevention of accidents.

6.12 SHOP DRAWINGS AND SAMPLES

A. After checking and verifying all field measurements and after complying with the applicable procedures specified in the Technical Specifications, the CONTRACTOR shall submit all shop drawings to the ENGINEER for review and approval in accordance with the approved schedule for shop drawings submittals specified in the Technical Specifications.

B. The CONTRACTOR shall also submit to the ENGINEER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the Technical Specifications.

C. Before submitting shop drawings or samples, the CONTRACTOR shall determine and verify all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and review or coordinate each shop drawing or sample with other shop drawings and samples and with the requirements of the WORK and the Contract Documents.

6.13 CONTINUING THE WORK

A. The CONTRACTOR shall carry on the WORK and adhere to the progress schedule during all disputes or disagreements with the OWNER. No work shall be delayed or postponed pending resolution of any dispute or disagreement, except as the CONTRACTOR and the OWNER may otherwise mutually agree in writing.

6.14 INDEMNIFICATION

A. To the fullest extent permitted by Laws and Regulations, the CONTRACTOR shall indemnify, defend, and hold harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of the Agreement or any performance of the WORK, but not from the sole negligence or willful misconduct of the OWNER and/or the ENGINEER. Such indemnification by the CONTRACTOR shall include but not be limited to the following:

1. Liability or claims resulting directly or indirectly from the negligence or carelessness of the CONTRACTOR or its agents in the performance of the WORK, or in guarding or maintaining the same, or from any improper materials, implements, or appliances used in its construction, or by or on account of any act or omission of the CONTRACTOR or its agents;

2. Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the CONTRACTOR or its agents;

3. Liability or claims arising directly or indirectly from the use or manufacture by the CONTRACTOR, its agents, or the OWNER in the performance of this Agreement of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Agreement.

4. Liability or claims arising directly or indirectly from the breach of any warranties, whether express or implied, made to the OWNER or any other parties by the CONTRACTOR or its agents;

5. Liabilities or claims arising directly or indirectly from the willful misconduct of the CONTRACTOR or its agents; and,

6. Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the CONTRACTOR.

B. The CONTRACTOR shall reimburse the OWNER, and the ENGINEER for all costs and expense, (including but not limited to fees and charges of engineers, architects, attorneys, and other professional and court costs) incurred by the OWNER, and the ENGINEER in enforcing the provisions of this Paragraph.

C. The indemnification obligation under this Paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any such subcontractor or other person or organization under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.15 CONTRACTOR'S DAILY REPORTS

A. The CONTRACTOR shall complete a daily report indicating manpower, major equipment, subcontractors, weather conditions, etc., involved in the performance of the WORK. The daily report shall be completed on forms prepared by the CONTRACTOR and acceptable to the ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

6.16 ASSIGNMENT OF CONTRACT

A. The CONTRACTOR shall not assign, sublet, sell, transfer, or otherwise dispose of the Agreement or any portion thereof, or its right, title, or interested therein, or obligations thereunder, without the written consent of the OWNER except as imposed by law. If the CONTRACTOR violates this provision, the Agreement may be terminated at the option of the OWNER. In such event, the OWNER shall be relieved of all liability and obligations to the CONTRACTOR and to its assignee or transferee, growing out of such termination.

GENERAL CONDITIONS

ARTICLE 7 - OTHER WORK

7.01 RELATED WORK

A. The OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners, or let other direct contracts for the performance of the other work which may contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contact Documents, written notice thereof will be given to the CONTRACTOR prior to commencing any other work.

B. The CONTRACTOR shall afford each utility owner and other contractor who is a party to a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of the other work. The CONTRACTOR shall properly connect and coordinate the WORK with the other work. The CONTRACTOR shall do all cutting, fitting, and patching of the WORK that may be required to make its several parts come together properly and integrate with the other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of the ENGINEER and the others whose work will be affected.

C. If the proper execution or results of any part of the CONTRACTOR's work depends upon the integration of work with the completion of other work by any other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and report to the ENGINEER in writing all delays, defects, or deficiencies in the other work that renders it unavailable or unsuitable for proper integration with the CONTRACTOR's work. Except for the results or effects of latent or nonapparent defects and deficiencies in the other work, the CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with the CONTRACTOR's work and as a waiver of any claim for additional time or compensation associated with the integration of the CONTRACTOR's work with the other work.

7.02 COORDINATION

A. If the OWNER contracts with others for the performance of other work on the Project at the site, a coordinator will be identified to the extent that the coordinator can be identified at this time, in the Supplementary General Conditions and delegated the authority and responsibility for coordination of the activities among the various contractors. The specific matters over which the coordinator has authority and the extent of the coordinator's authority and responsibility will be itemized in the Supplementary General Conditions or in a notice to the CONTRACTOR at such time as the identity of the coordinator is determined.

GENERAL CONDITIONS

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

A. The OWNER shall issue all its communications to the CONTRACTOR through the ENGINEER.

8.02 PAYMENTS

A. The OWNER shall make payments to the CONTRACTOR as provided in Paragraphs 14.05 and 14.09.

8.03 LANDS, EASEMENTS, AND SURVEYS

A. The OWNER's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. The OWNER shall identify and make available to the CONTRACTOR copies of exploration reports and subsurface conditions tests at the site and in existing structures which have been utilized by the ENGINEER in preparing the Drawings and Technical Specifications as set forth in Paragraph 4.02

8.04 CHANGE ORDERS

A. The OWNER shall execute approved Change Orders for the conditions described in Paragraph 10.01D.

8.05 INSPECTIONS AND TESTS

A. The OWNER's responsibility with respect to inspection, tests, and approvals is set forth in Paragraph 13.03B.

8.06 SUSPENSION OF WORK

A. In connection with the OWNER's right to stop work or suspend work, see Paragraphs 13.04 and 15.01. Paragraphs 15.02 and 15.03 deal with the OWNER's right to terminate services of the CONTRACTOR under certain circumstances.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

A. The ENGINEER will be the OWNER's representative during the construction period. The duties, responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in a separate agreement with the OWNER and are summarized hereafter.

9.02 VISITS TO SITE

A. The ENGINEER will make visits to the site during construction to observe and inspect the progress and quality of the WORK and to determine, in general if the WORK is proceeding in accordance with the Contract Documents.

9.03 PROJECT REPRESENTATION

A. The ENGINEER will furnish a Project Representative to observe and inspect the performance of the WORK. The Project Representative and/or other authorized agents of the Engineer shall serve as the chief Owner/Engineer contact(s) with the Contractor during the construction phase. All submittals shall be delivered to and communications between the Engineer and the Contractor shall be handled by the Project Representative and/or other authorized agents. The Project Representative shall be the chief authorized representative of the Owner and the Engineer at the site of the work in all on-site relations with the Contractor.

9.04 CLARIFICATIONS AND INTERPRETATIONS

A. The ENGINEER will issue with reasonable promptness written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK

A. The ENGINEER may authorize minor variation in the WORK as described in the Contact Documents when such variations do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These variations shall be accomplished by issuing a Field Order. The issuance of a Field Order requires the CONTRACTOR to perform the work described in the order promptly. If the

CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and parties are unable to agree as the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

9.06 REJECTION OF DEFECTIVE WORK

A. The ENGINEER is authorized to reject work which the ENGINEER believes to be defective and require special inspection or testing of the WORK as provided in Paragraph 13.03G, whether or not the WORK is fabricated, installed, or completed.

9.07 CONTRACTOR SUBMITTALS, CHANGE ORDERS, AND PAYMENTS

A. The ENGINEER will review for approval all Contractor submittals, including shop drawings, samples, substitutes, and "or equal" items, etc., in accordance with the procedures set forth in the Technical Specifications.

B. In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11, and 12.

C. In connection with the ENGINEER's responsibilities with respect to Applications for Payment, see Article 14.

9.08 DECISIONS ON DISPUTES

A. All claims, disputes, and other matters concerning the acceptability of the WORK, the interpretation of the requirements of the Contract Documents pertaining to the performance of the WORK, and claims for changes in the Contract Price or Contract Time under Articles 11 and 12 will be referred to the ENGINEER in writing with a request for formal decision in accordance with this paragraph. The ENGINEER will render a decision in writing within 30 days of receipt of the request. Written notice of each claim, dispute, or other matter will be delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the ENGINEER with the written claim unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

B. When reviewing the claim or dispute, the ENGINEER will not show partiality to the OWNER or the CONTRACTOR and will incur no liability in connection with any interpretation or decision rendered in good faith. The ENGINEER's rendering of a decision with respect to any claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in Paragraph 14.12) shall be a condition precedent to the OWNER's or the CONTRACTOR's exercise of their rights or remedies under the Contract Documents or by Law or Regulations with respect to the claim, dispute, or other matter.

9.09 LIMITATION ON ENGINEER'S RESPONSIBILITIES

A. Neither the ENGINEER's authority to act pursuant to its agreement with the OWNER, nor the description of that authority under this Article 9, nor any other description of the ENGINEER's responsibility in the Contract Documents, nor any decision made by the ENGINEER in good faith either to exercise or not exercise its authority, shall give rise to any duty or responsibility on the part of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, any surety or any other person or organization performing any part of the WORK.

B. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," as allowed," "as reviewed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgement of the ENGINEER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the ENGINEER any duty or authority to supervise or direct the performance of the WORK or any duty or authority to undertake responsibility contrary to the provisions of its agreement with the OWNER.

C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contact Documents or the safety precautions and programs incident thereto.

D. The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR nor of any subcontractor, supplier, or any other person or organization performing any of the WORK to the extent that such acts or omissions are not reasonably discoverable considering the level of observation and inspection required by the ENGINEER's agreement with the OWNER.

ARTICLE 10 - CHANGES IN THE WORK

10.01 GENERAL

A. Without invalidating the Agreement and without notice to any surety, the OWNER may at any time or from time to time, order additions, deletions, or revisions in the WORK; these will be authorized by a written Field Order and/or a Change Order issued by the ENGINEER. Upon receipt of any of these documents, the CONTRACTOR shall promptly proceed with the work involved pursuant to the applicable conditions of the Contract Documents.

B. If the OWNER and the CONTRACTOR are unable to agree upon the increase or decrease in the Contract Price or an extension or shortening of the Contract Time, if any, that should be allowed as a result of a Field Order, a claim may be made therefor as provided in Articles 11 or 12.

C. The CONTRACTOR shall not be entitled to an increase in the Contract Price nor an extension of the Contract Time with respect to any work performed that is not required by the Contact Documents as amended, modified, or supplemented by Change Order, except in the case of an emergency and except in the case of uncovering work provided in the Paragraph 13.03G.

D. The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:

1. Changes in the WORK which are ordered by the OWNER pursuant to Paragraph 10.01A;

2. Changes required because of acceptance of defective work under Paragraph 13.06;

3. Changes in the Contract Price or Contact Time which are agreed to by the parties; or

4. Any other changes agreed to by the parties.

E. If the provisions of any Bond require notice of any change to be given to a surety, the giving of these notices will be the CONTRACTOR's responsibility. The CONTRACTOR shall provide for the amount of each applicable Bond to be adjusted accordingly.

10.02 ALLOWABLE QUANTITY VARIATIONS

A. Whenever a unit price and quantity have been established for a bid item in the Contract Documents, the quantity stated may be increased or decreased to a maximum of 25 percent with no change in the unit price. An adjustment in the quantity in excess of 25 percent will be sufficient to justify a change in the unit price. Changes in the quantity of all bid items established in the Contract Documents, regardless of whether the changes are more or less than 25 percent and at the unit price established in the Contract Documents or adjusted otherwise, shall be documented by Change Orders.

B. In the event a part of the WORK is to be entirely eliminated and no lump sum or unit price is named in the Contract Documents to cover the eliminated work, the price of the eliminated work shall be agreed upon in writing by the OWNER and the CONTRACTOR. If the OWNER and the CONTRACTOR fail to agree upon the price of the eliminated work, the price shall be determined in accordance with the provisions of Article 11.

ARTICLE 11 - CHANGE OF CONTRACT PRICE

11.01 GENERAL

A. The Contact Price constitutes the total compensation payable to the CONTRACTOR for performing the WORK. Except as directed by Change Orders, all duties, responsibilities, and obligations assigned to or undertaken by the CONTRACTOR shall be at its expense without change in the Contract Price.

B. The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contact Price shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered with the claim, unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of the event. If the OWNER and the CONTRACTOR cannot otherwise agree on the amount involved, all claims for adjustment in the Contract Price shall be determined by the ENGINEER in accordance with Paragraph 9.08A. No claim for an adjustment in the Contact Price will be valid if not submitted in accordance with this Paragraph 11.01B.

C. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contact Price shall be determined in one of the following ways:

1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.

2. By mutual acceptance of a lump sum, which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.

3. On the basis of the cost of work (determined as provided in Paragraphs 11.02 and 11.03) plus a CONTRACTOR's fee for overhead and profit (determined as provided in Paragraph 11.04).

11.02 COST OF WORK (BASED ON TIME AND MATERIALS)

A. General: The term "cost of work" means the sum of all costs necessarily incurred and paid by the CONTRACTOR for labor, materials, and equipment in the proper performance of work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project.

B. Labor: The cost of labor used in performing work by the CONTRACTOR, a subcontractor, or other forces will be the sum of the following:

1. The actual wages paid plus any employer payments to, or on behalf of workers for fringe benefits including health and welfare, pension, vacation, and similar purposes. The cost of labor may include the rates paid to foremen when determined by the ENGINEER that the services of foremen do not constitute a part of the overhead allowance.

2. All payments imposed by state and federal laws including, but not limited to, compensation insurance, and social security payments.

3. The amount paid for subsistence and travel required by collective bargaining agreements, or in accordance with the regular practice of the employer.

At the beginning of the extra work and as later requested by the ENGINEER, the CONTRACTOR shall furnish the ENGINEER proof of labor compensation rates being paid.

C. Materials: The cost of materials used in performing work will be the cost to the purchaser, whether CONTRACTOR or subcontractor, from the supplier thereof, except as the following are applicable:

1. Trade discounts available to the purchase shall be credited to the OWNER notwithstanding the fact that such discounts may not have been taken by the CONTRACTOR.

2. For materials secured by other than a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid to the actual supplier as determined by the ENGINEER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

3. Payment for materials from sources owned wholly or in part by the purchaser shall not exceed the price paid by the purchaser for similar materials from these sources on extra work items or current wholesale price for the materials delivered to the work site, whichever is lower.

4. If in the opinion of the ENGINEER the cost of material is excessive, or the CONTRACTOR does not furnish satisfactory evidence of the cost of the material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned, delivered to the work site less trade discount. The OWNER reserves the right to furnish materials for the extra work and no claim shall be made by the CONTRACTOR for costs and profit on such materials.

D. Equipment: The CONTRACTOR will be paid for the use of equipment at the rental rate listed for the equipment specified in the Supplementary General Conditions. The rental rate will be used to compute payments for equipment whether the equipment is under the CONTRACTOR's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use. If it is deemed necessary by the CONTRACTOR to use equipment not listed in the Supplementary General Conditions an equitable rental rate for the equipment will be established by the ENGINEER. The CONTRACTOR may furnish cost data which might assist the ENGINEER in the establishing the rental rate.

1. All equipment shall, in the opinion of the ENGINEER, be in good working condition and suitable for the purpose for which the equipment is to be used.

2. Before construction equipment is used on the extra work, the CONTRACTOR shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the ENGINEER, in duplicate, a description of the equipment and its identifying number.

3. Unless otherwise specified, manufacturers' ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

4. Individual pieces of equipment or tools having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefore.

5. Rental time will not be allowed while equipment is inoperative due to breakdowns.

E. Equipment on the Work: The rental time to be paid for equipment used on the WORK shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location that requires no more moving time than that required to return it to its original location. Moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. However, no payment will be made for loading and transporting costs when the equipment is used on other than the extra work even though located at the site of the extra work. The following shall be used in computing the rental time of equipment on the WORK.

1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be 1/2-hour of operation, and any part of an hour in excess of 30 minutes will be considered one hour of operation.

2. When daily rates are listed, any part of a day less than 4 hours operation shall be considered to be 1/2-day of operation. When owner-operated equipment is used to perform extra work to be paid for on a time and materials basis, the CONTRACTOR will be paid for the equipment and operator, as set forth in Paragraph (3), (4), and (5), following.

3. Payment for the equipment will be made in accordance with the provisions in Paragraph 11.02D, herein.

4. Payment for the cost of labor and subsistence or travel allowance will be made at the rates paid by the CONTRACTOR to other workers operating similar equipment already on the WORK, or in the absence of such labor, established by collective bargaining agreements for the type of workmen and location of the extra work, whether or not the operator is actually covered by such an agreement. A labor surcharge will be added to the cost of labor described herein in accordance with the provisions of Paragraph 11.02B, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all payments made to on behalf of workers other than actual wages.

5. To the direct cost of equipment rental and labor, computed as provided herein, will be added the allowances for equipment rental and labor as provided in Paragraph 11.04, herein.

11.03 SPECIAL SERVICES

A. Special work or services are defined as that work characterized by extraordinary complexity, sophistication, or innovation or a combination of the foregoing attributes which are unique to the construction industry. The following may be considered by the ENGINEER in making estimates for payment for special services:

1. When the ENGINEER and the CONTRACTOR, by agreement, determine that a special service or work is required which cannot be performed by the forces of the CONTRACTOR or those of any of its subcontractors, the special service or work may be performed by an entity especially skilled in the work to be performed. After validation of invoices and termination of market values by the ENGINEER, invoices for special services or work based upon the current fair market value thereof may be accepted without complete itemization of labor, material, and equipment rental cost.

2. When the CONTRACTOR is required to perform work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, the charges for that portion of the work performed at the off-site facility may by agreement, be accepted as a special service and accordingly, the invoices from the work may be accepted without detailed itemization.

3. All invoices for special services will be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit specified in Paragraph 11.04, herein, an allowance of 5 percent will be added to invoices for special services.

B. All work performed hereunder shall be subject to all of the provisions of the Contract Documents and the CONTRACTOR's sureties shall be bound with reference hereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the OWNER for review prior to the performance of any work hereunder.

11.04 CONTRACTOR'S FEE

A. WORK ordered on the basis of time and materials will be paid for at the actual necessary cost as determined by the ENGINEER, plus allowances for overhead and profit. For extra work involving a combination of increases and decreases in the WORK the actual necessary cost will be the arithmetic sum of the additive and deductive costs. The allowance for overhead and profit shall include full compensation for superintendence, bond and insurance premiums, taxes, office expenses, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.02B, C, and D, herein including extended overhead and home office overhead. The allowance for overhead and profit will be made in accordance with the following schedule:

ACTUAL NECESSARY COST OVERHEAD AND PROFIT ALLOWANCE

Labor .... 10 percent

Materials .... 10 percent

Equipment .... 10 percent

B. It is understood that labor, materials, and equipment may be furnished by the CONTRACTOR or by the subcontractor, the allowance specified herein shall be applied to the labor, materials, and equipment costs of the subcontractor, to which the CONTRACTOR may add 5 percent of the subcontractor's total cost for the extra work. Regardless of the number of hierarchical tiers of subcontractors, the 5 percent increase above the subcontractor's total cost which includes the allowances for overhead and profit specified herein may be applied one time only for each separate work transaction.

ARTICLE 12 - CHANGE OF CONTRACT TIME

12.01 GENERAL

A. The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract time shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's written statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with Paragraph 9.08 if the OWNER and the CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this Paragraph 12.01A.

B. The Contract Time will be extended in an amount equal to time lost if the CONTRACTOR makes a claim as provided in Paragraph 12.01A and the ENGINEER determines that the delay was caused by events beyond the control of the CONTRACTOR. Examples of events beyond the control of the CONTRACTOR include acts or neglect by the OWNER or others performing additional work as contemplated by Article 7, or by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, sabotage, or freight embargoes.

C. All time limits stated in the Contract Documents are of the essence.

D. None of the aforesaid time extensions shall entitle the CONTRACTOR to any adjustment in the Contract Price or any damages for delay. Furthermore, the CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees from and against all claims, damages, losses and expenses (including lost property and attorney's fees) arising out of or resulting from the temporary suspension of work whether for the OWNER's convenience as defined in Article 15.01 (a) or for whatever other reasons including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

12.02 EXTENSIONS OF THE TIME FOR DELAY DUE TO INCLEMENT WEATHER

A. "Inclement weather" is any weather condition or conditions resulting immediately therefrom, causing the CONTRACTOR to suspend construction operations or preventing the CONTRACTOR from proceeding with at least 75 percent of the normal labor and equipment force engaged on the WORK.

B. Should the CONTRACTOR prepare to begin work at the regular starting time at the beginning of any regular work shift on any day on which inclement weather, or its effects on the condition of the WORK prevents work from beginning at the usual starting time and the crew is dismissed as a result thereof, the CONTRACTOR will not be charged for a working day whether or not conditions change thereafter during the day and the major portion of the day could be considered to be suitable for construction operations.

C. The CONTRACTOR shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in the paragraph entitled "Inclement weather delays" of the Supplementary General Conditions. No extension of the Contract Time due to inclement weather will be considered until after the stated number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if the number of inclement weather days is not reached.

12.03 EXTENSIONS OF TIME FOR OTHER DELAYS

A. If the CONTRACTOR is delayed in completion of the WORK beyond the time named in the Contract Documents for the completion of the WORK, by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, industry-wide shortage of raw materials, sabotage or freight embargoes, the CONTRACTOR shall be entitled to an adjustment in the Contract Time. No such adjustment will be made unless the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The ENGINEER shall ascertain the facts and the extent of the delay. No adjustment in time shall be made for delays resulting from noncompliance with the Contract, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract including failure to provide materials, equipment or workmanship meeting the requirements of the Contract Documents; the occurrence of such events shall not relieve the CONTRACTOR from the necessity of maintaining the required progress.

B. In the event that Contract completion is delayed beyond the Contract Time named in the Specifications by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to an adjustment in the Contract Time in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER; provided, however, that the CONTRACTOR shall furnish documentation acceptable to the OWNER and ENGINEER that he placed or attempted to place firm orders with suppliers at a reasonable time in advance of the required date of delivery of the items in question, that such shortages shall have developed following the date such orders were placed or attempts made to place same, that said shortages are general throughout the affected industry, that said shortages are shortages of raw materials required to manufacture CONTRACTOR-furnished items and not simply failure of CONTRACTOR's suppliers to manufacture, assemble or ship items on time, and that the CONTRACTOR shall, to the degree possible, have made revisions in the sequence of his operations, within the terms of the Contract, to offset the expected delay. The CONTRACTOR shall notify the ENGINEER, in writing, concerning the cause of delay, within 15 calendar days of the beginning of such delay. The validity of any claim by the CONTRACTOR to an adjustment in the Contract Time shall be determined by the OWNER acting through the ENGINEER, and his findings thereon shall be based on the ENGINEER's knowledge and observations of the events involved and documentation submitted by the CONTRACTOR, showing all applicable facts relative to the foregoing provisions. Only the physical shortage of raw materials will be considered under these provisions as a cause for adjustment of time and no consideration will be given to any claim that items could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the OWNER that such items could have been obtained only at exorbitant prices entirely out of line with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

C. If the CONTRACTOR is delayed in completion of the WORK by reason of changes made under the provisions of Article 10 or changed conditions as provided under Article 4.03, or by failure of the OWNER to acquire or clear right-of-way as provided under Article 15.01, or by any act of the ENGINEER or of the OWNER, not contemplated by the Contract, an adjustment in the Contract time will be made by the OWNER in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER, except, that if the WORK is increased as a result of changes, the OWNER, at his sole discretion, may grant an adjustment in the number of calendar days for completion of the Contract. In the event of such delay, the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

GENERAL CONDITIONS

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

13.01 WARRANTY, GUARANTEE AND MAINTENANCE PERIOD

A. The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all work, equipment, materials and workmanship are in accordance with the Contract Documents and are not defective. Prompt notice of defects discovered by the OWNER or ENGINEER shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

B. If within one (1) year after the date of Final Completion, as set by the Engineer's Notice of Completion, or a longer period of time prescribed by Laws or Regulations or by the terms of any applicable special guarantee or specific provisions of the Contract Documents, any work is found to be defective, the OWNER shall notify the CONTRACTOR in writing and the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written notification, either correct the defective work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective work. In the event the CONTRACTOR does not promptly comply with the notification, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective work corrected or rejected work removed and replaced. All direct, indirect, and consequential costs of the removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the CONTRACTOR. This paragraph shall not be construed to limit nor diminish the CONTRACTOR's absolute guarantee to complete the WORK in accordance with the Contract Documents.

13.02 ACCESS TO WORK

A. The ENGINEER, other representatives of the OWNER, testing agencies, and governmental agencies with jurisdictional interests shall have access to the work at reasonable times for their observation, inspections, and testing. The CONTRACTOR shall provide proper and safe conditions for their access.

13.03 TESTS AND INSPECTIONS

A. The CONTRACTOR shall give the ENGINEER timely notice of readiness of the WORK for all required inspections, tests, or approvals.

B. If Laws or Regulations of any public body other than the OWNER, with jurisdiction over the WORK require any work to be specifically inspected, tested, or approved, the CONTRACTOR shall pay all costs in connection therewith. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the OWNER's or the ENGINEER's acceptance of a Supplier of materials or equipment proposed as a substitution or-equal to be incorporated in the WORK and of materials or equipment submitted for review prior to the CONTRACTOR's purchase for incorporation in the WORK. The cost of all inspections, tests, and approvals with the exception of the above which are required by the Contract Documents shall be paid by the OWNER (unless otherwise specified).

C. The ENGINEER will make, or have made, such inspections and test as the ENGINEER deems necessary to see that the WORK is being accomplished in accordance with the requirements of the Contract Documents. The Contractor without additional cost to the OWNER, shall provide the labor and equipment necessary to make the WORK available for inspections. Unless otherwise specified in the Supplementary General Conditions or the OWNER-ENGINEER Agreement, all other costs of inspection and testing will be borne by the OWNER. In the event the inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the ENGINEER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the ENGINEER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

D. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by properly licensed organizations selected by the OWNER.

E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the ENGINEER's written authorization, it must, if requested by the ENGINEER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the ENGINEER of the CONTRACTOR's intention to cover the same and the ENGINEER failed to act with reasonable promptness in response to the notice.

F. In any work is covered contrary to the written request of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER's observation and replaced at the CONTRACTOR's expense.

G. If the ENGINEER considers it necessary or advisable that covered work be observed, inspected or tested by the ENGINEER or others, the ENGINEER shall direct the CONTRACTOR to uncover, expose, or otherwise make available for observation, inspection, or testing that portion of the work in question. The CONTRACTOR shall comply with the ENGINEER's direction and furnish all necessary labor, material, and equipment. If found the work is defective, the CONTRACTOR shall bear all direct, indirect and consequential costs of uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction of the work, including but not limited to fees and charges for engineers, architects, attorneys, and other professionals. However, if the work is not defective, the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both. The increase in Contract Time and Contract Price shall be the CONTRACTOR's actual time and costs directly attributable to uncovering and exposing the work. If the parties are unable to agree as to the amount or extent of the changes, the CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

13.04 OWNER MAY STOP THE WORK

A. If the WORK is defective, or the CONTRACTOR fails to perform work in such a way that the completed WORK will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the WORK, or any portion thereof, until the cause for the order has been eliminated. This right of the OWNER to stop the WORK shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

13.05 CORRECTION OR REMOVAL OF DEFECTIVE WORK

A. When directed by the ENGINEER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the work has been rejected by the ENGINEER, remove it from the site and replace it with non-defective work. The CONTRACTOR shall bear all direct, indirect and consequential costs of correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

13.06 ACCEPTANCE OF DEFECTIVE WORK

A. If, instead of requiring correction or removal and replacement of defective work, the OWNER prefers to accept the work, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the OWNER's evaluation of and determination to accept the defective work. If any acceptance of defective work occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contact Documents with respect to the WORK, and the OWNER shall be entitled to an appropriate decrease in the Contract Price.

ARTICLE 14 - PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 SCHEDULE OF VALUES (LUMP SUM PRICE BREAKDOWN)

A. The schedule of values or lump sum price breakdown established as provided in the Technical Specifications shall serve as the basis for progress payments and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID SCHEDULE

A. Progress payments for unit price work will be based on the number of units completed.

14.03 APPLICATION FOR PROGRESS PAYMENT

A. Unless otherwise prescribed by the Owner, on the 25th of each month, the CONTRACTOR shall submit to the ENGINEER for review and approval, an Application for Payment completed and signed by the CONTRACTOR covering the WORK completed as of the date of the Application and accompanied by such supporting documentation as required by the Contract Documents.

B. The Application for Payment shall identify, as a sub-total, the amount of the CONTRACTOR's Total Earnings to Date, plus the Value of Materials at the Site which have not yet been incorporated in the WORK, and less a deductive adjustment for materials installed which were not previously incorporated in the WORK, but for which payment was allowed under the provisions of payment for Materials Stored at the Site but not yet incorporated in the WORK.

C. The Net Payment Due to the CONTRACTOR shall be the above-mentioned sub-total, from which shall be deducted the retainage amount and the total amount of all previous payments made to the CONTRACTOR.

D. The OWNER may withhold and retain 5% of each approved progress payment to the CONTRACTOR. The total retention proceeds withheld shall not exceed 5% of the total construction price. All retention proceeds shall be placed by the OWNER in an interest-bearing account. The interest accrued shall be for the benefit of the CONTRACTOR and its subcontractors, and it shall be paid after the WORK has been completed and accepted by the OWNER. CONTRACTOR shall ensure that any interest accrued on the retainage is distributed by the CONTRACTOR to its subcontractors on a pro rata basis.

E. Any retention proceeds withheld, and any accrued interest, shall be released by the OWNER pursuant to an Application for Payment from the CONTRACTOR within 45 days from the later of:

1. the date the OWNER receives the final Application for Payment from the CONTRACTOR;

2. the date that a certificate of occupancy or final acceptance notice is issued to:

   (a) the Contractor who obtained the building permit from the building inspector or from a public agency;

   (b) the OWNER; or

   (c) the ENGINEER.

3. the date the CONTRACTOR accepts final payment for the Work; or

4. the date that a public agency or building inspector having authority to issue its own certificate of occupancy does not issue the certificate but permits partial or complete occupancy of a newly constructed or remodeled building; provided, however, that if only partial occupancy of a building is permitted, any retention proceeds withheld and retained, and any accrued interest, shall be partially released in direct proportion to the value of the part of the building occupied.

Each Application for Payment from the CONTRACTOR shall include documentation of lien releases or waivers.

F. Notwithstanding any other provision in this Article to the contrary,

1. If the CONTRACTOR is in default or breach of the terms and conditions of the Contract Documents, the OWNER may withhold from payment to the CONTRACTOR for so long as reasonably necessary an amount necessary to cure the breach or default of the CONTRACTOR; or

2. If the WORK or a portion of the WORK has been substantially completed, the OWNER may retain until completion up to twice the

fair market value of the WORK of the CONTRACTOR that has not been completed:

(a) in accordance with the Contract Documents; or

(b) in the absence of applicable provisions in the Contract Documents to generally accepted craft standards.

3. If the OWNER refuses payment under subparagraphs (F)(i) or (ii), it shall describe in writing within 45 days of withholding such amounts what portion of the WORK was not completed according to the standards specified in the Contract Documents.

G. The CONTRACTOR shall distribute retention proceeds as outlined below:

1. Except as provided in Paragraph 14.03.G.2, below, if the CONTRACTOR receives retention proceeds, it shall pay each of its subcontractors from whom retention has been withheld each subcontractor’s share of the retention received within ten days from the day that all or any portion of the retention proceeds is received from the OWNER.

2. Notwithstanding Paragraph 14.03.G.1, above, if a retention payment received by the CONTRACTOR is specifically designated for a particular subcontractor, payment of the retention shall be made to the designated subcontractor.

H. Except as otherwise provided in the Supplementary General Conditions, the value of materials stored at the site shall be valued at 95 percent of the value of the materials. This amount shall be based upon the value of all acceptable materials and equipment stored at the site or at another location agreed to in writing by the OWNER; provided, each individual item has a value of more than $5,000 and will become a permanent part of the WORK. The Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that the CONTRACTOR has received the materials and equipment free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the OWNER's interest therein, all of which will be satisfactory to the OWNER.

14.04 CONTRACTOR'S WARRANTY OF TITLE

A. The CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by an Application for Payment, whether incorporated in the WORK or not, will pass to the OWNER no later than the time of final payment free and clear of all liens.

14.05 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

A. The ENGINEER will, within 7 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the ENGINEER's reasons for refusing to recommend payment. In the later case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with the ENGINEER's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR.

B. The OWNER may refuse to make payment of the full amount recommended by the ENGINEER to compensate for claims made by the OWNER on account of the CONTRACTOR's performance of the WORK or other items entitling the OWNER to a credit against the amount recommended, but the OWNER must give the CONTRACTOR written notice within 7 days (with a copy to the ENGINEER) stating the reasons for such action.

14.06 PARTIAL UTILIZATION

A. The OWNER may utilize or place into service any item of equipment or other usable portion of the WORK at any time prior to completion of the WORK. The OWNER shall notify the CONTRACTOR in writing of its intent to exercise this right. The notice will identify the equipment or specific portion or portions of the WORK to be utilized or otherwise placed into service.

B. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all items or portions of the WORK to be partially utilized shall be borne by the CONTRACTOR. Upon the issuance of a notice of partial utilization, the ENGINEER will deliver to the OWNER and the CONTRACTOR a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's aforesaid recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The CONTRACTOR shall retain full responsibility for satisfactory completion of the WORK, regardless of whether a portion thereof has been partially utilized by the OWNER and the CONTRACTOR's one year correction period shall commence only after the date of Final Completion for the WORK.

14.07 LIQUIDATED DAMAGES

A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplemental General Conditions, not as a penalty but as liquidated damages, if he fails to complete the WORK or specified parts of the WORK within the time or times agreed upon. The periods for which these damages shall be paid shall be the number of Days from the agreed date or Contract Time as contained in the Agreement, or from the date of termination of any extension of time approved by the OWNER, to the date or dates on which the ENGINEER certifies Substantial Completion of WORK or specified parts of the WORK as provided in Article 14.08, herein. The OWNER may deduct the amount of said damages from any monies due or to become due the CONTRACTOR. After Substantial Completion, if the CONTRACTOR fails to complete the remaining WORK within 45 days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount stated in the Supplemental General Conditions as liquidated damages for each day that expires after the 45 days until readiness for final payment.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would sustain; and said amount is agreed to be the amount of damages which the OWNER would sustain. Said damages are not in lieu of but in addition to other actual or consequential damages to which the OWNER may be entitled.

C. All times specified in the Contract Documents are hereby declared to be of the essence.

14.08 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers the WORK ready for its intended use, and the CONTRACTOR has delivered to the ENGINEER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents, the CONTRACTOR may notify the OWNER and the ENGINEER in writing that the WORK is substantially complete and request that the ENGINEER prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the OWNER, the CONTRACTOR, and the ENGINEER shall make an inspection of the WORK to determine the status of completion. If the ENGINEER does not consider the WORK substantially complete, the ENGINEER will notify the OWNER and CONTRACTOR in writing giving the reasons therefor. If the ENGINEER considers the WORK substantially complete, the ENGINEER will prepare and deliver to the OWNER for its execution the Certificate of Substantial Completion signed by the ENGINEER and CONTRACTOR, which shall fix the date of Substantial Completion.

B. The Certificate of Substantial Completion shall be a release by the CONTRACTOR of the OWNER and its agents from all claims and liability to the CONTRACTOR for anything done or furnished for, or relating to, the WORK or for any act or neglect of the OWNER or of any person relating to or affecting the WORK, to the date of Substantial Completion, except demands against the OWNER for the remainder of the amounts kept or retained from progress payments and excepting pending, unresolved claims filed in writing prior to the date of Substantial Completion. At the time of delivery of the Certificate of Substantial Completion, the ENGINEER will deliver to the OWNER and the CONTRACTOR, if applicable, a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The OWNER, upon written notice to the CONTRACTOR, shall have the right to exclude the CONTRACTOR from the WORK after the date of Substantial Completion, and complete all or portions of the WORK at the CONTRACTOR's expense.

14.09 COMPLETION AND FINAL PAYMENT

A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Certificate of Substantial Completion has been issued this certification must occur within 45 days of that date), the ENGINEER will make a final inspection with the OWNER and the CONTRACTOR. If the OWNER and ENGINEER do not consider the WORK complete, the ENGINEER will notify the OWNER and the CONTRACTOR in writing of all particulars in which this inspection reveals that the WORK is incomplete or defective. The CONTRACTOR shall immediately take the measures necessary to remedy these deficiencies. If the ENGINEER and OWNER consider the WORK complete, the CONTRACTOR may proceed to file its application for final payment pursuant to this Article. At the request of the CONTRACTOR, the ENGINEER may recommend to the OWNER that certain minor deficiencies in the WORK that do not prevent the entire WORK from being used by the OWNER for its intended use, and the completion of which will be unavoidably delayed due to no fault of the CONTRACTOR, be exempted from being completed prerequisite to final payment. These outstanding items of pickup work, or "punch list items", shall be listed on the ENGINEER's Notice of Completion, together with the recommended time limits for their completion, and extended warranty requirements for those items and the value of such items.

B. After the issuance of the Notice of Completion and after the CONTRACTOR has completed corrections that have not been exempted to the satisfaction of the ENGINEER and delivered to the ENGINEER all required additions and modifications to maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents; and after the ENGINEER has indicated that the WORK is acceptable, the CONTRACTOR may make application for final payment following the procedure for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents and other data and schedules as the OWNER or ENGINEER may reasonably require, including an affidavit of the CONTRACTOR that all labor, services, material, equipment and other indebtedness connected with the WORK for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, and a consent of the payment bond surety to final payment, all in forms approved by the OWNER.

14.10 FINAL APPLICATION FOR PAYMENT

A. If, on the basis of the ENGINEER's observation of the WORK during construction and final inspection, and the ENGINEER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the ENGINEER will, within ten days after receipt of the final application for payment, indicate in writing his recommendation of payment and present the application to the OWNER for payment. Thereupon, the ENGINEER will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the ENGINEER's Notice of Completion. Otherwise, the ENGINEER will return the application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the application.

B. Within 45 calendar days after the ENGINEER's filing of the Notice of Completion, the OWNER will make final payment including all deducted retainage (except as noted below) to the CONTRACTOR. The OWNER's remittance of final payment shall be the OWNER's acceptance of the WORK if formal acceptance of the WORK is not indicated otherwise. The final payment shall be that amount remaining <u>after</u> deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract, including the following items:

1. Liquidated damages, as applicable.

2. All amounts retained by the OWNER under Paragraph 14.03(F).

14.11 CONTRACTOR'S CONTINUING OBLIGATIONS

A. The CONTRACTOR's obligation to perform and complete the WORK in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a Certificate of Substantial Completion or Notice of Completion, nor payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the WORK or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review of a shop drawing or sample submittal, will constitute an acceptance of work or materials not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

14.12 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

A. Final payment is defined as the last progress payment made to the CONTRACTOR for earned funds, less deductions listed in Paragraph 14.10B herein. The acceptance by the CONTRACTOR of the final payment referred to in Paragraph 14.10 herein, shall be a release of the OWNER and its agents from all claims of liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except demands against the OWNER for the remainder, if any, of the amounts kept or retained under the provisions of Paragraph 14.10 herein; and excepting pending, unresolved claims filed prior to the date of the Certificate of Substantial Completion.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

A. The OWNER acting through the ENGINEER may, by written notice to the Contractor, temporarily suspend the WORK, in whole or in part, for a period or periods of time, but not to exceed 90 days, for the convenience and benefit of the OWNER upon the occurrence of any one or more of the following: (1) unsuitable weather; (2) delay in delivery of OWNER- furnished equipment or materials, or such other conditions as are considered unfavorable for prosecution of the work; (3) Shortfall in construction funds; (4) Constraints imposed by public entities, public utilities, property owners or legal proceedings; (5) Failure or delay in acquisition of easements or right-of-way by the OWNER; or (6) Other conditions which, in the opinion of the OWNER, warrant a delay in the WORK. Suspended WORK shall be resumed by the CONTRACTOR within 10 calendar days of receipt from the ENGINEER of written notice to proceed. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article 15.01 A, the CONTRACTOR shall be entitled to an adjustment in the Contract Time as specified in Article 12.03 C.

B. The suspension of work shall be effective upon receipt by the Contractor of the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

C. The CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees, from and against all claims, damages, losses and expenses, including lost profits and attorney's fees, arising out of or resulting from the temporary suspension of the WORK, whether for the OWNER's convenience described in this Article or for whatever other reasons, including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

15.02 TERMINATION OF AGREEMENT BY OWNER (CONTRACTOR DEFAULT)

A. In the event of default by the CONTRACTOR, the OWNER may give written notice to the CONTRACTOR of OWNER's intent to terminate the Agreement. The notice shall state the event of default and the time allowed to remedy the default. It shall be considered a default by the CONTRACTOR whenever the CONTRACTOR shall: (1) declare bankruptcy, become insolvent, or assign its assets for the benefit of its creditors; (2) fail to provide materials or workmanship meeting the requirements of the Contract Documents; (3) disregard or violate provisions of the Contract Documents or ENGINEER's instructions, (4) fail to prosecute the WORK according to the approved progress schedule; or, (5) fail to provide a qualified superintendent, competent workmen, or materials or equipment meeting the requirements of the Contract Documents. If the CONTRACTOR fails to remedy the conditions constituting default within the time allowed, the OWNER may then issue a Notice of Termination.

B. In the event the Agreement is terminated in accordance with Paragraph 15.02A, the OWNER may take possession of the WORK and may complete the WORK by whatever method or means the OWNER may select. The cost of completing the WORK shall be deducted from the balance which would have been due the CONTRACTOR had the Agreement not been terminated and the WORK completed in accordance with the Contract Documents. If such cost exceeds the balance which would have been due, the CONTRACTOR shall pay the excess amount to the OWNER. If such cost is less than the balance which would have been due, the CONTRACTOR shall have no claim to the difference.

15.03 TERMINATION OF AGREEMENT BY OWNER (FOR CONVENIENCE)

A. The OWNER may terminate the Agreement at any time if it is found that reasons beyond the control of either the OWNER or CONTRACTOR make it impossible or against the OWNER's interests to complete the WORK. In such a case, the CONTRACTOR shall have no claims against the OWNER except: (1) for the value of the work, as determined by the engineer, performed by the Contractor up to the date the Agreement is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Agreement is terminated, which would be needed in the WORK and which meet the requirements of the Contact Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned above, shall be determined by the ENGINEER in accordance with the procedure prescribed from making the final application for payment and final payment under Paragraphs 14.09 and 14.10.

15.04 TERMINATION OF AGREEMENT BY CONTRACTOR

A. The CONTRACTOR may terminate the Agreement upon 10 days written notice to the OWNER, whenever: (1) the WORK has been suspended under the provisions of Paragraph 15.01, for more than 90 consecutive days through no fault or negligence of the CONTRACTOR, and notice to resume work or to terminate the agreement has not been received from the OWNER within this time period; or, (2) the OWNER should fail to pay the

CONTRACTOR any monies due him in accordance with the terms or the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefor, unless within said 10-day period the OWNER shall have remedied the condition upon which the payment delay was based. In the event of such termination, the CONTRACTOR shall have no claims against the OWNER except for those claims specifically enumerated in Paragraph 15.03, and as determined in Accordance with the requirements of that paragraph.

GENERAL CONDITIONS

ARTICLE 16 - MISCELLANEOUS

16.01 GIVING NOTICE

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 TITLE TO MATERIALS FOUND ON THE WORK

A. The OWNER reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the WORK. Unless otherwise specified in the Contract Documents, neither the CONTRACTOR nor any subcontractor shall have any right, title, or interest in or to any such materials. The CONTRACTOR will be permitted to use in the WORK, without charge, any such materials which meet the requirements of the Contract Documents.

16.03 RIGHT TO AUDIT

A. If the CONTRACTOR submits a claim to the OWNER for additional compensation, the OWNER shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the CONTRACTOR's books. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the CONTRACTOR's plants, or such parts thereof, as may be or have been engaged in the performance of the WORK. The CONTRACTOR further agrees that the right to audit encompasses all subcontracts and is binding upon subcontractors. The right to examine and inspect herein provided for shall be exercisable through such representatives as the OWNER deems desirable during the CONTRACTOR's normal business hours at the office of the CONTRACTOR. The CONTRACTOR shall make available to the OWNER for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the OWNER.

16.04 ASBESTOS

A. If the CONTRACTOR during the course of work observes the existence of asbestos in any structure or building, the CONTRACTOR shall promptly notify the OWNER and the ENGINEER. The OWNER shall consult with the ENGINEER regarding removal or encapsulation of the asbestos material and the CONTRACTOR shall not perform any work pertinent to the asbestos material prior to receipt or special instruction from the OWNER through the ENGINEER.

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. The Work to be performed under this Contract consists of furnishing Special Services and Goods to replace all chain and flight mechanisms in Basins 3, 4, 5, and 6 at the Jordan Valley Water Treatment Plant. Each basin consists of three long mechanisms, three short mechanisms and one cross collector for a total of 28 chain and flight mechanisms.

B. The chain and flight equipment package shall include all necessary equipment, controls, and appurtenances for a fully functioning chain and flight system. The Owner will provide labor to install the equipment under a separate contract with the successful Contractor at which time the Bidder's contract will be assigned to the Contractor.

C. The overall scope of work includes 'Special Services' and 'Goods' or the 'Equipment' which are summarized by the following:

1. Special Services
    a. Develop and submit shop drawings for review by Owner and Engineer; coordinate with Owner and Engineer regarding design details and controls for equipment provided by Others. This work will be accomplished in advance of the Owner contracting with a general contractor.
    b. Submittals are required within 6 weeks of Notice of Award, which is anticipated to occur on August 12, 2021. This would place the submittal due date at September 23, 2021.
2. Goods
    a. Furnish 28 complete chain and flight mechanisms to replace existing units found in Basins 3 through 6 as shown on the record drawings provided in Exhibit A of this contract.
        1) Milestone 1: Provide half the equipment by February 1, 2022
        2) Milestone 2: Provide the remainder of the equipment by February 28, 2022
    b. Bidder is responsible to coordinate installation and start up with Owner and Owner's Contractor.

1.02 BASIN INSPECTION

A. Record drawings contained in Exhibit A of the contract shall be used for bidding purposes only. The Bidder takes full responsibility that the supplied equipment will fit and operate within the extents of each basin. Bidder shall be required to visit the site and field verify necessary dimensions within each of the four basins with chain and flight equipment (Basins 3 through 6).

B. Basin Availability and Inspection Sequencing

1. Availability for the Bidder to inspect each basin shall occur when plant demand consistently drops below 100 mgd, which typically occurs the first week of October.
2. The Owner will notify Bidder two weeks in advance of the anticipated shutdown. Only one basin will be made available in a given week, providing time to drain and fill

before the next basin is taken offline. All basins four basins will be made available by November 5, 2021.

END OF SECTION

SECTION 01 11 80

ENVIRONMENTAL CONDITIONS

PART 1 GENERAL

1.01 ENVIRONMENTAL CONDITIONS

A. This section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

1.02 CLIMATE CONDITIONS

A. The site of the work is at an elevation of 4733 feet above mean sea level.

B. Climate conditions are described as follows:

Description	Range of Conditions
Low Winter Temperature (degrees F)	22° (average), 0° (low)
High Summer Temperature (degrees F)	90° (average), 105° (high)

1.03 ADDITIONAL CONDITIONS

A. Additional conditions which may be applicable are specified in other sections.

B. Fluid service is raw water diverted from the Provo River and conveyed to the treatment plant via the Jordan Aqueduct and Provo River Aqueduct. Water will be coarse screened, but will have grit, silt, fines, and potentially larger material that passes the screens.

C. Basins 3, 4, 5, and 6 are uncovered.

D. Basins 3, 4, 5, and 6 are typically drained each fall and left empty and exposed over the winter until startup the following spring.

END OF SECTION

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SECTION 01 20 01

INTERFACE AND COORDINATION REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL

A. During completion of final design, the successful Bidder shall interface, cooperate, and coordinate with the Owner, Engineer and Construction Manager.

B. During the bidding of construction, the Bidder shall interface, cooperate, and coordinate with all project Bidders (Contractors) as necessary.

C. Following Notice of Award to the Contractor, the interface will be between the Bidder and Contractor who is awarded the Contract for construction of the JVWTP Sedimentation Basin Equipment Replacement Project.

D. Before and during installation and startup of the Work, the Bidder shall interface directly with the Contractor. The Contractor shall be responsible to communicate all Submittals, Requests for Information, and other construction correspondences to the Engineer for review.

E. The Bidder shall coordinate with all subcontractors who are providing equipment and appurtenances associated with the Bidder, but not manufactured by the Bidder.

F. The Bidder shall coordinate with all subcontractors who are providing equipment that will interface with the Bidder, but not supplied by the Bidder.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Bidder shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

1.02 BIDDER'S RESPONSIBILITIES

A. General:

1. The Bidder shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Bidder shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Bidder shall ensure that there is no conflict with other submittals. The Bidder shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in paragraph 43 05 11-1.02 Unit Responsibility and applicable technical sections.
2. The Bidder shall coordinate submittals with the work so that work will not be delayed. The Bidder shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Bidder shall not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Bidder stamped "No Exceptions Taken" or "Make Corrections Noted."
3. The Bidder shall certify on each submittal document that he has reviewed the submittal, verified field conditions, and complied with the contract documents.

B. Request for substitution--special equipment:

1. Requests for substitution for equipment specified by manufacturer or manufacturer's model number and listed below shall be in writing and shall be accompanied with sufficient information to permit the Construction Manager to identify the nature and scope of the request. Information to be provided along with the request for substitution shall include:

a. All submittal information required for the specified equipment, including all deviations from the specified requirements necessitated by the proposed substitution.
b. Materials of construction, including material specifications and references.
c. Performance data, including performance curves and guaranteed power consumption, over the range of specified operating conditions.
d. Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.
e. Where controls are a part of the proposed substitution, piping, process and instrumentation drawings (P&IDs), produced in the project format and with project-specific symbols, along with control descriptions.
f. Where controls specified in the project manual require modification to accommodate the proposed substitution, piping, process and instrumentation drawings (P&IDs), produced in project format and with project-specific symbols, with all required modifications clearly highlighted.
g. Information and performance characteristics for all system components and ancillary devices to be furnished as a part of the proposed substitution.
h. Reproducible contract drawings, marked up to illustrate the alterations to all structural, architectural, mechanical, electrical and HVAC systems required to accommodate the proposed substitution.
i. A list of installations of the proposed substitution indicating application, location, owner and date of first use.

2. Upon receipt of written application for substitution from the Bidder, including the information specified above, the Construction Manager will estimate the cost of evaluating the request and present the estimate to the Bidder. The Bidder is advised that the estimate is based upon the best information available to the Construction Manager at the time; however, the actual cost, based on time and expense, will be documented and applied in the final analysis of the substitution request. If the Bidder wishes to proceed with the request, he shall advise the Construction Manager in writing and submit sufficient additional information as may be requested by the Construction Manager. No evaluation will take place until such time as the Bidder has agreed to the estimate in writing and has authorized the Construction Manager to deduct the cost of the evaluation from monthly progress payments due the Bidder.

1.03 CATEGORIES OF SUBMITTALS

A. General:

a. Submittals fall into three general categories; Action Submittals - Action Submittals require review and response by the Engineer before the Bidder proceeds with incorporating the equipment, materials, or procedure addressed in a submittal into the work. Review comments for Action Submittals, and the subsequent actions of the Bidder based on the review comments, shall conform to REVIEW ACTION requirements specified in this section.
b. Informational Submittals - Informational Submittals are examined to verify that the information has been furnished as specified. If the information has not been furnished as specified the submittal will be returned marked “MAKE CORRECTIONS NOTED” and any deficiencies will be noted. If the information has been furnished as specified the submittal will be returned marked “RECEIPT ACKNOWLEDGED”.

c. Closeout Submittals – Closeout Submittals consist of documentation that is not available for review at the time Action Submittals are submitted for review or documentation that is typically generated or furnished following supply of the equipment. Closeout submittals include spare parts inventory listing, spare parts, extra stock materials, special tools and other materials or components that are furnished separate from the primary equipment. Closeout Submittals require review and response by the Engineer. Closeout Submittal requirements are not satisfied until they have been reviewed and returned marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".

2. At the beginning of work, the Construction Manager will furnish the Bidder lists of those submittals specified in the project manual. Two separate lists will be provided: submittals for review and comment and product data (submittals) for information only.

B. Submittals for review and comment:

1. All submittals except where specified to be submitted as product data for information only shall be submitted by the Bidder to the Construction Manager for review and comment.

C. Submittals (product data) for information only:

1. Where specified, the Bidder shall furnish submittals (product data) to the Construction Manager for Information only. Submittal requirements for operation and maintenance manuals, which are included in this category, are specified in Section 01 78 23.

1.04 TRANSMITTAL PROCEDURE

A. General:

1. All submittals shall be prepared and submitted in electronic format (pdf) complete with cover sheet, index, and bookmarks. Owner may choose to use a Web Based Construction Document Management software; if Owner chooses to use such software, Bidder shall submit all submittals through said software.

2. Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01 33 00-A. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01 78 23-A. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

3. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Bidder. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

a. Prepare resubmittal, if applicable. Clearly identify each correction or change made. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal. Acceptable responses to Engineer's comments are listed below:
   1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
   2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
b. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
c. Review costs:
   1) Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Bidder.
   2) Reimbursement to Owner will be made by deducting such costs from Bidder's subsequent progress payments.

B. Deviation from contract:
1. If the Bidder proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

C. Submittal completeness:
1. Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

1.05 REVIEW PROCEDURE

A. General:
1. Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Bidder's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Bidder to determine acceptable options without submittals. The review procedure is based on the Bidder's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of manufacture, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.
2. When the contract documents require a submittal, the Bidder shall submit the specified information as follows:
   a. Two copies of all submitted information plus one reproducible original of all information shall be transmitted with submittals for review and comment.

b. Unless otherwise specified, two copies of all submitted information shall be transmitted with submittals (Product Data) for information only.

B. Submittals for review and comment:

1. Unless otherwise specified, within 7 calendar days after receipt of a submittal for review and comment, the Construction Manager shall review the submittal and return one copy of the marked-up reproducible original noted in 1 above to the Owner. The reproducible original will be retained by the Construction Manager. The returned submittal shall indicate one of the following actions:

   a. If the review indicates that the material, equipment or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Bidder may begin to implement the work method or incorporate the material or equipment covered by the submittal.

   b. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Bidder may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.

   c. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Bidder shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

   d. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Bidder shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

C. Submittals (product data) for information only:

1. Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.06 EFFECT OF REVIEW OF BIDDER'S SUBMITTALS:

A. General:

1. Review of contract drawings, methods of work, or information regarding materials or equipment the Bidder proposes to provide, shall not relieve the Bidder of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Construction Manager or the Owner, or by any officer or employee thereof, and the Bidder shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Owner has no objection to the Bidder, upon his own responsibility, providing the materials or equipment proposed.

END OF SECTION

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SECTION 01 73 24

DESIGN REQUIREMENTS FOR
NON-STRUCTURAL COMPONENTS AND NON-BUILDING STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Minimum structural requirements for the design, anchorage, and bracing of non-structural components such as architectural/mechanical/HVAC/electrical components, equipment, or systems, and non-building structures such as tanks.

B. The requirements of this section apply to design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.

C. This section applies to non-building structures and non-structural components that are permanently attached to structures as defined below and in ASCE 7.

D. Design and conform to criteria and design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the Drawings or where the size of attachments, anchorage, or bracing is defined in specific technical specification sections.

E. The following non-structural components are exempt from seismic design loading requirements of this section.
1. Components in Seismic Design Category A.
2. Furniture (except permanent floor supported storage cabinets over 6 ft tall).
3. Temporary or movable equipment.
4. Architectural components in Seismic Design Category B other than parapets supported by bearing walls or shear walls provided that the component importance factor, I_p, is equal to 1.0.
5. Mechanical and electrical components in Seismic Design Category B.
6. Mechanical and electrical components in Seismic Design Category C provided that the component importance factor, I_p, is equal to 1.0.
7. Mechanical and electrical components in Seismic Design Categories D, E, or F where all of the following apply:
    a. The component importance factor, I_p, is equal to 1.0;
    b. The component is positively attached to the structure;
    c. Flexible connections are provided between the component and associated ductwork, piping, and conduit;
    d. And either:
        1) the component weighs 400 lb or less and has a center of mass located 4 ft or less above the adjacent floor level; or
        2) the component weighs 20 lb or less, or in the case of a distributed systems, 5 lb/ft or less.

1.02 RELATED SECTIONS

A. This section contains specific references to the following related section. Additional related sections may apply that are not specifically listed below.

1. Section 46 43 11: Chain and Flight Equipment

1.03 REFERENCES

A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.3	Seismic Design of Liquid-Containing Concrete Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
IBC	International Building Code with local amendments
NFPA-13	Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems
UOSH	Utah Occupational Safety and Health Act

1.04 DEFINITIONS

A. Structure: The structural elements of a building that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.

B. Non-structural Components: Non-structural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist effects of wind, snow, impact, temperature and seismic loads. Non-structural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

C. Non-building Structures: Self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature and seismic loads. Non-building structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels and structural towers that support tanks and vessels.

1.05 SUBMITTALS

A. Action Submittals:
1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Bidder with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to specification requirements, with the submittal is sufficient cause for rejection of the entire submittal with no further consideration.
4. For structural elements of non-structural components and non-building structures required to be designed per this section, provide Drawings and design calculations stamped by a Utah licensed professional engineer qualified to perform structural engineering.
5. List of non-structural components and non-building structures requiring wind and seismic design and anchorage.
6. Shop drawings showing details of complete wind and seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
7. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
8. Identify interface points with supporting structures or foundations, as well as size, location, and grip of required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Bidder shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
9. Calculations for supports, bracing, and attachments shall clearly indicate design criteria applied. Coordinate concrete embedment calculations with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in design calculations.

1.06 QUALITY ASSURANCE

A. Quality Control By Owner:

1. Special Inspection of non-structural components and non-building structures, and their anchorages shall be performed by the Special Inspector under contract with the Owner and in conformance with IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements. Where sampling and testing required conforms to Special Inspection standards, such sampling and testing need not be duplicated.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide materials in conformance with information shown on the Drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

2.02 DESIGN CRITERIA

A. Design Codes

Design	Code
Buildings/Structures:	International Building Code (IBC) 2018 and ASCE 7-16
Reinforced concrete:	ACI 350-06 and ACI 350.3-06 for Concrete Liquid Containing Structures, ACI 318-14 for all other reinforced concrete
Structural steel:	AISC 360-16 and AISC 341-16
Aluminum:	Aluminum Design Manual, Latest Edition
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	OSHA and DOSH

Note: When conflicting requirements occur, the most stringent requirements will govern the design.

B. Design Loads

1. Design non-structural components and non-building structures for the following minimum loads: (Do not apply wind and snow loads to non-structural components and non-building structures that are located inside buildings.)
2. Dead Loads:
   a. Add an additional allowance for piping and conduit when supported and hung from the underside of equipment and platforms.
   b. Typical allowance for piping and conduit: 20 psf
3. Uniform Live Loads:

Elevated grating floors:	100 psf
Columns:	No column live load reduction allowed
Exitways, stairs and landings:	100 psf

Equipment platforms, walkways/catwalks (other than exitways):	60 psf
Utility bridges:	75 psf per level

4. Snow Loads:

Code:	IBC 2018 & ASCE 7
Risk Category:	IV
Drifting:	Per ASCE 7
Ground Snow Load (pg):	38 psf

5. Wind Loads:

Code:	IBC 2018 & ASCE 7-16
Risk Category:	IV
Basic Wind Speed (Ultimate, 3-second gust) for Risk Category Shown Above:	115 mph
Exposure:	C
Topographic Factor (K_{zt})	1.0

Note:

1. *Design exterior non-structural components and non-building structures, unless located in a pit or basin, to withstand design wind loads without consideration of shielding effects by other structures.*

6. Seismic Loads:

Code:	IBC 2018 & ASCE 7-16
Risk Category:	IV
0.2 Sec. Mapped Spectral Response, S_S:	1.177 g
1.0 Sec. Mapped Spectral Response, S_1:	0.43 g
Site Class:	D- Default
0.2 Sec. Design Spectral Response, S_{DS}:	0.95 g
1.0 Sec. Design Spectral Response, S_{D1}:	0.55 g
Importance Factor (I_e):	1.5
Component Importance Factor (I_p):	1.0, except I_p=1.5 for components identified in Section 13.1.3 of ASCE 7
Seismic Design Category	D

Notes:

1. *Calculate seismic loads on the basis of governing building code. Include equipment operating loads in structure dead load.*
2. *Check individual members for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Combine equipment operating loads with seismic loads.*

7. Impact Loads:
   a. Consider impact loads in design of support systems.
   b. Use the following impact load factors unless recommendations of the equipment manufacturer will cause a more severe load case:

Rotating machinery:	20% of moving load

Reciprocating machinery:	50% of moving load

8. Temperature:
   a. Include effects of temperature in design where non-structural components and non-building structures are exposed to differential climatic conditions. See climatic conditions below for temperature extremes.

C. Load Combinations
   1. Design non-structural components and non-building structures to withstand load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, ignore the load when evaluating that member.

D. Design Considerations
   1. Design non-structural components and non-building structures for the following conditions:
   2. Climatic Conditions: Reference Section 01 11 80 Environmental Conditions.
   3. Foundations:
      a. Extend foundations supporting non-structural components and non-building structures below the frost line, or support on non-frost susceptible structural fill down to the frost line.

Frost line for foundations:	30 inches

Note: *Consult project geotechnical report for allowable soil bearing recommendations at location of structure.*

E. Column Base Fixity
   1. Design column bases as pinned connections. No moments shall be assumed to be transferred to foundations.
   2. Where significant shear loads (greater than 5,000 lb. per anchor bolt) are transferred at column base plates, provide a shear key designed to transfer shear load.

F. Deflection
   1. Maximum beam deflection as a fraction of span for walkways and platforms: L/240 for total load and L/360 for live load.
   2. Maximum total load deflection for equipment support: L/450.

PART 3 EXECUTION

3.01 GENERAL

A. Make attachments and braces in such a manner that component force is transferred to the lateral force-resisting system of the structure. Base attachment requirements and size and number of braces per calculations submitted by Bidder.

B. Anchorage of equipment is specified to be made by epoxy anchor bolts in concrete elements unless specifically noted otherwise on the Drawings or other specification sections. The Contractor is responsible for remedial work or strengthening (of concrete elements because of superimposed seismic loading) if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to Owner or Bidder.

C. Provide anchor bolts in accordance with Section 05 05 20 and 46 43 11. Base size of anchor bolts and embedment on submitted calculations.

D. Submit details of and calculations for anchorages prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. Bidder is responsible for revisions to anchorages and/or strengthening of structural support so that there is no overstress condition, at no additional cost to Owner.

END OF SECTION

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE

A. Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.

B. O&M instructions must be submitted and accepted before on-site training may start.

1.02 TYPES OF INFORMATION REQUIRED

A. General:
   1. O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.

B. Operating Instructions:
   1. Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:
      a. Safety Precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.
      b. Operator Prestart: Provide requirements to set up and prepare each system for use.
      c. Start-Up, Shutdown, And Post-Shutdown Procedures: Provide a control sequence for each of these operations.
      d. Normal Operations: Provide control diagrams with data to explain operation and control of systems and specific equipment.
      e. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
      f. Operator Service Requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
      g. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

C. Preventive Maintenance:
   1. The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:

a. Lubrication Data: Provide lubrication data, other than instructions for lubrication in accordance with Paragraph 1.02 Operator Service Requirements.

1) A table showing recommended lubricants for specific temperature ranges and applications;

2) Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

3) A lubrication schedule showing service interval frequency.

b. Preventive Maintenance Plan And Schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. Corrective Maintenance:

1. Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.

a. Troubleshooting Guides And Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

b. Wiring Diagrams And Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.

c. Maintenance And Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.

d. Removal And Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.

e. Spare Parts And Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

f. Corrective Maintenance Manhours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

E. Appendices:

1. The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

a. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
b. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
c. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
d. Testing Equipment And Special Tool Information: Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.03 TRANSMITTAL PROCEDURE

A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01 33 00 accompanied by Transmittal Form 01 78 23-A and Equipment Record Forms 01 78 23-B and/or 01 78 23-C, as appropriate, all as specified in Section 01 99 90. The transmittal form shall be used as a checklist to ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.

B. Three copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.

C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.04 PAYMENT

A. Acceptable O&M information for the project must be delivered to the Construction Manager prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Construction Manager.

1.05 FIELD CHANGES

A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Bidder to reflect any field changes or information requiring field data.

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

A. GENERAL

1. DESCRIPTION

A. This section contains requirements for training the Owner's personnel, by persons retained by the Bidder specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

2. QUALITY ASSURANCE

A. Where required by the detailed specifications, the Bidder shall provide on-the-job training of the Owner's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufac-turers. Training shall include instruction in both operation and maintenance of the subject equipment.

3. SUBMITTALS

A. The following information shall be submitted to the Construction Manager in accordance with the provisions of Section 01 33 00. The material shall be reviewed and accepted by the Construction Manager as a condition precedent to receiving progress payments in excess of 50 percent of the contract amount and not less than 3 weeks prior to the provision of training.

1. Lessons plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
2. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

B. PRODUCTS

1. GENERAL

A. Where specified, the Bidder shall conduct training sessions for the Owner's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date scheduled for the individual training session.

2. LOCATION

A. Training sessions shall take place at the Jordan Valley Water Treatment Plant in Herriman, UT

3. LESSON PLANS

A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.

B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the Owner and shall be suitably bound for proper organization and easy reproduction. The Bidder shall furnish an electronic copy of necessary training manuals, handouts, visual aids and reference materials at least 1 week prior to each training session.

4. FORMAT AND CONTENT
   A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:
      1. Familiarization
         a. Review catalog, parts lists, drawings, etc., which have been previously provided for the plant files and operation and maintenance manuals.
         b. Check out the installation of the specific equipment items.
         c. Demonstrate the unit and indicate how all parts of the specifications are met.
         d. Answer questions.
      2. Safety
         a. Using material previously provided, review safety references.
         b. Discuss proper precautions around equipment.
      3. Operation
         a. Using material previously provided, review reference literature.
         b. Explain all modes of operation (including emergency).
         c. Check out Owner's personnel on proper use of the equipment.
      4. Preventive Maintenance
         a. Using material previously provided, review preventive maintenance (PM) lists including:
            1. Reference material.
            2. Daily, weekly, monthly, quarterly, semiannual, and annual jobs.
         b. Show how to perform PM jobs.
         c. Show Owner's personnel what to look for as indica-tors of equipment problems.
      5. Corrective Maintenance
         a. List possible problems.
         b. Discuss repairs--point out special problems.
         c. Open up equipment and demonstrate procedures, where practical.
      6. Parts
         a. Show how to use previously provided parts list and order parts.
         b. Check over spare parts on hand. Make recommenda-tions regarding additional parts that should be available.
      7. Local Representatives
         a. Where to order parts: name, address, telephone.
         b. Service problems:
            1. Who to call.
            2. How to get emergency help.
      8. Operation and Maintenance Manuals
         a. Review any other material submitted.
         b. Update material, as required.
5. VIDEO RECORDING:
   A. Bidder shall record each training session conducted with the Owner and provide the recording within one week of the training session.

C. EXECUTION

1. Summary

A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Bidder shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Training shall be certified on Form 43 05 11-B specified in Section 01 99 90.

C. Acceptable operation and maintenance manuals for the specific equipment shall be provided to the Owner prior to the start of any training. Recordings shall take place concurrently with all training sessions.

D. The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum classroom equipment training for operations personnel will include:
    a. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
    b. Purpose and plant function of the equipment.
    c. A working knowledge of the operating theory of the equipment.
    d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
    e. Identify and discuss safety items and procedures.
    f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
    g. Operator detection, without test instruments, of specific equipment trouble symptoms.
    h. Required equipment exercise procedures and intervals.
    i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.
2. As a minimum, hands-on equipment training for operations personnel will include:
    a. Identify location of equipment and review the purpose.
    b. Identifying piping and flow options.
    c. Identifying valves and their purpose.
    d. Identifying instrumentation:
        1. Location of primary element.
        2. Location of instrument readout.
        3. Discuss purpose, basic operation, and information interpre-tation.
    e. Discuss, demonstrate, and perform standard operating procedures and round checks.
    f. Discuss and perform the preventative maintenance activities.
    g. Discuss and perform start-up and shutdown procedures.
    h. Perform the required equipment exercise procedures.

i. Perform routine disassembly and assembly of equipment if applicable.
j. Identify and review safety items and perform safety procedures, if feasible.

3. Classroom equipment training for the maintenance and repair personnel will include:
   a. Theory of operation.
   b. Description and function of equipment.
   c. Start-up and shutdown procedures.
   d. Normal and major repair procedures.
   e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
   f. Routine and long-term calibration procedures.
   g. Safety procedures.
   h. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
4. Hands-on equipment training for maintenance and repair personnel shall include:
   a. Locate and identify equipment components.
   b. Review the equipment function and theory of operation.
   c. Review normal repair procedures.
   d. Perform start-up and shutdown procedures.
   e. Review and perform the safety procedures.
   f. Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

END OF SECTION

SECTION 01 99 90

REFERENCE FORMS

PART 1 FORMS

1.01 DESCRIPTION

A. The forms listed below and included in this section are referenced from other sections of the project manual. This section may include forms not required for this project:

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Equipment Record Form
43 05 11-A	Manufacturer's Installation Certification Form
43 05 11-B	Manufacturer's Instruction Certification Form
43 05 11-C	Unit Responsibility Certification Form
43 05 21-A	Motor Data Form

01 33 00-A. SUBMITTAL TRANSMITTAL FORM

Submittal Transmittal

Submittal Description:	Submittal No:[1]	Spec Section:

	Routing	Sent	Received
Owner:	Supplier/CM		
Project:	CM/Engineer		
	Engineer/CM		
Supplier:	CM/Supplier		

We are sending you:
☐ Attached
☐ Under separate cover via _________
☐ Submittals for review and comment
☐ Product data for information only

Remarks: ____

Item	Copies	Date	Section No.	Description	Review action[a]	Reviewer initials	Review comments attached

[a]Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

Supplier

Certify either a or b:

a. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).

b. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by:

Supplier's Signature:

[1] See Section 01 33 00-1.04. A, Transmittal Procedure.

01 78 23-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:	Submittal No:[2]
To:	Contract No:
	Spec. Section:
	Submittal Description:
Attention:	From:

Checklist	Manufacturer		Construction Manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and postshutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks:

Supplier's Signature :

[2] See Section 01 33 00-1.04.A, Transmittal Procedure.

01 78 23-B. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address			Phone
Supplier		Supplier Contact	
Supplier Address			Phone

Maintenance Requirements	D	W	M	Q	S	A	Hours

Lubricants:	Recommended:
	Alternative:

Misc. Notes:

Recommended Spare Parts					Electrical Nameplate Data			
Part No	Quan	Part Name	Cost		Equip			
					Make			
					Serial No.		Id No.	
					Model No.		Frame No.	
					Hp	V	Amp	Hz
					Ph	Rpm	Sf	Duty
					Code	Insl. Cl	Des	Type
					Nema Des	C Amb	Temp Rise	Rating
					Misc.			
					Mechanical Nameplate Data			
					Equip			
					Make			
					Serial No.		Id No.	
					Model No.		Frame No.	
					Hp	Rpm	Cap	Size
					Tdh	Imp Sz	Belt No.	Cfm
					Psi	Assy No.	Case No.	
					Misc			

01 78 23-C. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address			Phone
Supplier		Supplier Contact	
Supplier Address			Phone

Maintenance Requirements	D	W	M	Q	S	A	Hours

43 05 11-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No:	Specification section:
Equipment name:	
Contractor:	
Manufacturer of equipment item:	
The undersigned manufacturer representative of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.	
Comments:	

Manufacturer	Contractor
Signature of Authorized Representative	Signature of Authorized Representative
Date	Date

43 05 11-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No:	Specification Section:
Equipment name:	
Contractor:	
Manufacturer of equipment item:	
The undersigned manufacturer representative certifies that a service engineer has instructed the Owner's personnel in the proper maintenance and operation of the equipment designated herein.	

Operations Check List (check appropriate spaces)	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	

Maintenance Check List (check appropriate spaces)	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

Signature of Manufacturer's Representative Date

Signature of Contractor's Representative Date

Signature of Owner's Representative Date

43 05 11-C. UNIT RESPONSIBILITY CERTIFICATION FORM

SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

CERTIFICATE OF UNIT RESPONSIBILITY

FOR SPECIFICATION SECTION 46 43 11

CHAIN AND FLIGHT EQUIPMENT

In accordance with Section 46 43 11 of the contract documents, the undersigned Bidder (Supplier) accepts unit responsibility for all components of equipment furnished to the Project under specification Section 46 43 11, and for related equipment.

We have reviewed the requirements for Section 46 43 11 where applicable and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by Supplier. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section 46 43 11 are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section 46 43 11 due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public	Name of Corporation
Commission expiration date	Address
Seal:	By:
	Duly Authorized Official
	Legal Title of Official
	Date

43 05 21-A. MOTOR DATA FORM

Equipment Name: __________________ Equipment No(s): _________________________

Project Site Location: ____

Nameplate Markings

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb Temp Rating:	°C

Time rating:		Design Letter:	
	(NEMA MG1-10.35)		(NEMA MG-1.16)
KVA Code Letter:		Insulation Class:	

The following information is required for explosion-proof motors only:

A. Approved by UL for installation in Class _____, Div _____, Group _____
B. UL frame temperature code ____ (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency ____

(Section 43 05 21-2.02D Motor Efficiency)

B. Nameplate or nominal efficiency ____

Data Not Necessarily Marked on Nameplate

Type of Enclosure:			Enclosure Material:		
Temp Rise:		°C (NEMA MG1-12.41,42)			
Space Heater included?	☐ Yes	☐ No	If Yes:	Watts	Volts
Type of motor winding over-temperature protection, if specified:					

Provide information on other motor features specified:

____

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SECTION 05 05 20

ANCHOR BOLTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.

B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
   1. Section 01 73 24 Design Requirements for Nonstructural Components and Nonbuilding Structures

1.02 REFERENCES

A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments

1.03 SUBMITTALS

A. Action Submittals
   1. Procedures: Section 01 33 00.

2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Utah. Calculations shall comply with the provisions of ACI 318-14, Chapter 17 Assume compressive strength of existing concrete is 3,000 psi unless otherwise noted.
7. Product Data:
   a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
   b. Product data indicating load capacity charts/calculations.
   c. Chemical resistance.
   d. Temperature limitations.
   e. Manufacturers written installation instructions.
8. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.04 QUALITY ASSURANCE

A. Quality Assurance By Owner
   1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
   2. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
   3. The Special Inspector shall furnish a report to the Engineer, Owner’s Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer’s Printed Installation Instructions (MPII).

B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 PRODUCTS

2.01 GENERAL

A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch.

B. Tapered washers shall be provided where mating surface is not square with the nut.

C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 PERFORMANCE/DESIGN CRITERIA

A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Section 01 73 24.

B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Section 01 73 24.

2.03 MATERIALS

A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti “HIT-RE 500v3”, Simpson Strong-Tie “SET-XP”, or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie “SET-XP”, or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel
Concrete Expansion (wedge) Anchors *	Hilti “KWIK BOLT TZ”, or approved equal, Type 316 Stainless Steel

**Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:
   1. Suitable for potable water supply. (NSF 61 Compliant)
   2. Formulated to resist washout.
   3. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

2.05 ANCHOR BOLT SLEEVES

A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
   1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
   2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
   3. Acceptable manufacturers are Contec, Wilson, or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.

B. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.

B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:
   1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
      a. Acid concentrations higher than 10 percent
      b. Chlorine gas
      c. Machine or diesel oils

2. Limit to applications where exposure to the following is extremely unlikely:
   a. Fire
   b. Concrete or rod temperature above 120 degrees F
3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
6. Embedment depth shall be as specified or as required by the equipment manufacturer.
7. Follow the anchor system manufacturer's installation instructions.
8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.

B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.

C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.

D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.

E. Reinforcing steel in masonry shall not be damaged.

F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
   1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of Utah.
   2. Calculations and details for redesign shall be submitted.

END OF SECTION

SECTION 43 05 11

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies general requirements which are applicable to all mechanical equipment. The Bidder is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. Equipment Lists:

1. Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Construction Manager and Bidder and are not complete listings of all equipment, devices and material required to be provided under this contract. The Bidder shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

A. Arrangement:

1. The arrangement of equipment shown on the drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The Bidder shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. References:

1. This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. Unit Responsibility:

1. The Bidder shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Bidder of his responsibility to the Owner for performance of all systems as provided in the General Conditions of the Contract Documents.

D. The Bidder shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Bidder to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 43 05 11-C specified in Section 01 99 90, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

E. Balance:

1. Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

a. $$U_{per} = 6.015\frac{GW}{N}$$

b. Where:

1) U_{per} = permissible imbalance, ounce-inches, maximum
2) G = Balance quality grade, millimeters per second
3) W = Weight of the balanced assembly, pounds mass
4) N = Maximum operational speed, rpm

2. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be *G* 2.5 (*G* = 2.5 mm/sec) or better in accordance with ANSI S2.19.

PART 2 PRODUCTS

2.01 FLANGES AND PIPE THREADS

A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 BEARINGS

A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 100,000 hours. The rating life shall be determined using the maximum equipment operating speed.

B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

D. All bearings accessible to touch, and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.03 GUARDS

A. Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.04 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "Caution - Automatic Equipment May Start At Any Time". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.05 NAMEPLATES

A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.06 LUBRICANTS

A. The Bidder shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. All lubricant shall be food grade and compliant with NSF 61 requirements. The Bidder shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. The Bidder shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.07 ANCHOR BOLTS

A. Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the following.
   1. Anchor bolts for equipment shall be designed by the Bidder’s Engineer, licensed in the State of Utah, to include operational loads with seismic forces.
   2. All anchors shall be adhesive anchors in accordance with Section 05 05 20.

PART 3 EXECUTION

3.01 GENERAL

1. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

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SECTION 43 05 21

COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Squirrel cage type, AC induction motors, up to 500 HP, for up to 4 poles (3600 or 1800 rpm nominal), or up to 250 HP for over 6 poles (1200 rpm or slower) shall be per NEMA MG1, Small or Medium.
   2. Special purpose motors with features or ratings which are not specified herein, are specified in the particular equipment specifications.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry- Premium-Efficiency, Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
Department of Energy	Energy Policy and Conservation Act, Final Rules EERE-2010-BT-STD-0027-0117
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

1.03 DEFINITIONS

A. Terminology used in this Section conforms with NEMA MG-1. Motors covered in this specification are those defined in NEMA MG1 as Small (Fractional) and Medium (Integral) AC induction motors.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Unit Responsibility: Where Unit Responsibility is specified in the driven equipment sections of these specifications, the motor supplier shall coordinate with the provider of the driven equipment to verify that the motor provided under this section is fully compatible with and meets the specified performance requirements for that equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
   a. Copy of this Section, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
   b. Check-marks (✓) to denote full compliance with a paragraph as a whole. Underline deviations and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance. Include a detailed, written justification for each deviation.
   c. Failure to include a copy of the marked-up specification sections with justification(s) for any requested deviation will cause rejection of the entire submittal with no further consideration.
2. Motor Data Sheets specified in this Section and Division 01.
   a. Motors in conformance with IEEE 841: Manufacturers to complete IEEE Standard 841 Data Sheet for AC Induction Motors.
   b. Motors not in conformance with IEEE 841: Motor supplier to complete Form 43 05 21-A in Section 01 99 90 with required factory data.
   c. Motor Speed-Torque curve, where specified.
3. Routine Factory test data for polyphase motors.
   a. High-potential test.
4. Factory test data, from required dynamometer tests, where specified.
5. Vibration level when measured in accordance with NEMA MG 1, for all IEEE 841 motors, and where elsewhere specified.
6. Motor heating curve, where specified,
7. Motor mounting, outline, dimensions, and weight.
8. Motor bearing and winding RTDs (resistance temperature detector), where specified.
9. Motor winding thermostat or thermistor, where specified.
10. Motor winding space heaters, where specified.
11. Motor nameplate data.

B. Informational Submittals:

1. Procedures: Section 01 33 00 and 01 78 23.
2. Submittal requirements for operation and maintenance manuals as per requirements of Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Factory Testing:

1. All polyphase motors shall be factory tested in conformance with routine tests per NEMA MG1 and IEEE 112. Provide the following tests:
   a. Measurement of winding resistance.
   b. No-load readings of current and speed at normal voltage and frequency.
   c. Current input at rated frequency with rotor at standstill.
   d. High potential test.

B. Where specified for use in corrosive or hazardous locations, motor testing shall additionally be per IEEE 841. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.

1. For motors larger than 100 horsepower, test and submit results for the following:
    a. Routine tests per NEMA MG1 and IEEE 112. Provide tests as noted in paragraph 1.06 Factory Testing. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.
    b. For motors larger than 200 horsepower, efficiency and power factor by Test Method B, IEEE 112. Submit Form B and B-2.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. The manufacturer's standard product may require modification to conform to specified requirements:

1. Baldor
2. General Electric
3. Siemens
4. US Motors
5. WEG
6. Approved Equal

2.02 PERFORMANCE/DESIGN CRITERIA

A. Service Conditions:

1. Temperature: -25-degree C to +40 degree C.
2. Altitude: 5000 feet above sea level minimum.
3. Derate motors for higher ambient temperature and for higher altitude with motor size based on brake-horsepower.

B. Design Requirements:

1. Operation: Continuous.
2. Compliance: Energy Policy Act of 1992 (EPAct), Final Rule 2014.
3. Tolerance: +/- 10-percent of rated voltage at rated frequency; +/- 5-percent of rated frequency at rated voltage.
4. Standard design: NEMA Design B.

C. Service Factor (percent of additional horsepower):

1. 1.15 for Sine-wave motors.
2. Dual rating: 1.15 Sine-wave and 1.0 Inverter Duty for Inverter Duty motors.

D. Motor Efficiency:

1. NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole (1-250 HP),

squirrel cage induction motors, NEMA Design B, continuous rated. NEMA Standards Publication MG 1 2011, in Table 12-12.

Table 12-12

Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors

Rated 600 Volts or Less (Random Wound)

Open Motors

HP	2 Pole		4 Pole		6 Pole		8 Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84	81.5	86.5	84.0	86.5	84.0	77.0	74.0
2	85.5	82.5	86.5	84.0	87.5	85.5	86.5	84.0
3	85.5	82.5	89.5	87.5	88.5	86.5	87.5	85.5
5	86.5	84.0	89.5	87.5	89.5	87.5	88.5	86.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5	89.5	87.5
10	89.5	87.5	91.7	90.2	91.7	90.2	90.2	88.5
15	90.2	88.5	93.0	91.7	91.7	90.2	90.2	88.5
20	91.0	89.5	93.0	91.7	92.4	91.0	91.0	89.5
25	91.7	90.2	93.6	92.4	93.0	91.7	91.0	89.5
30	91.7	90.2	94.1	93.0	93.6	92.4	91.7	90.2
40	92.4	91.0	94.1	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	91.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	93.0	91.7
75	93.6	92.4	95.0	94.1	94.5	93.6	94.1	93.0
100	93.6	92.4	95.4	94.5	95.0	94.1	94.1	93.0
125	94.1	93.0	95.4	94.5	95.0	94.1	94.1	93.0
150	94.1	93.0	95.8	95.0	95.4	94.5	94.1	93.0
200	95.0	94.1	95.8	95.0	95.4	94.5	94.1	93.0
250	95.0	94.1	95.8	95.0	95.8	95.0	95.0	94.1
300	95.4	94.5	95.8	95.0				
350	95.4	94.5	95.8	95.0				
400	95.8	95.0	95.8	95.0				
450	96.2	95.4	96.2	95.4				
500	96.2	95.4	96.2	95.4				

Table 12-12 Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound)								
Enclosed Motors								
HP	2 Pole		4 Pole		6 Pole		8 Pole	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5	78.5	75.5
2	85.5	82.5	86.5	84.0	88.5	86.5	84.0	81.5
3	86.5	84.0	89.5	87.5	89.5	87.5	85.5	82.5
5	88.5	86.5	89.5	87.5	89.5	87.5	86.5	84.0
7.5	89.5	87.5	91.7	90.2	91.0	89.5	86.5	84.0
10	90.2	88.5	91.7	90.2	91.0	89.5	89.5	87.5
15	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
20	91.0	89.5	93.0	91.7	91.7	90.2	90.2	88.5
25	91.7	90.2	93.6	92.4	93.0	91.7	90.2	88.5
30	91.7	90.2	93.6	92.4	93.0	91.7	91.7	90.2
40	92.5	91.0	94.2	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	94.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	92.4	91.0
75	93.6	92.4	95.4	94.5	94.5	93.6	93.6	92.4
100	94.1	93.0	95.4	94.5	95.0	94.1	93.6	92.4
125	95.0	94.1	95.4	94.5	95.0	94.1	94.1	93.0
150	95.0	94.1	95.8	95.0	95.8	95.0	94.1	93.0
200	95.4	94.5	96.2	95.4	95.8	95.0	94.5	93.6
250	95.8	95.0	96.2	95.4	95.8	95.0	95.0	94.1
300	95.8	95.0	96.2	95.4				
350	95.8	95.0	96.2	95.4				
400	95.8	95.0	96.2	95.4				
450	95.8	95.0	96.2	95.4				
500	95.8	95.0	96.2	95.4				

2.03 MATERIALS

A. Motor frames:
1. TEFC motors shall be cast iron.
2. Aluminum frame motors are not permitted.

B. Stator windings:
1. Shall be copper with Class F minimum insulation not to exceed Class B temperature rise of 80-degree C at rated load and with Design B torque /current characteristics for all Medium (Integral) motors.
2. Small (fractional) motors shall be supplied with Class F insulation where available.

C. Rotor material shall be aluminum or copper.

D. Fans shall be non-sparking fan blades.

E. Motor leads shall be non-hygroscopic.

2.04 MOTOR TYPES

A. General Requirements for motors 1/2 horsepower through 500 horsepower:
   1. Three phase, squirrel cage, with copper windings.
   2. Rated for full voltage starting and continuous duty.
   3. Rating shall be:
      a. 460/ 230 volts, three-phase, 60-Hertz, as shown on the contract drawings.
   4. General Purpose Type motors, which may also be called Type 1 per the project equipment specifications shall be:
      a. Open Drip Proof Motors, shall be as defined per NEMA MG1, self-cooled by convection air.
      b. Weather-Protected Type I Motors (WP-I), shall be as defined per NEMA MG1, similar to ODP construction with addition of screens to prevent entry of rain, snow, and particles, or objects into the motor. Suitable for clean indoor and protected outdoor installations.
      c. Weather Protected Type II Motors (WP-II) shall be as defined per NEMA MG1, with maximum protection from entry of airborne particles, moisture and high velocity air. Suitable for unprotected outdoor installations.
   5. Severe Duty Type Motors, which may also be called Type 2 per the project equipment specifications, shall be in accordance with IEEE 841.
      a. Totally Enclosed Fan-Cooled Motors (TEFC) shall be defined per NEMA MG1.
      b. Enclosure: totally enclosed, fan cooled, with external fan blowing air to the motor frame cooling fins for cooling.
      c. Applications: severe duty and most outdoor installations.
   6. Explosion Proof Type Motors, which may also be called Type 3 per the project equipment specifications.
      a. Enclosures: UL listed explosion proof
      b. Applications: hazardous locations including Class I and Class II (Division 1 and 2), and Class III classified areas.

B. Motors Less Than 1/2 Horsepower:
   1. Type shall be:
      a. Squirrel cage, capacitor start with Class F insulation and copper windings.
      b. Fan motors rated 1/8 horsepower or less: split-phase or shaded-pole type.
   2. Rating shall be:
      a. 115Volts, single phase, 60 Hz.
      b. 208 Volts, single phase, 60 Hz.
      c. 230 Volts, single phase, 60 Hz.

2.05 COMPONENTS

A. Inverter-Fed Polyphase Motors per NEMA MG1 Part 31:
   1. Applications: variable torque or constant torque loads, for vertical or horizontal motors with variable frequency drive controllers (VFD).

2. Features shall include:
    a. Insulation design to meet 2000-Volt peak at a minimum of 0.1 micro-second rise time.
    b. Built-in motor winding protection as specified.
    c. Electrically insulated bearings or,
    d. Provide Electro Static Technology's AEGIS Shaft Grounding Ring for Bearing Protection or equal. The shaft grounding ring shall be solidly bonded per manufacturer's recommendations.

B. Vertical Motors:
  1. Features: Inverter duty or non-inverter duty with solid shaft P-base and high thrust bearing compatible with loads imposed by the driven equipment.

C. Thermal Protection:
  1. Inverter duty motors:
    a. Motors up to 50 horsepower:
      1) Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type.
      2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
  2. Motors larger than 50 horsepower up to and including 250 horsepower:
    a. Unless another form of thermal protection is specified in the driven equipment specification, provide a NEMA Type 1 temperature sensing device embedded in the motor winding which is sensitive to motor running over temperature.
    b. Sensor: Wired to a temperature relay in a NEMA 4 box located near or on the motor, or to the variable frequency drive controller.
    c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
  3. Motors larger than 250 horsepower:
    a. Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.
    b. RTDs shall be brought out to a separate control terminal box mounted on the motor.
    c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
  4. Explosion proof motors:
    a. Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type:
      1) Constant speed motors (non-explosion proof).
    b. Motors up to 50 horsepower:
      1) Where thermal protection is specified in the driven equipment specifications, provide NEMA Type 2 bi-metallic thermal switch (Klixon) type.
      2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
    c. Motors larger than 50 horsepower up to 250 horsepower:
      1) Where thermal protection is specified in the driven equipment specifications, provide a NEMA Type 1 temperature sensing device embedded in the motor

winding which is sensitive to both motor running over temperature and with fast response to rate of temperature rise for locked rotor protection.

2) Sensor: Wired to a NEMA 4 temperature monitor box located near or on the motor

3) Temperature Sensing System: Automatic reset, normally closed contact, rated 2A at 115 VAC.

4) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.

d. Motors larger than 250 horsepower:

1) Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.

2) RTDs shall be brought out to a separate control terminal box mounted on the motor.

3) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.

D. Motor Nameplates:

1. Materials: Engraved or stamped stainless steel.

2. Features shall be as follows:

a. NEMA Standard MG 1 motor data.

b. Permanently fastened to the motor frame.

c. ABMA bearing identification number for motors meeting IEEE 841.

d. NEMA nominal efficiency for all motors.

e. NEMA nominal and minimum efficiency for motors meeting IEEE 841.

f. UL frame temperature limit code for explosion proof motors.

g. Space heater data.

h. Over Temperature Protection Type Number.

i. Temperature device rating and alarm and shutdown setpoint.

j. Provide motor nameplates for motors with space heaters located in Class I, Division 2, Groups C, and D areas in accordance with NEC 501.125(B).

E. Conduit Boxes:

1. Provide oversized boxes, with split construction with threaded hubs and petroleum-resistant gaskets.

2. Conduit boxes can be rotated in order to permit installation in any of four positions 90 degrees apart.

3. Provide grounding lug located within the conduit box for ground connection.

4. Provide separate conduit boxes for temperature devices and space heaters.

5. Separate terminal box for any signal leads (RTD, thermistor, vibration transmitter, etc.).

F. Bearings:

1. Provide oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads.

2. Rated for a minimum L-10 life of 50,000 hours for direct-connected loads.
3. Cartridge type bearings will not be accepted.
4. Fitted with lubricant fill and drain or relief fittings.
5. Belt loads not to exceed forces calculated from NEMA MG 1 Table 14-1 and 14-1A.

G. Bearing lubrication shall be either grease or oil as per the requirements in either 1 or 2:
1. Grease lubricated bearings:
   a. Shall be for electric motor use only.
   b. Grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
   c. Provide grease fittings, similar to Alemite™ type (or equivalent).
   d. Shielded bearings with regreasable provisions are permissible.
2. Provide oil lubricated bearings with externally visible sight glass to view oil level.
3. All lubricants shall be in accordance with Section 43 05 11.

H. Lifting Eyes:
1. Provide lifting eyes with a safety factor of 5.
2. Provide one lifting eye for motors more than 50 pounds.
3. Provide two lifting eyes for motors over 150 pounds.

I. Winding Space Heaters:
1. Provide winding space heaters to prevent condensation.
2. Rating: 120 volts, single phase, 60 Hertz.
3. Motor nameplate to show space heater rating in watts and volts.
4. Provide terminal block in motor conduit box for heater leads termination.

2.06 FINISHES

A. Paint Finish:
1. Provide standard manufacturer paint finish.
2. Provide motors with semi-gloss finish, scratch and heat resistance electric motor paint.

PART 3 EXECUTION

3.01 EXAMINATION

A. Delivery Inspection:
1. Inspect driven equipment-motor assembly and components immediately upon delivery and unloading at the job site for damages.
2. Take photos of damage(s) if any, to substantiate the delivery inspection report.

3.02 INSTALLATION

A. Grounding of Motors:
1. Connect the motor feeder ground cable (green) to the grounding lug terminal in the conduit terminal box.

B. Supplemental Grounding of Motors: Provide for motors fed from VFDs, all motors above 100 horsepower, and all motors in classified areas, where feasible.
   1. Bond the motor frame to the grounding grid/electrode system to provide supplemental grounding.

3.03 FIELD QUALITY CONTROL

A. Field Testing:
   1. Measure winding insulation resistance of motors to no less than 10-megohm with a 1000-Vac megohmmeter.
   2. Perform motor phases current imbalance testing for motors 20 horsepower and larger.
   3. Test motors for proper rotation prior to connection to the driven equipment.
   4. Perform thermographic survey per NETA ATS, for motors over 100 horsepower.

B. Field Inspection:
   1. Compare equipment nameplate data with drawings and specifications.
   2. Inspect physical and mechanical condition.
   3. Inspect anchorage, alignment, and grounding.
   4. Verify the installation of breather/drain fittings as specified herein.
   5. Check for proper connections of space heaters, winding and RTDs and or thermostats.
   6. Visually check for correct phase and ground connections:

3.04 CLOSEOUT ACTIVITIES

A. Operation and Maintenance:
   1. Provide the operation and maintenance manual of the motor(s). Include testing result information in the O&M manual.

END OF SECTION

SECTION 46 43 11

CHAIN-AND-FLIGHT EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Solids collector mechanisms for installation in rectangular sedimentation basins.

B. Related Sections:
1. Section 01 11 80: Environmental Conditions
2. Section 01 33 00: Submittal Procedures
3. Section 01 73 24: Non-structural Components and Non-building Structures
4. Section 01 78 23: Operation and Maintenance Data
5. Section 05 05 20: Anchor Bolts
6. Section 43 05 11: General Requirements for Equipment
7. Section 43 05 21: Common Motor Requirements for Equipment

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. D 570 - Test Method for Water Absorption of Plastics.
2. D 638 - Test Methods for Tensile Properties of Plastic.
3. D 785 - Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
4. D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.03 SYSTEM DESCRIPTION

A. General: Furnish a total of 28 mechanisms: 12 longitudinal (long), 12 longitudinal (short) and 4 cross collector solids collector mechanisms across 4 sedimentation basins with necessary appurtenances, modified as necessary, for complete installation as indicated on the Drawings and as specified in this Section.

B. Equip each sedimentation basin with longitudinal collectors and cross collectors as indicated on the Drawings.
1. Provide longitudinal collectors that are driven in combination by single output shafts from gear reducers and motor drive units, as indicated on the Drawings and as specified in this Section.
2. Provide cross collectors that are driven in combination by single output shafts from gear reducers and motor drive units, as indicated on the Drawings and as specified in this Section.
3. Provide each longitudinal solids collector consisting of 2 parallel endless strands of chain with scraping flights attached thereto and passing over 3 pairs of sprockets, as indicated on the Drawings (4-pair of sprockets for the long collectors if the Bid Alternate is selected).

4. Provide each cross collector consisting of 2 parallel endless strands of chain with scraping flights attached thereto and passing over 3 pairs of sprockets, as indicated on the Drawings.

C. Design Requirements:
1. Solids Collectors: Provide collectors that are:
   a. Specifically designed for collection of concentrated solids in a municipal water treatment plant produced from Ferric Chloride, Ferric Sulfate, Aluminum Sulfate, or Polyaluminum Chloride (PACL).
   b. Suitable for continuous duty and exposure to water and solids containing organic and inorganic solids including silt, sediment, plant matter, algae, grit, dirt, silica, polymer, chlorine, chlorine dioxide, caustic soda, and/or permanganate.
   c. Capable of operating when water temperatures vary between 35 degrees and 80 degrees Fahrenheit.
   d. Capable of operating under dry tank conditions, and in basins that are taken offline, drained each winter, and not refilled until the following spring.
   e. Capable of operating under solids concentrations of up to 5 percent.

D. Performance Requirements:
1. Solids Collection Equipment: Provide equipment suitable for installation and operation in rectangular sedimentation basin, as indicated on the Drawings.
2. Basin Flow Rate: up to 54 mgd
3. Longitudinal and Cross Collector Speed Tolerances:
   a. Linear speed tolerance not to exceed 4 percent, plus or minus.
   b. Solids Collector Linear Speed:
      1) Longitudinal Solids Collectors: 1 foot per minute.
      2) Cross Collector: 2 feet per minute.

1.04 SUBMITTALS

A. Product Data:
1. Submit manufacturer's standard brochure showing flights, sprockets, chains, drive assemblies, and instrumentation.

B. Shop Drawings and Calculations: Prepare and submit the following:
1. Provide a copy of this specification and acknowledge each section with a check mark or an X to indicate acceptance or requests for deviation.
2. General: Submit shop drawings as specified in Section 01 33 00.
3. Details of Parts: Submit drawings showing details of each part individually and separately to show that equipment offered satisfies performance, structural strength, vibration, and other requirements of this Section.
4. Calculations: Submit structural and mechanical calculations showing that parts and equipment comply with specified requirements. It shall be detailed on the manufacturer's drawings.
5. Anchor bolt calculations for all wall connections as defined in Section 05 05 20, signed and stamped by a structural engineer licensed in the State of Utah.

C. Manufacturer's Drawings:
   1. Submit drawings that clearly and completely show the following:
      a. Complete details, size, make, type, duty, and catalog number of every piece of equipment to be provided.
      b. Type of alloy or material used, size, pitch, and speed of each type of sprocket and chain.
      c. No substitutes of inferior grade, type, design, or strength will be accepted.
   2. Setting Drawings: Submit drawings showing requirements for setting of anchor bolts and any other information required for setting of equipment.
   3. Chain Path Drawings: Submit drawings showing manufacturer's proposed chain path.
   4. Flight Path Drawings: Submit drawings showing manufacturer's proposed flight path. Include on drawing concrete walls, sump walls, and all submerged equipment including gates and valves so that potential conflicts are accounted for in final layout and positioning of collector shafts within the basins.

D. Quality Control Submittals:
   1. Test Data: Submit certified test data with chains supplied for use stating that chains, including flight attachment links, comply with specified load testing requirements.
   2. Stainless Steel cleaning and Passivation procedure as defined in Section 2.03.A.2
   3. Manufacturer's Instructions: Submit precise installation instructions for positive location and alignment of all shafts to ensure uniform chain tension.

E. Contract Closeout Submittals:
   1. Project Record Documents.
   2. Operation and Maintenance: Submit operation and maintenance manuals as specified in Section 01 78 23, and as specified in this Section.

F. Manufacturer’s Warranty

1.05 QUALITY ASSURANCE

A. Qualifications of Manufacturer of Solids Collector(s):
   1. Collector Manufacturers Qualifications:
      a. Provide collectors from manufacturer which has been regularly engaged in manufacture of non-metallic solids collectors for not less than the past 10 years.
      b. Provide collectors from manufacturer of non-metallic solids collectors that have been successfully used in municipal water treatment applications for not less than the past 10 years and that are currently in continuous operation.
   2. List of Manufacturer's Installations:
      a. Submit list of at least 5 installations for applications of comparable size (180-mgd facility) and requirements substantiating collector manufacturer's qualifications.
      b. Provide list that includes name, address, and telephone number of OWNER, average design flow of plant and each basin where solids collectors are being used, solids collector dimensions, and time in operation.

B. Certifications:

1. After initial test runs as specified in Article Field Quality Control, submit documents certifying that the equipment has been installed and adjusted in accordance with the manufacturer's requirements.
2. That all submerged equipment is NSF 61 compliant.

C. Unit Responsibility:

1. The Contractor shall assign unit responsibility as specified in Section 43 05 11-1.02 Unit Responsibility to the sedimentation tank collector chain manufacturer. A certificate of unit responsibility shall be provided.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:

1. Flight Chains and Collector Sprockets: Protect against corrosion and dust during shipment and storage until installed.
2. Ship flights so that there is no bending or warpage of the flights.
3. Protect all fiberglass and plastic from sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements as specified in 01 11 80.

1.08 WARRANTY

A. Flight Straightness:

1. Tolerances for Flight Straightness:
    a. Warranty: Tolerances for flight straightness shall not be exceeded during warranty period. Flights that do exceed these tolerances during warranty period shall be replaced.
    b. Warranty Period: 1-1/2 years, from final acceptance of the project.
    c. Warranty Period for Replacement Flights: Is to start at time flights are replaced and extended for period of 1 year from that date.

B. Manufacturer shall warranty against defects in materials and workmanship for 1 year from acceptance.

1.09 MAINTENANCE

A. Maintenance Service:

1. Supervision: Furnish a Field Engineer experienced in erection and operation of equipment provided under this Section capable of complying with following requirements:
    a. Minimum number of trips and time at site:
        1) Minimum of 4 trips for total time of not less than 8 working days.
        2) Not less than 2 days.
    b. Duties at site:
        1) Supervise installation and adjustment of equipment.
        2) Supervise initial assembly and installation of equipment.

2. Operation Instructions:
    a. Provide training by a factory representative who has complete knowledge of proper operation and maintenance of equipment furnished under this and related Sections complying with following requirements:
        1) Minimum number of trips and time at site: Provided 2 trips of 1 working day each for startup of Basins 3 and 4 as a pair, and Basins 5 and 6 as a pair.
        2) Duties at site: Instruct representatives of OWNER and ENGINEER on proper operation and maintenance and cleaning of the equipment.
    b. Operation instruction may be given during same visit as for inspection of installation and testing required under Article “Field Quality Control” provided that testing is successful, and that operating and maintenance instructions have been previously furnished to and found acceptable by the ENGINEER.
    c. Bidder shall prepare a recording of field training.
3. Third Month Inspection and Service (this will occur in the Fall of 2022 after peak demand has subsided):
    a. Equipment Manufacturer:
        1) Inspect, realign, adjust tension, and lubricate solids collectors within three months after final acceptance.
        2) Service to include items required by manufacturer's maintenance instructions.
    b. Coordination: CONTRACTOR, in conjunction with equipment manufacturer, is to coordinate this work with OWNER and ENGINEER prior to initiating the work.
4. Eleventh Month Inspection and Service:
    a. Scheduling and Notification:
        1) Scheduling: 11 months following final acceptance, CONTRACTOR and equipment manufacturer are to schedule inspection with OWNER.
        2) Notification: CONTRACTOR is to notify OWNER at least 30 days prior to desired inspection date to enable OWNER to schedule removal of any sedimentation basin from service and to dewater basins.
    b. Inspection:
        1) Inspection to include same service as provided under subparagraph “Third Month Inspection and Service” and any other service required by manufacturer's maintenance instructions.
        2) Flights:
            a) Examine each longitudinal and cross collector flights for straightness.
            b) Each flight which fails to meet straightness requirements of specified under Article “Field Quality Control” is to be replaced with factory-finished flights.
        3) Collector Chain Strands:
            a) Each collector chain strands are to be inspected and adjusted.
            b) If any collector chain strands have elongated due to wear or stretch, more than 1.5 percent of total strand length, as determined by links removed to bring sedimentation basin into proper adjustment, complete strand is to be replaced.

4) Sprockets, bearings, shafts, and gear reduction: Each sprocket, bearing, shaft, and gear reduction is to be inspected, adjusted, and aligned as required.

B. Spare Parts:
1. Furnish following spare parts, including hardware and ancillary equipment necessary to make such spare parts operative:
a. Longitudinal Fiberglass Flights: 10 flights
b. Cross Collector Fiberglass Flights: 5 flights
c. Flight Chain: 100-ft.
d. Drive Chain: Sufficient length to drive one longitudinal collector.
e. Drive and Flight Chain Sprockets: 1 of each size.
f. Bearings: Sufficient number for sprockets supplied as spare parts.
g. Shear Pins: 50 as specified in this Section.
2. Spare Parts List: Furnish complete list which includes spare parts unit prices and identification of local supplier.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
1. Envirex, Inc. (Evoqua)
2. Polychem, a division of Brentwood Industries, Inc.

B. Tag Numbers
1. Refer to record drawings found in Exhibit A of preselection package.

2.02 MANUFACTURED UNITS

A. Fiberglass Flights:
1. Flight Design (Evoqua's Sigma+ or equal):
a. Provide approximately 3-inch by 8-inch nominal size flights designed for solids collector service.
b. Pultruded channel or rectangular shape having 45 percent minimum (by weight) continuous fiberglass filaments.
1) Include a scraper lip on the leading edge to provide cleaning of the basin floor.
c. Minimum moment of inertia along the major axis of 18.5 inch to the fourth power and 1.5 inch to the fourth power along the minor axis.
d. Minimum modulus of elasticity of 4,323,000 pounds per square inch determined on full section bend tests used on actual flights to determine the modulus of elasticity.
e. Maximum water absorption no greater than 0.5 percent in accordance with ASTM D 570 based on 24-hour exposure.
f. Provide polypropylene filler blocks for bolting the flight to the chain attachment links.

g. Flight deflection and twist calculations:

   1) Deflect below a level straight line no more than 1/16 of an inch when supported at the wearing shoes on the return rails under its weight.

   2) Deflect no more than 1/60 of the spacing between sprocket centers when pushing a solids load of 15 pounds per foot distributed along the face of the flight in a wet basin condition.

2. Flight Attachments:

   a. Same material and strength as specified herein for the collector chains and shall be molded integrally with the link side bars.

   b. Extend practically the full depth of the flight. Flight fasteners shall be four 3/8-inch diameter Type 316 stainless steel hexagon head bolts, hexagon nuts, flat washers, and cut washers. Lock nuts in lieu of standard nuts and cut washers are also acceptable.

   c. Associated flight to wear shoe fasteners shall be two Type 316 stainless steel flight attachment bolts.

3. Flight Wearing Shoes:

   a. Material:

      1) Alternative A - Ultra-high molecular weight polyethylene with minimum tensile strength of 6,000 pounds per square inch (psi) and ASTM D 2240 durometer hardness of A/80/85.

      2) Alternative B - Nylon 6-6 with minimum tensile strength of 12,000 pounds per square inch and ASTM D 785 Rockwell hardness of R110.

      3) Alternative C – Polyurethane

   b. Provide minimum 1/2-inch thick shoes.

   c. Fasten shoes which bear against the bottom rails at the chain attachment to reinforce the connectors to the flight.

   d. Provide guide lugs on at least every second flight for shoes which bear on the return tracks.

   e. Shoe fasteners shall be 3/8-inch diameter Type 316 stainless steel hexagon head bolts, hexagon nuts, flat washers, and cut washers.

B. Drive Chain:

1. Material:

   a. Alternative A - Reinforced acetal resin.

   b. Alternative B - Reinforced nylon resin.

2. Chain Pins: Type 303 or 304 stainless steel.

3. Service Factor: Minimum 1.2 for all chains and sprockets.

4. Pitch: 2.609 inches.

5. Minimum Work Load: 1,740 pounds.

6. Side Bars: Height shall not be less than 1-1/8 inches and have overall width not exceeding 3-1/4 inches.

7. Chain Pin Diameter: Not less than 7/16-inch diameter.

8. Chain Sprockets:

   a. Chain Tighteners:

      1) Provide adjustable chain tighteners on drive chains.

2) Provide tighteners that are adjustable laterally for alignment and vertically for lightening purposes.

9. Drive Chain Guards:
   a. Provide removable guards not less than 14 gauge 316 stainless steel that enclose moving parts above basin walkway slab.
   b. Provide guards that are close-fitting and constructed in neat, workmanlike fashion.
10. Provide tensioner sprockets having 7 teeth and of the same material as the driven sprocket or glass-reinforced Nylon 6-6.

C. Collector Chain and Pins:
1. Chain Material:
   a. Alternative A: Nonmetallic unfilled acetal resin thermoplastic material.
   b. Alternative B: Reinforced thermoplastic polyester resin.
2. Pin Material:
   a. Alternative A: Reinforced nylon resin.
   b. Alternative B: Reinforced acetal co-polymer.
3. Chain Characteristics: Provide chain complying with following:
   a. Pitch: 6 inches.
   b. Minimum Working Load: 2,400 pounds.
   c. Average Weight: Not less than 1.3 pounds per foot.
   d. Type: Non-metallic NCS-720S.
4. Side Bars:
   a. Shape: Provide bars that are curved to match rim of sprockets.
5. Chain Pins: Design to provide full dead load bearing capacity throughout full length of link side bar hubs.
   a. Pins shall have a T-head to engage a seat or retainer lug molded as part of the chain link.
   b. The lock shall be positioned and prevent rotation.
   c. Pins using separate pin locks or cotter keys are unacceptable, unless the locking clips provide a positive locking contact around the full periphery of the pin.
   d. Minimum Diameter: 0.866 inch.

D. Driven Bull Sprocket:
1. General:
   a. Sprockets shall be keyed to the shaft.
   b. Sprocket rims shall be designed to match the drive chain and shall be 33.25-inch pitch with 40 teeth.
   c. All fasteners and other hardware shall be Type 316 stainless steel.
2. Alternative A:
   a. Material: Polyurethane having Durometer hardness of not less than Shore 70D determined in accordance with ASTM D 2240 and a water absorption rate not to exceed 1.3 percent as determined in accordance with ASTM D 570.
   b. The rim shall be a 4-segment rim mounted on a split body.

c. The sprocket shall be held in place with 2 full width clamping bands which exert the compressive force around the full periphery of each shoulder. The shoulder shall include retainers to hold the band in place.

d. The wedge dogs shall be located along the split line of the body to draw the sprocket body into diametrical and lateral alignment.

e. Each rim segment shall be mounted to the sprocket body by four 5/8-inch bolts.

3. Alternative B:

a. Material: Nylon 6-6 or Cast Nylon-6 with a Rockwell hardness of R110 determined in accordance with ASTM D 785 and a water absorption rate not to exceed 0.6 percent as determined in accordance with ASTM D 570.

b. The body shall be held in place with set screws.

c. The body shall have bolts located along the split line to draw the 2 halves into diametrical and lateral alignment.

E. Head Shaft Drive Sprocket:

1. General:

a. Sprocket rims shall be chain saver type.

b. Sprocket rims shall be keyed to the shaft.

c. Sprocket rims shall be designed to match the collection chain and shall be 22.21- inch pitch diameter with 23 teeth.

d. All fasteners and hardware shall be Type 316 stainless steel.

e. Material: Same material as the driven bull sprocket.

f. Sprockets shall be split construction with double life tooth profile.

g. Clamping Bands: Same as for the driven bull sprocket.

h. Wedge Dogs: Same as for the driven bull sprocket.

F. Idler Sprockets:

1. General:

a. Sprocket rims shall be chain saver type.

b. Sprocket rims shall be designed to match the collector chain and shall be no less than 22.21- inch pitch diameter with 23 teeth.

c. Use Type 316 stainless steel for all fasteners and other hardware.

d. 2 sprockets shall be mounted on each cross shaft. 1 of the sprockets shall turn free. The other sprocket shall be keyed to the shaft.

2. Alternative A:

a. Material: Same as the driven bull sprocket.

b. The fixed sprocket shall be clamped to the shaft same as the driven bull sprocket.

c. Secure free turning sprockets to the bearing sleeves by 2 clamping bands. The clamping bands shall be the same as for the driven bull sprocket.

d. Sprockets shall be split construction with double life tooth profile.

e. Wedge Dogs: Same as for the driven bull sprocket.

f. Bearing Sleeves:

1) Material: Same as for sprocket.

2) Split construction.

3) The sleeves shall be secured to the shaft by 2 clamping bands which exert compressive force around the full periphery of each shoulder.
4) Each shoulder shall have retainer rings to contain the clamping band.

G. Shafts and Bearings:
1. Shafts shall be 316 Stainless Steel. Shafts shall be full-width live shafts with bearings mounted to the walls.
2. Regardless of shaft size requirements determined by the loads and safe working stresses, steel shaft size shall not be less than indicated in the following table:

Description	Diameter (inches)
Longitudinal collector head shaft	3-15/16
Longitudinal collector idler shafts	3-7/16
Cross collector head shaft	2-7/16
Cross collector idler shaft	2-7/16

3. The shafting and bearing tolerances shall be as follows:
   a. Shafts: Nominal shaft size as specified plus 0.000 inch to minus 0.006 inch.
   b. Bearings: Nominal size as specified plus 0.006 inch to plus 0.001 inch.
   c. Sprockets: Nominal shaft size as specified plus 0.003 inch to plus 0.001 inch.
4. A combined shock and fatigue factor, in a dry tank, of 2 shall be applied to bending moment.
5. A combined shock and fatigue factor, in a dry tank, of 1-1/2 shall be applied to the torsional moment.
6. Shafts shall have an L/d ratio of no less than 360 under a load of 15 pounds per foot along the face of the flights in a wet basins condition.
7. Shearing stress shall not exceed 6,000 pounds per square inch for shafts with key seats and 8,000 pounds per square inch for shafts without key seats.
8. Shafts shall have a keyway as required for the sprockets.
9. Shaft bearing housings shall be 316 SS.
10. Shaft bearing shall be split type made of UHMW polyethylene or polyurethane.
11. All bearings shall be mounted to the wall with a minimum of two 3/4-inch anchor bolts. Anchor calculations shall be provided as required in Section 1.04 of this document.
12. All bearings shall be tapped for lubrication fittings. Lubrication fittings shall be buttonhead type and shall be connected to the bearing with 1/4-inch Type 316 stainless steel tubing. Brackets shall be furnished to mount the fittings at the walkway level. Lubricant shall be in accordance with Section 43 05 11.
13. All miscellaneous hardware and fasteners shall be Type 316 stainless steel.

H. Return Rail (Evoqua's J Track or equal), Support and Hardware:
1. Wall Bracket Assembly: Return tracks and supporting brackets shall be 316 stainless-steel fastened by 316SS anchor bolts to the basin or channel divider walls. Each bracket shall be designed to cantilever the return track approximately 9 inches off the wall. 316SS support brackets shall be spaced maximum 10 ft apart. Systems that require separate wear strips and mounting hardware will not be allowed.

a. Return tracks shall be 12-gauge, type 316 SS, in the shape of an inverted capital J with dimensions of 4 inches (Long Leg), 1 inch (short leg) and 2 inches (wear shoe riding surface). Material finish shall be 2B polished finish to allow for the smooth travel of the flight wear shoe with the need for any additional wearing strips.
b. Contractor shall field butt weld joined ends of return track and grind the top surface smooth. Stainless steel tracks, brackets, stainless steel anchors, stainless steel attachment hardware are to be furnished by the equipment manufacturer.
c. In additional to the weight of the return tracks, Supports shall be designed to support a minimum uniform load of 2.5 pounds per foot or the 8 pound concentrated load at mid span.
d. Material: 316 Stainless Steel.
e. Assembly shall consist of wall bracket, and hardware.
f. All mounting holes shall be predrilled.
g. All hardware shall be Type 316 stainless steel.

2. If the Bid Alternate is selected, wall brackets are not required, but return tracks are and hardware are still required.

I. Bottom Wear Strips and Hardware:

1. 316 stainless-steel wear strips shall be provided for the floor consisting of 3/8-inch thick sections with countersunk holes for attachment to the floor. The floor shall have two (2) lines of wear strips which are secured with Type 316 stainless-steel anchors. Anchors shall be set in pre-drilled holes.

J. Driver Sprocket:

1. Sprockets shall be designed to match the drive chain and shall be 9.26-inch pitch diameter and have 11 teeth.
2. Material:
   a. The driver sprocket and driving assembly shall be cast nylon-6 with a 316 SS shear pin hub.
      1) Alternate Method: A polymeric plate section bolted to a 316 Stainless Steel driving hub. The sprocket plate section shall be molded of polyurethane as described under the collector chain sprocket section.
   b. All hardware shall be Type 316 stainless steel.

K. Shear Pin:

1. Shear Pin:
   a. Material: Aluminum.
   b. Provide polymeric gasket between shear faces.
   c. Sized to protect equipment from failure or excessive loads.

L. Overload Protection:

1. In addition to shear pins installed in the sprocket, a mechanical type overload protection device shall be provided.
   a. The overload mechanism shall be adjustable with a manual reset.
   b. Shall activate overload alarm contacts which represents the high torque alarm.

1) Normally closed contact that opens on high torque

c. The mechanical type overload protection device shall be Bibbigard or equal.

M. Collector Drives: Provide collector drives consisting of drive units, drive and driven sprockets, chain, chain guards, and other equipment necessary and as required for driving longitudinal solids collectors and cross collectors with separate drive units in the sedimentation basins and as required for safely guarding all rotating parts at work center.

1. Provide longitudinal solids collectors and cross collector as indicated on the Drawings that are driven by variable speed drives. For each basin, five independent drives shall be provided to drive each of the following:

a. Two longitudinal collectors (long)

b. One longitudinal collector (long)

c. Two longitudinal collectors (short)

d. One longitudinal collector (short)

e. One cross collector

N. Gear Reduction Units:

1. Provide units of quadruple or quintuple reduction, helical or herringbone type with anti-friction bearings as specified in Section 43 05 11.

2. Shafts of Motors, Gear Reduction Units, Right Angle Drives (If applicable), Drive Sprockets, and Other Units as Required:

a. Are to be proportioned to provide for overhung loads imposed by chain linkage.

b. Outboard Bearings:

1) If required, provide bearings to reduce overhung loads.

2) Provide bearings of sealed self-aligning, antifriction type, mounted on common base.

O. Motors:

1. Provide collector drive motors for longitudinal solids collectors and cross collector having following characteristics in addition to those specified in Section 43 05 21.

a. Variable Speed Motors:

1) Speed: Not more than 1,750 revolutions per minute.

2) Horsepower: Not less than 0.5.

3) Volts: 460.

4) Phase: 3.

5) Hertz: 60.

6) Enclosure: TEFC.

7) Service Factor: 1.15.

8) Insulation: Class F.

9) Ambient Temperature: 40 degrees Celsius.

10) Duty: Severe Duty and Inverter Duty

b. Show characteristics listed above on motorplate.

2. Collector Drive Motor Horsepower:

a. Provide motors having horsepower capacity capable of driving collectors without overloading under any operating conditions.

b. Provide horsepower sufficient for dragging flights and for power losses through gear boxes, reduction units, bearings, and other mechanical devices which absorb power.

c. At any time during operation, rated full load current to motors is not to be exceeded.

2.03 SOURCE QUALITY CONTROL

A. Tests:

1. Chains and Flight Attachment Links:

   a. Test strands consisting of 6 pitches each, including flight attachment link, to 5,000 pounds without failure as part of manufacturer's quality assurance procedure during manufacture. Test no less than 1 percent of the total length supplied. Discard tested strands. Submit test results to Engineer.

2. Stainless Steel Components

   a. Stainless steel components shall be protected from carbon steel contamination during fabrication and assembly as defined in Paragraph 8 of ASTM A380. Surfaces shall be descaled and cleaned in accordance with Paragraph 5 and Paragraph 6 of ASTM A380, respectively. Components shall then receive final cleaning-passivation in accordance with the requirements of Table A2.1 Part II of ASTM A380. Testing to ensure proper passivation and cleaning has occurred shall be in accordance with Paragraph 7.2.5 of ASTM A380. The manufacturer shall supply a cleaning, passivation and testing procedure outlining the procedure followed by the manufacturer to ensure proper cleaning and passivation has occurred along with test results upon completion of the testing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Verify that rails are level and straight before installing chain and flights.

3.02 PREPARATION

A. Basins are existing, and were constructed in 1987. As part of Bidder's inspections to field verify dimensions, observe and provide comments on the condition of the existing basins that may need additional preparation by Contractor.

3.03 INSTALLATION

A. Sprockets:

1. General:

   a. Set chains and sprockets in alignment so that chain is centered on sprocket teeth.

   b. Install chain links such there is no touching or rubbing between inside of chain link and outside of sprocket teeth.

c. Center driving sprockets on true plane passing through true center of driven sprockets.

B. Rails and Guides:
1. Return Rail Brackets:
a. Install brackets for return rails as follows:
1) At columns: On column center line.
2) At walls: Not more than 10 feet center to center.

C. Flight Guides:
1. Set anchor bolts in cross walls for anchoring of guides.

D. Tolerances:
1. Tolerances of Concrete Floor Slabs:
a. Finish concrete slabs so that straightedge will ride only on wear strips and never on concrete slab.
b. At no location shall the concrete be higher than the wear strips.
2. Sprockets: Alignment of sprockets is not to vary from true plane more than 1/16 inch.
3. Shafting:
a. Longitudinal: Set to within 1/8 inch of true line and level.
b. Collector: Set to within 1/16 inch of true line and level.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Cost of Testing: Cost of testing is to be borne by Bidder.
2. Chain Proof Load Testing: At ENGINEER's discretion, 5 strands consisting of 6 pitches each, including flight attachment link, will be randomly selected by ENGINEER from chain shipped to project site for 5,000-pound proof load testing, by independent testing laboratory.
3. Straightness Testing: Select minimum of 10 flights randomly from flights manufactured specifically for this project. Test each of these flights at project site to determine flight's straightness as follows:
a. Sag: While simply supported on wearing shoes, front bottom edge of flight is not to deviate more than 1/8 inch above nor 1/16 inch below straight line between bottom edge of flight at wearing shoes.
b. Bow: Horizontal displacement of front bottom edge from straight line is not to exceed 1 inch.

B. Required Results:
1. Chain Proof Load Testing: Should any:
a. 1 of samples fail proof load testing, additional 5 strands will be selected and subjected to test procedures.
b. If additional strands fail, entire lot of chain will be rejected and stored on project site until receipt of acceptable chain from manufacturer.

2. Collector Drive Motors: When equipment is tested with basins dry or with water in basins, no overloading of motors or other mechanical gear is allowed.

C. Manufacturer's Field Service:

1. Coordination: CONTRACTOR, in conjunction with equipment manufacturer, is to coordinate field service work with OWNER and ENGINEER prior to initiating such work.
2. Equipment Manufacturer: Furnish factory-trained service engineer to instruct CONTRACTOR's personnel as to proper installation of equipment, supervise initial installation, check complete installation, make necessary adjustments prior to initial operation and supervise initial operation of equipment.
3. CONTRACTOR: Furnish all necessary oil and grease in accordance with the manufacturer's installation instructions prior to initial operation.
4. Service Engineer:
    a. Make certain that each bearing and contact surfaces between sprockets and shafts, and guide rails, both upper and lower, have been properly lubricated prior to testing of equipment.
    b. Do not apply power to any equipment until, in service Engineer verifies that each part to be in motion has been thoroughly and carefully checked for alignment, smoothness of operation, and lubrication.
    c. Test Runs:
        1) Dry Startup: Run the equipment without water in the basins to check for alignment of sprockets, chain, flights, wearing surfaces, and binding and excessive heat buildup in the drive units.
        2) Wet Startup: Fill the basins with water at a slow rate so the solids collectors do not rotate. Run the equipment to verify smooth operation.
        3) Solids Startup: Run the equipment with wastewater in the basins to verify proper operation.
        4) Inspection:
            a) After each startup, each and every bearing, sprocket, chain, shaft, and drive shall be carefully inspected by the service engineer for tightness,
            b) heating, vibration, binding, unusual noisiness, wobbling, eccentricity, overloading, and any other maladjustment or fault.
            c) Repair or adjust any such fault immediately to satisfaction of the ENGINEER.
        5) During test runs, allow sufficient time for any heating, binding, or eccentricity by virtue of tight or loose connections to develop.
5. Third and Eleventh Month Inspection and Service:
    a. Inspection and Service: Perform as specified in subparagraphs “Third Month Inspection and Service,” and “Eleventh Month Inspection and Service.”
    b. Inspection and Services: Equipment manufacturer to inspect, realign, adjust tension and lubricate solids collectors once at 3 and 11 months after initial start-up and testing.

3.05 ADJUSTING

A. Repair and Replacement: Any equipment damaged or broken from improper installation, material defects, or incorrect adjustment are to be replaced.

END OF SECTION

EXHIBIT A

RECORD DRAWINGS

REV	DATE	BY	DESCRIPTION
A	10/85	JMM	ADDENDUM 1-5
RD	11/22/89	MTS	RECORD DRAWING

SCALE: 3/32" = 1'-0"

DESIGNED: DMH/RSG
DRAWN: D.S.
CHECKED: D.M. Hanley

SUBMITTED: PROJECT ENGINEER 7307 R.C.E. NO. 7-31-85 DATE
RECOMMENDED: JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. 4960 R.C.E. NO. 7-31-85 DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

APPROVED: Don A. Christiansen 7-31-85 DATE
APPROVED: Matthew R. Marshall 7-31-85 DATE

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
FLOCCULATION/SEDIMENTATION BASINS PLAN

SHEET 1S-2 OF SHEETS

JOB NO. 568.0205
FILE

PROJECT NO. 86C196A

RECORD DRAWING

This record drawing has been prepared based upon information provided by others. The Engineer has not verified the accuracy of such information and shall not be responsible for any errors or omissions which have been incorporated herein as a result.

REGISTERED PROFESSIONAL ENGINEER No. 7307 Garry J. Wohlgemuth STATE OF UTAH

ALL WORK THIS SHEET IS SCHEDULE 2 AND/OR 6

REV	DATE	BY	DESCRIPTION
A	10/85	JMM	ADDENDUM 1-5
RD	11/19/86	MS3	RECORD DRAWING

SCALE: AS SHOWN

DESIGNED D.M.H. DRAWN Glenn Shields CHECKED D.M. Hoody

SUBMITTED PROJECT ENGINEER 7307 R.C.E. NO. 7-31-85 DATE

RECOMMENDED JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. 4960 R.C.E. NO. 7-31-85 DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

APPROVED Don A. Christiansen 7-31-85 DATE

APPROVED Matthew R. Marshall 7-31-85 DATE

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
FLOCCULATION/SEDIMENTATION BASINS SECTION & DETAILS

SHEET 1S-6 OF SHEETS

JOB NO. 368.0205 FILE

PROJECT NO. 86C196A

REV	DATE	BY	DESCRIPTION
A	10/85	JMM	ADDENDUM 1-5
RD	11/30/88	MTS	RECORD DRAWING

SCALE:	AS SHOWN
DESIGNED	D.M.H.
DRAWN	R.S. Garcia
CHECKED	D.N. Hardy
SUBMITTED — PROJECT ENGINEER	7307 R.C.E. NO. — 7-31-85 DATE
RECOMMENDED — JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	4960 R.C.E. NO. — 7-31-85 DATE
APPROVED — Don A. Christiansen	7-31-85 DATE
APPROVED — Matthew R. Marshall	7-31-85 DATE

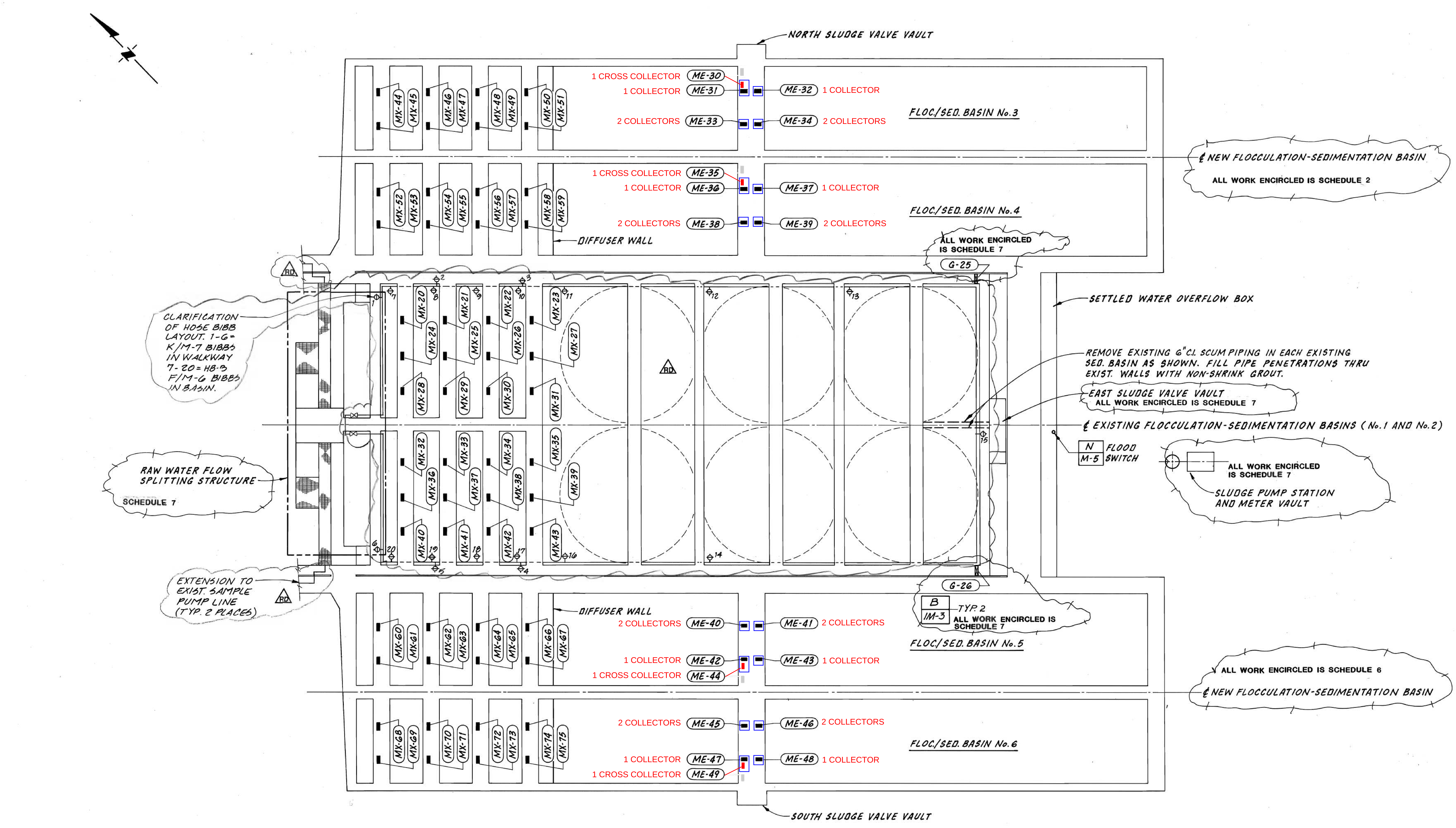
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
FLOCCULATION/SEDIMENTATION BASINS
SECTION & DETAILS

SHEET 1S-7 OF SHEETS

JOB NO. 568.0205 FILE

PROJECT NO. 86C196A



ALL MIXERS (MX) AND MECHANICAL EQUIPMENT (ME) SHOWN IS SCHEDULE 8

FLOCCULATION-SEDIMENTATION BASIN OVERVIEW PLAN

AS-BUILT CONFIGURATION

REGISTERED PROFESSIONAL ENGINEER No. 7307 Gerry J. Wohlgemuth STATE OF UTAH

RECORD DRAWING

This record drawing has been prepared based upon information provided by others. The Engineer has not verified the accuracy of such information and shall not be responsible for any errors or omissions which have been incorporated herein as a result.

REV	DATE	BY	DESCRIPTION
RD	12/4/02	MJS	RECORD DRAWING

SCALE: 1" = 30'

DESIGNED PATRICK WHITE
DRAWN G. WARREN
CHECKED G. WOHLGEMUTH

SUBMITTED — PROJECT ENGINEER — 7307 R.C.E. NO. — 7-31-85 DATE

RECOMMENDED — JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. — 4960 R.C.E. NO. — 7-31-85 DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

APPROVED Don A. Christiansen 7-31-85 DATE

APPROVED Matthew R. Marshall 7-31-85 DATE

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
FLOCCULATION / SEDIMENTATION BASINS OVERVIEW PLAN

SHEET 1M-1 OF SHEETS

JOB NO. 568.0202 FILE CC 7/79

PROJECT NO: 86C196A

REV	DATE	BY	DESCRIPTION
A	10/85	JMM	ADDENDUMS 1-5 ADDENDUMS
A	10/85	JMM	REVISIONS & CLARIFICATIONS
RD	1/88	MJS	RECORD DRAWING

SCALE: 3/32" = 1'-0"

DESIGNED P.C.W., G.L.W.
DRAWN G. WARREN
CHECKED G. WOHLGEMUTH

SUBMITTED
PROJECT ENGINEER 7307 R.C.E. NO. 7-31-85 DATE
RECOMMENDED
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. 4960 R.C.E. NO. 7-31-85 DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

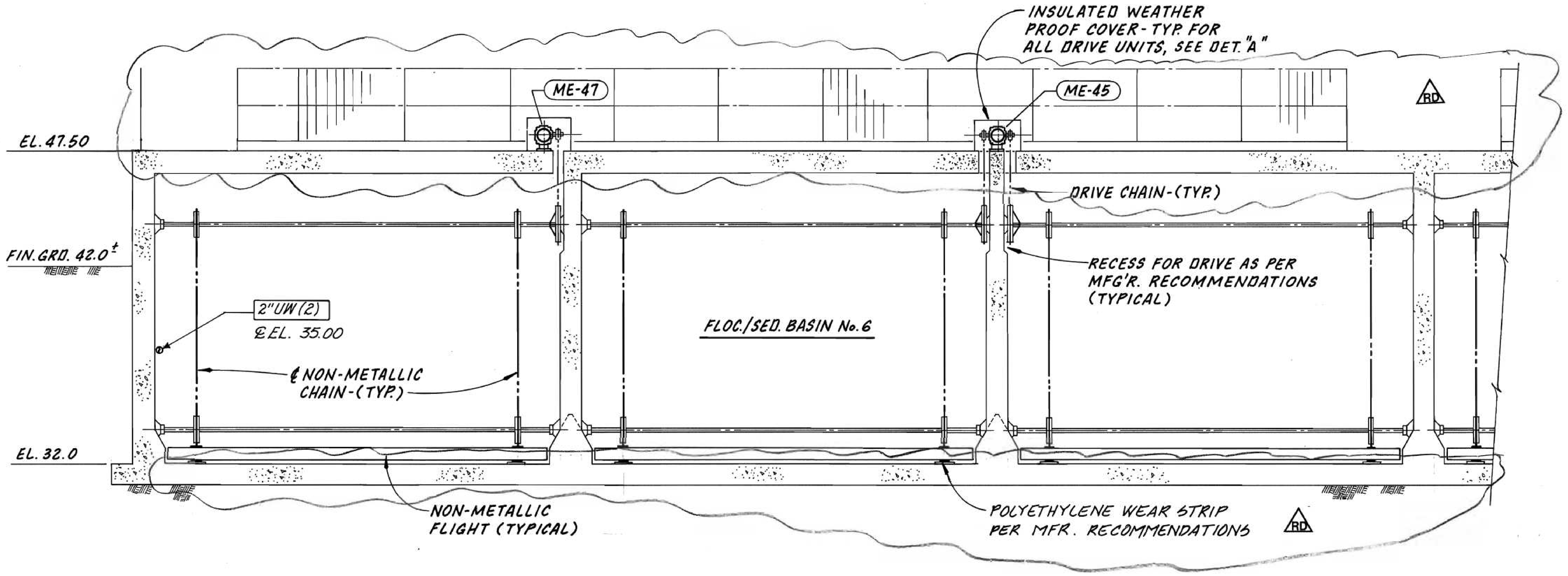
APPROVED Don A. Christiansen 7-31-85 DATE
APPROVED Matthew R. Marshall 7-31-85 DATE

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
NEW FLOCCULATION / SEDIMENTATION BASINS
PLAN & SECTIONS

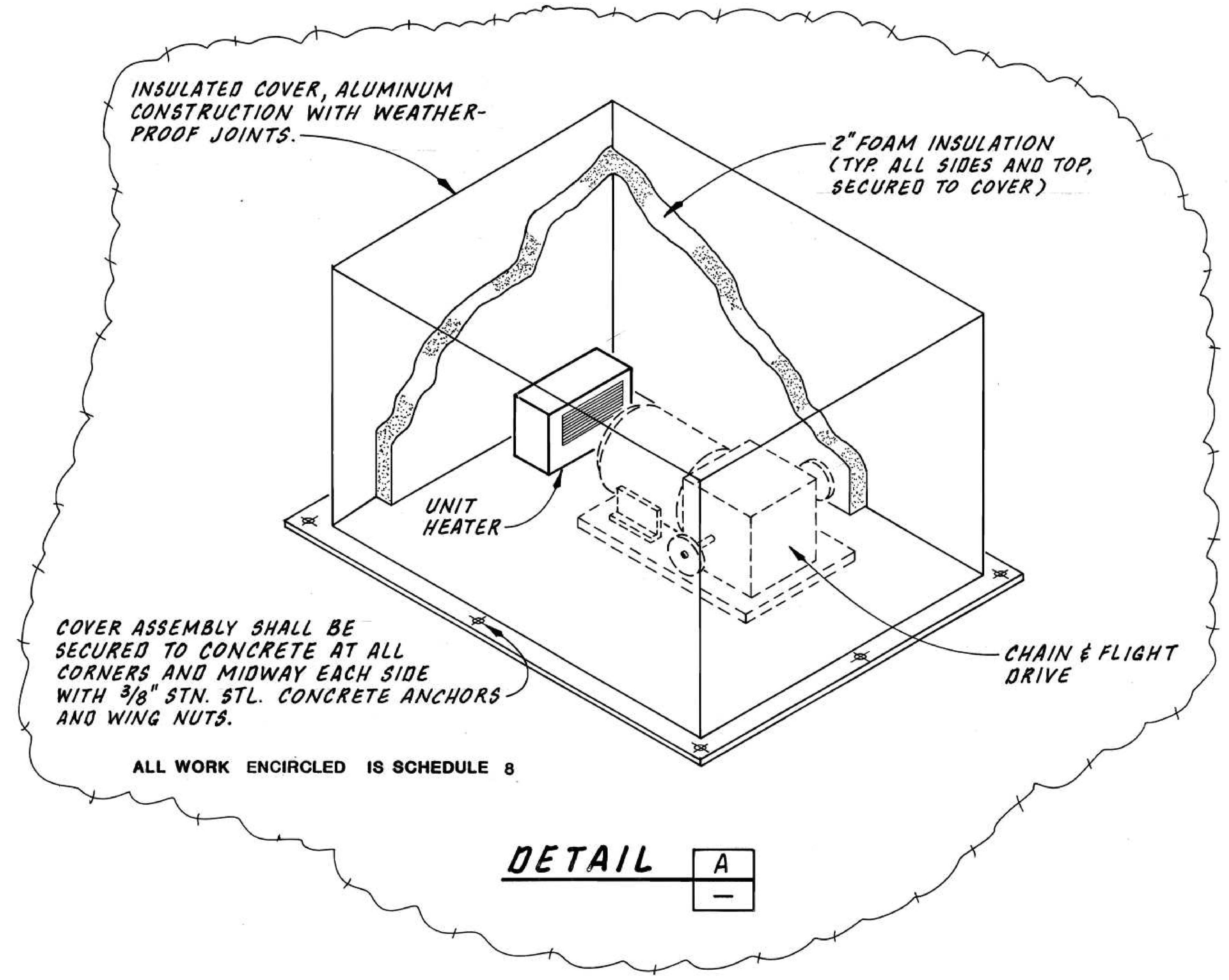
SHEET 1M-4 OF SHEETS

JOB NO. 568.0202 FILE CC 8-80

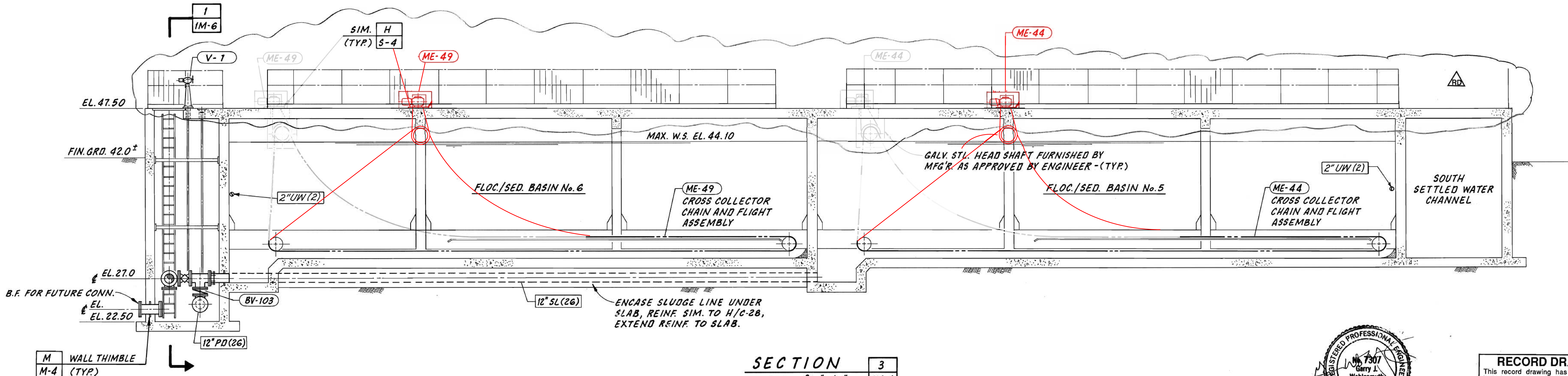
PROJECT NO. 86C196A



SECTION 2 / 1M-4
SCALE: 1/4" = 1'-0"



DETAIL A / —



SECTION 3 / 1M-4
SCALE: 3/16" = 1'-0"

ALL REMAINING WORK THIS SHEET IS SCHEDULE 6 UNLESS NOTED OTHERWISE

ALL MIXERS "MX" AND MECHANICAL EQUIPMENT "ME" THIS SHEET ARE SCHEDULE 8

AS-BUILT CONFIGURATION

REGISTERED PROFESSIONAL ENGINEER No. 7307 Garry J. Wohlgemuth STATE OF UTAH

RECORD DRAWING
This record drawing has been prepared based upon information provided by others. The Engineer has not verified the accuracy of such information and shall not be responsible for any errors or omissions which have been incorporated herein as a result.

REV	DATE	BY	DESCRIPTION
RD	12/11/85	[illegible]	RECORD DRAWING

SCALE: AS SHOWN

DESIGNED P.C.W., G.L.W.
DRAWN G. WARREN
CHECKED G. WOHLGEMUTH

SUBMITTED — PROJECT ENGINEER — 7307 R.C.E. NO. — 7-31-85 DATE
RECOMMENDED — JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. — 4960 R.C.E. NO. — 7-31-85 DATE

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.
12200 E. ILIFF AVE., SUITE 108, AURORA, COLORADO 80014

APPROVED — Don A. Christiansen — 7-31-85 DATE
APPROVED — Matthew R. Marshall — 7-31-85 DATE

CENTRAL UTAH WATER CONSERVANCY DISTRICT
JORDAN VALLEY WATER PURIFICATION PLANT EXPANSION
NEW FLOCCULATION / SEDIMENTATION BASINS
SECTIONS & DETAILS

SHEET 1M-5 OF SHEETS

PROJECT NO: 86C196A

JOB NO. 568.0202 FILE CC 8-80

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SECTION 02
SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE – ADDENDUM NO. 1

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ADDENDUM NO 1
TO
CONTRACT DOCUMENTS
FOR
Jordan Valley Water Treatment Plant
JVWTP Sedimentation Basin Equipment replacement Project

Solids Handling Equipment Preselection Package

JVWCD PROJECT NO.: 4138

7/22/2021

This addendum is hereby attached to and made part of the Contract Documents. The addendum consists of 1 page of written text (including this cover sheet) and 0 pages of drawings. Each Bidder shall acknowledge receipt of this addendum on the bid (page C-1) and by signing and attaching this addendum to the bid.

1. RECEIPT OF BIDS: The bid deadline for this project is hereby extended from 1:00 pm, on July 27, 2021 (mountain daylight time) **to 4:00 pm, on July 29, 2021** (mountain daylight time).

2. All other conditions of the contract documents remain unchanged.

David R. McLean

David R. McLean, P.E.
Senior Engineer

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

BIDDER'S CERTIFICATE

I acknowledge receipt of the foregoing Addendum No. 1 and accept all conditions contained therein.

Bidder:______________________________

By:______________________________
Signature

Date:______________________________

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SECTION 03
CHANGE ORDER 1

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JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. 01

Date: 9/8/2021

NAME OF PROJECT: Jordan Valley Water Treatment Plant Solids Handling Equipment Preselection Package

PROJECT NUMBER: 4072

SUPPLIER: Evoqua Water Technologies

CONTRACT DATE: September 8, 2021

The following changes are hereby made to the CONTRACT DOCUMENTS:

1. Incorporate JVWTP Solids Handling Equipment Preselection package Addendum #1 into the contract documents.
2. Incorporate Supplemental General Conditions into the contract.

Total Change to CONTRACT PRICE: $0

Original CONTRACT PRICE: $3,725,657

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S) $3,725,657

The new CONTRACT PRICE including this CHANGE ORDER will be $3,725,657

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER
(CONTINUED)

Change Order No. 1

Date: 9/8/2021

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

Recommended: ______________________ 9/8/2021
Engineer – Brown and Caldwell Date

Accepted: ______________________ 09/09/2021
Contractor – Evoqua Water Technologies Date
Scott Lapcewich, VP & General Manager Applied Product Technologies

Approved: ______________________ 9-13-2021
Owner - Jordan Valley Water Conservancy District Date

Addendum 1 to the Agreement dated the 8th day of September, 2021, between Jordan Valley Water Conservancy District and Evoqua Water Technologies, LLC, for the Jordan Valley Water Treatment Plant Solids Handling Equipment Preselection Package.

Modifications to the **Notice Inviting Bids**:

Replace 'Project Schedule' with the following:

- Project schedule for this equipment is critical on this project. The equipment shall be shipped by June 15, 2022 with an invoice sent by the same date. If the Work is not completed within the specified time frame, the Supplier herein agrees to accept liquidated damages in the amount of $1,000 per day. The payment by Supplier of Liquidated Damages will be Owner's sole and exclusive remedy for delay, and shall not exceed 12% of Project value. Supplier shall not incur liquidated damages that arise from a force majeure event or for delays caused by Owner or third parties not under the control of Supplier.

Basis of Award under **Bid, Bid Schedule(s)**:

In addition to the Base Bid, the following Bid Alternates have been selected:

- Bid Alternate 1
- Bid Alternate 2
- Bid Alternate 3

Responses to the Clarifications/Exceptions in Evoqua's bid dated July 29, 2021 (page 19 of the pdf); note that the project scope is per the preselection package issued July 20, 2021.

Item	Section	Clarification/Proposed Modification	Response
1	N/A	Evoqua Water Technologies LLC enters into this bid with the Evoqua terms of sale dated May 2015 attached hereto and incorporated by reference. If upon award of the contract, at the request of the customer, Evoqua will negotiate mutually agreeable terms between the parties. Evoqua reserves the right to revisit such terms and conditions with the customer.	Mutually-agreeable terms between the parties as specified in the agreement form shall apply.
2	N/A	Evoqua shall perform a site visit to take field dimensions required for final submittals. Condition of tanks and equipment will not be verified. Field dimensions are needed by November 1, 2021 in order to meet our schedule described in this proposal. All tanks must be drained and accessible for this visit.	Basin inspection may occur one-at-a-time beginning October 1, 2021, and may require multiple visits as described in the bid package. All basins will be made available for inspection by November 1, 2021.
3	N/A	Evoqua will furnish equipment as proposed for the Contractor to install. Labor, equipment necessary for alterations and/or installation of our equipment, repair and alterations or cleaning of the existing structures, is the responsibility of the Contractor. Evoqua is not responsible for the locations, condition or dimensions of existing concrete, anchors, or any equipment not furnished by Evoqua.	Clarification is acceptable.

Item	Section	Clarification/Proposed Modification	Response
4	46 43 11 Paragraph 1.08 A.1.b/c	Flight warranty period shall be 3 years from shipment.	Per the meeting with Evoqua on August 10, 2021, flight warranty period shall be four (4) years from shipment or three (3) years from substantial completion, whichever is less.
5	46 43 11 Paragraph 1.09 A.4.b.3.b	Evoqua takes exception to this requirement. Chain elongation is a function of the operating environment, not the quality of the chain. We do not control the operating conditions and therefore cannot provide a warranty around chain elongation.	As discussed in meeting with Evoqua on August 10, 2021, Evoqua shall adhere to the requirements in this paragraph if Bid Alternate 2 (Supply of HS730 Chain) is approved.
6	46 43 11 Paragraph 2.02 A.1.d	The minimum modulus of elasticity for Sigma Plus flights is 3,830,000 pounds per square inch.	Supply of flights with a modulus of elasticity of 3,830,000 pounds per square inch is acceptable.
7	46 43 11 Paragraph 2.02 G.3.a	Shaft tolerance shall be nominal shaft size as specified plus 0.005 inch to minus 0.005 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.	Manufacturer shall provide shaft tolerances based on load, velocity and application in lieu of tolerances specified in this paragraph.
8	46 43 11 Paragraph 2.02 G.3.b	Bearing tolerance shall be nominal size as specified plus 0.040 inch to minus 0.000 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.	Manufacturer shall provide bearing tolerances based on load, velocity and application in lieu of tolerances specified in this paragraph.
9	46 43 11 Paragraph 2.02 G.3.c	Sprocket tolerance shall be nominal shaft size as specified plus 0.040 inch to minus 0.000 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.	Manufacturer shall provide sprocket tolerances based on load, velocity and application in lieu of tolerances specified in this paragraph.
10	46 43 11 Paragraph 2.02 G.6	Shearing stress shall not exceed 12,000 pounds per square inch for shafts with key seats and 12,000 pounds per square inch for shafts without key seats. Tolerance provided in specifications is typical of high speed machinery, which does not apply.	A maximum allowable shear stress of 12,000 psi is permitted provided: [1] yield strength of material is equal to or exceeds 36,000 psi; and [2] maximum shear stress does not exceed 12,000 psi with stress concentration factors included.
11	46 43 11 Paragraph 2.02 O.1.a.10	Motors shall be severe duty only due to constant expected speeds.	As discussed in meeting with Evoqua on August 10, 2021, supplied motors shall be severe duty rated as well as inverter duty rated as specified.
12	46 43 11 Paragraph 3.04 A.3.a	Sag for Sigma Plus flights shall not deviate more than ½" inch below straight line between bottom edge of flight at wearing shoes.	A sag of less than 1/2" below the straight line between bottom edge of flight at wearing shoes is permitted. Manufacturer is responsible to ensure proposed sag limit will not interfere with operation of equipment.
13	Bid Form Alternative 1	The deduct total price is the result of the non-supply of brackets/supports used for Evoqua J-track return rails. Any/all brackets that are intended to be used for this alternative must be compatible with our design. Any other costs associated with this alternative are the responsibility of the contractor.	Clarification is acceptable.

JORDAN VALLEY WATER TREATMENT PLANT SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 17- GENERAL

17.01 GENERAL

1. These Supplemental General Conditions amend or supplement the General Conditions of the Contract and any other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.

2. The terms used in these Supplemental General Conditions which are defined in the General Conditions of the Contract have the meanings assigned to them in the General Conditions of the Contract herein.

17.02 SUPPLEMENTAL DEFINITIONS

1. ENGINEER

   The "Engineer" is Brown and Caldwell.

2. CONTRACTOR
   References to "Contractor" shall apply to Evoqua Water Technologies, LLC as the equipment supplier for this project.

17.03 TESTING COSTS

1. Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs. The Owner reserves the right to have additional tests performed by a testing organization selected by the OWNER and at the OWNER's expense.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 18

18.01 INSURANCE AMOUNTS

The limits of liability for the insurance required by Paragraph 5.02 of the General Conditions shall provide for not less than the following amounts or greater where required by Laws and Regulations:

A. Workers' Compensation under Paragraph 5.02B.1 of the General Conditions:

1. State: As applicable — Statutory

B. Comprehensive General Liability: (under Paragraph 5.02B.2 of the General Conditions):

1. Bodily Injury (including completed operations and products liability):

$ 500,000	Each Occurrence
$ 1,000,000	Annual Aggregate

Property Damage:

$ 500,000	Each Occurrence
$ 1,000,000	Annual Aggregate
or a combined single limit of	$1,000,000

2. Property Damage liability insurance including, Explosion, Collapse and Underground coverages, where applicable.

3. Personal Injury, with employment exclusion deleted

$ 1,000,000 Annual Aggregate

C. Comprehensive Automobile Liability: (Under Paragraph 5.02B.3 of the General Conditions:)

1. Bodily Injury

$ 500,000 Each Person
$ 1,000,000 Each Occurrence

2. Property Damage:

$ 500,000 Each Occurrence

or combined single limit of $1,000,000

D. Builders Risk: Not required.

18.02 MODIFICATIONS TO GENERAL CONDITIONS

1. Preselection Package Section 2.01 Delivery of Bonds/Insurance Certificates- Delete 10 days and replace with 30 days.

2. Preselection Package Section 5.01 Performance and Other Bonds- Delete the requirement for payment and performance bonds.

3. General Conditions Article 5.02.B.5 Builder's Risk- Delete the requirement for Builder's Risk insurance.

4. General Conditions Article 6.06.A Permits- Equipment supplier shall not be responsible for Building and other local permit fees. Building permit and other local permit fees, as applicable, shall be paid for by the installation contractor.

5. General Conditions Article 13.01 Warranties Guarantees and Maintenance Period-- Delete and replace with: Subject to the following sentence, Contractor warrants to Owner that the (i) the goods provided by Contractor shall materially conform to the description in Contractor's proposal which is the subject of this Agreement and shall be free from defects in material and workmanship and (ii) the services provided by Contractor shall be performed in a timely and workmanlike manner. Determination of suitability of treated water for any use by Owner shall be the sole and exclusive responsibility of Owner. The foregoing warranty shall not apply to any goods specified or otherwise demanded by Buyer and not manufactured or selected by Contractor, as to which (i) Contractor hereby assigns to Owner to the extent assignable, any warranties made to Contractor and (ii) Contractor shall have no other liability to Buyer under warranty, tort or any other legal theory. Contractor warrants the goods, or any components thereof, through the earlier of (i) eighteen (18) months from delivery of the goods or (ii) twelve (12) months from initial operation of the goods or ninety (90) days from the performance of services (the "Warranty Period"). If Owner gives Contractor prompt written notice of breach of this warranty within the Warranty Period, Contractor shall, at its sole option and as Owner's sole and exclusive remedy, repair or replace the subject parts, re-perform the service or refund the purchase price. Unless otherwise agreed to in writing by Contractor, (i) Owner shall be responsible for any labor required to gain access to the goods so that Contractor can assess the available remedies and (ii) Owner shall be responsible for all costs of installation of repaired or replaced goods. If Contractor determines that any claimed breach is not, in fact, covered by this warranty, Owner shall pay Contractor its then customary charges for any repair or replacement made by Contractor. Contractor's warranty is conditioned on Owner's (a) operating and maintaining the goods in accordance with Contractor's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Contractor. Contractor's warranty does not cover (i) damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Contractor) and (ii) media goods (such as, but not limited to, resin, membranes, or granular activated carbon media) once media goods are installed. The warranties set forth in this section are contractor's sole and exclusive warranties, and owner makes no other warranties of any kind, express or implied, including without limitation, any warranty of merchantability or fitness for purpose.

6. General Conditions Article 14.03 D and E. Application for progress payment- Replace with payment terms stated in the BID.

7. General Conditions Article 17.07 Liquidated Damages- Reference liquidated damage terms in Contract Addendum # 1.

8. Add as new: Limitation of Liability- Notwithstanding anything else to the contrary, contractor shall not be liable for any consequential, incidental, special, liquidated, punitive or other indirect damages, and contractor's total liability arising at any time from the sale or use of the work, including without limitation any liability for all warranty claims or for any breach or failure to perform any obligation under the contract, shall not exceed the purchase price paid for the work on which such liability is based. These limitations apply whether the liability is based on contract, tort, strict liability or any other theory.

ARTICLE 19 - MISCELLANEOUS

19.01 PATENTS AND COPYRIGHTS

The Contractor shall indemnify and save harmless the Owner, the Engineer, and their officers, agents, and employees, against all claims or liability arising from the use of any patented or copyrighted design, device, material, or process by the Contractor or any of his subcontractors in the performance of the work.

SECTION 04
CHANGE ORDER 2

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JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. 02

Date: April 27, 2022

NAME OF PROJECT: Jordan Valley Water Treatment Plant Solids Handling Equipment Preselection Package

PROJECT NUMBER: 4138

SUPPLIER: Evoqua Water Technologies

CONTRACT DATE: September 8, 2021

The following changes are hereby made to the CONTRACT DOCUMENTS:

1. Provide 4-axle system in the forebays of Basins 3 – 6 per the attached proposal dated 4/4/2022.
2. Provide two of the twelve flight mechanisms as more “narrow width” and “higher elevation” to accommodate structural sister walls and topping slabs.
    1) In Basin 4 adjacent to the shared wall between Basins 3 and 4 as per the attached drawing.
    2) In Basin 5 adjacent to the shared wall between Basins 5 and 6 as per the attached drawing.

The milestone dates listed in the contract documents remain unchanged.

Total Change to CONTRACT PRICE: $233,506

Original CONTRACT PRICE: $3,725,657

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S)....... $3,725,657

The new CONTRACT PRICE including this CHANGE ORDER will be........... $3,959,163

CHANGE ORDER
(CONTINUED)

Change Order No. 2

Date: April 27, 2022

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

Recommended: ______________________________ ____________
Engineer – Brown and Caldwell Date

Accepted: ______________________________ ____________
Contractor – Evoqua Water Technologies Date

Approved: ______________________________ ____________
Owner - Jordan Valley Water Conservancy District Date

SECTION 05
NOTICE OF AWARD

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801.565.4300
fax 801.565.4399
jvwcd.org
8215 South 1300 West
West Jordan, UT 84088

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

NOTICE OF AWARD

To: Evoqua Water Technologies LLC
N19 W23993 Ridgeview Parkway, Suite 200
Waukesha, Wisconsin 53188 USA

Re: Solids Equipment Preselection Package

You are hereby notified that the OWNER has accepted your bid (including alternates 1, 2 and 3) for the above referenced project in the amount of 3,725,657.

Furnish the required Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: David McLean, PE.

A Notice to Proceed will be issued after negotiation and signature of the Agreement. When the Agreement is provided, sign and return it within ten calendar days.

Dated this 24th day of August, 2021.

Alan E. Packard, PE
Assistant General Manager & Chief Engineer
Jordan Valley Water Conservancy District

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:
This acceptance notice is signed in accordance with Proposal 419383 dated July 29, 2021.

This 25th day of August, 2021.

Signature:

Printed Name: James V. Harshman

Title: Director of Sales, Applied Product Technologies

Agenda Item No. 7.a.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONSIDER AWARD OF CONTRACT TO SUPPLY SOLIDS HANDLING EQUIPMENT AT THE JORDAN VALLEY WATER TREATMENT PLANT

August 11, 2021

Project: JVWTP Sedimentation Basins Equipment Replacement

Project Number: 4138

Budget: $4,518,800 in 2021/2022 Capital Projects Budget

Cost Sharing: MWDSLS - 2/7 ($1,064,473)

Bids were received from:

Bidder	Bid Amount
Engineer's Estimate	*$3,150,000 – $3,8500,000*
Evoqua	$3,725,657
Brentwood Industries	$6,513,000

Award of Purchase Contract Recommended to: Evoqua

Total Authorization Amount (Approval Requested): $3,725,657

Summary: The Jordan Valley Water Treatment Plant (JVWTP) was originally constructed in 1971, and was expanded in 1979, and again in 1986.

In October 2019, JVWCD commissioned Brown and Caldwell Engineers to complete a condition assessment of the JVWTP sedimentation basins equipment. This evaluation concluded that the 1971 circular solids collection equipment in Basins 1 and 2, and the 1985 chain and flight solids collection equipment in Basins 3-6, need to be replaced. The equipment was documented to have signs of advanced corrosion and age-related wear.

This purchase procures the chain and flight solids collection equipment for Basins 3-6. Included are 28 separate chain and flight mechanisms. The equipment is being pre-purchased due to long equipment lead times and the installation will be completed by a contractor selected through a separate competitive bidding procurement process.

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
Phone (801) 565-4300 • FAX (801) 565-4399
Fed. I.D. No. 87-6011348
Sales Tax Exemption No. 12060110-002-STC

Purchase Order

Fiscal Year 2022

THIS NUMBER MUST APPEAR ON ALL INVOICES, PACKAGES AND SHIPPING PAPERS.

Purchase Order # **20220390 - 00**

BILL TO
ADMINISTRATION - BLDG A
8215 S 1300 W
WEST JORDAN, UT 84088

VENDOR
3532
EVOQUA WATER TECHNOLOGIES LLC
28563 NETWORK PLACE
CHICAGO, IL 60673-1285

SHIP TO
ADMINISTRATION - BLDG A
8215 S 1300 W
WEST JORDAN, UT 84088
Phone: 801-565-4300
Fax: 801-565-4399

Vendor Phone Number	Vendor Fax Number	Requisition Number	Requested By
724-772-0044		22000436	DAVID MCLEAN

Date Ordered	Vendor Number	Date Required	Freight Method/Terms	Department/Location
08/18/2021	3532			ENGINEERING

Item#	Description/PartNo	G/L Acct. No.	QTY	UOM	Unit Price	Extended Price
	JVWTP SEDIMENTATION EQUIPMENT					
1	JVWTP SOLIDS HANDLING EQUIPMENT.	11000182 - 6010 - 4138	1.0	EACH	$3,725,657.00	$3,725,657.00

PURCHASING COPY

1. Acceptance of this order implies acceptance of these conditions.
2. Render invoices in DUPLICATE.
3. No charges will be allowed for packing or crating unless specified in quotation.
4. Please acknowledge this order PROMPTLY.
5. IF YOU CANNOT SHIP ON DATE SPECIFIED, ADVISE IMMEDIATELY.
6. Goods on this order must not be invoiced at a price higher than shown on purchase order without written consent.

Purchase Order Total
$3,725,657.00

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SECTION 06
AGREEMENT BETWEEN BUYER AND SELLER

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AGREEMENT

An Agreement made as of the 8th day of September, 2021, by and between the Jordan Valley Water Conservancy District, a Utah local district ("OWNER"), and Evoqua Water Technologies, LLC, a Delaware limited liability company qualified to do business and doing business in the State of Utah ("SUPPLIER").

TERMS:

OWNER and SUPPLIER, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I
WORK

SUPPLIER shall complete all Work as specified or indicated in the Contract Documents for the Jordan Valley Water Treatment Plant (JVWTP) Solids Handling Equipment Preselection Package. The Work is generally described as follows:

Furnishing all services, materials, equipment, and supplies except for such materials, equipment, and services as may be stipulated in the Contract Documents to be furnished by the OWNER; furnishing and removing all plant machinery, temporary structures, tools, supplies, transportation, utilities, and all other items, facilities and equipment, and to do everything required by this Agreement and the Contract Documents; accepting all responsibility for and paying for all loss and damage arising out of the nature of the Work aforesaid, or from the action of the elements, or from any unforeseen difficulties which may arise during the prosecution of the Work until its acceptance by OWNER, and for all risks of every description connected with the Work; also for all expenses resulting from the suspension or discontinuance of work, except as in the Contract Documents are expressly stipulated to be borne by OWNER.

ARTICLE II
ENGINEER

The Project has been designed by Brown and Caldwell, a California corporation qualified to do business and doing business in the State of Utah, who is hereinafter called "ENGINEER" and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III
CONTRACT TIME

3.1 The Work shall be complete, in accordance with paragraphs 14.08 and 14.09 of the General Conditions, on or before August 1, 2022.

3.2 Liquidated Damages: OWNER and SUPPLIER recognize that time is of the essence of this Agreement and that the OWNER will suffer financial loss if the Work is not completed within the time specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any proof of loss, OWNER and SUPPLIER agree that as liquidated damages for delay (but not as a penalty) SUPPLIER shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplementary General Conditions for each day that expires after the time specified in paragraph 3.1 for final completion until the Work is substantially complete. And, after Substantial Completion if SUPPLIER neglects, refuses or fails to complete the remaining Work within forty-five (45) days or any proper extension thereof granted by OWNER, SUPPLIER shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplemental General Conditions for each day that expires after the forty-five (45) days until readiness for final payment.

ARTICLE IV
CONTRACT PRICE

All payments to Supplier shall be made in accordance with the Contract Documents. OWNER shall pay SUPPLIER for completion of the Work in accordance with the Contract Documents in current funds those prices stated in the approved Bid Schedule as named in the Notice of Award.

ARTICLE V
PAYMENT PROCEDURES

SUPPLIER shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price on the basis of SUPPLIER's Applications for Payment as recommended by ENGINEER, on a monthly basis. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

5.2 Final Payment: Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in Article 14.

ARTICLE VI
INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of twelve percent (12%) per annum.

ARTICLE VII
SUPPLIER'S REPRESENTATION

In order to induce OWNER to enter into the Agreement, SUPPLIER makes the following representations:

7.1 SUPPLIER has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2 SUPPLIER has studied carefully all exploration reports and test of subsurface conditions and drawings of physical conditions which are identified in the Supplementary General Conditions, as provided in paragraph 4.02 of the General Conditions, and accepts the Technical Data contained in such reports and drawings upon which SUPPLIER is entitled to rely.

7.3 SUPPLIER has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as SUPPLIER considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by SUPPLIER for such purposes.

7.4 SUPPLIER has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.

7.5 SUPPLIER has correlated the results of all observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6 SUPPLIER has given ENGINEER written notice of all conflicts, errors or discrepancies that he had discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to SUPPLIER.

ARTICLE VIII
CONTRACT DOCUMENTS

The Contract Documents for the JVWTP Solids Handling Equipment Preselection Package, which comprise the entire agreement between OWNER and SUPPLIER concerning the Work, consist of the following:

8.1 This Agreement;
8.2 Notice of Award;
8.3 Notice to Proceed;
8.4 General Conditions;
8.5 Supplemental General Conditions;
8.6 Notice Inviting Bids;
8.7 Instructions to Bidders;
8.8 Information Required of Bidder;
8.9 Technical Specifications;
8.10 Addendum Number One; and,
8.11 SUPPLIER's Bid, including all schedules and explanatory attachments; attached as Exhibit A.

The SUPPLIER (1) acknowledges that he has received a copy of each document, specified above, (2) acknowledges that he has read and understands each document specified above and (3) agrees to every term, condition and contract obligation set forth in each document specified above.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.03 of the General Conditions.

ARTICLE IX
FEDERAL REQUIREMENTS

The SUPPLIER shall comply with federal regulations as stated in the Supplemental General Conditions, Article 21.

ARTICLE X
MISCELLANEOUS

10.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

10.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.3 In the event any legal action or other proceeding is brought for the enforcement of this Agreement and/or the Contract Documents, or for damages, because of an alleged dispute, breach, default or misrepresentation in connection with any of the provisions thereof, the successful or prevailing party shall be entitled to recover reasonable attorneys' fees and other costs incurred in the action or proceeding, in addition to any other relief to which it may be entitled.

10.4 Any notice to be given hereunder shall be deemed given when sent by registered or certified mail, postage prepaid to the parties at their respective addresses stated below or at any other address when notice of such change of address has been given as provided in this Article 10.4.

[SIGNATURE PAGE FOLLOWS]

"OWNER":	"SUPPLIER":
Jordan Valley Water Conservancy District 8215 South 1300 West West Jordan, Utah 84088	Evoqua Water Technologies, LLC N19W23993 Ridgeview Parkway, Suite 200 Waukesha, Wisconsin 53188
By: Barton A. Forsyth Barton A. Forsyth Its General Manager/CEO	By: Scott Lapcewich Scott Lapcewich Its: VP & General Manager Applied Product Technologies

EXHIBIT A

SUPPLIER'S BID

evoqua
WATER TECHNOLOGIES

JORDAN VALLEY WATER TREAMENT PLANT - JVWCD
HERRIMAN, UT

REQUEST FOR PROPOSALS FOR SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

Proposal No.: 419383, 29 July 2021

Questions related to this Proposal should be directed to Evoqua's area sales representative.

TC Sales & Service

10132 S. 440 E.

Sandy, UT 84070-4318

Mr. Cory Firzlaff

Mobile 801-201-3121

July 29, 2021

Jordan Valley WTP – JVWCD – Herriman, UT

Dear Reviewer,

I write this cover letter to thank you for the opportunity to put a replacement proposal together for the upgrade of your sedimentation tanks at the Jordan Valley Water Treatment Plant. This proposal will include the equipment required to update the currently installed equipment.

The specifications within the RFQ are primarily written around Evoqua standard components. One item of importance is the live stainless steel shafting which Evoqua has a long successful history of providing. Our competitor, who is also named in the specification, more typically provides three (3) piece non-metallic shafting which does not meet this specification.

Included in our proposal is a project schedule that provides an overview of the milestones Evoqua can commit to. We are proposing a "phased" submittal process in which partial submittals will be provided early on to deliver equipment as soon as possible. As of now, Evoqua can commit to a delivery of fifteen (15) weeks after approval of final submittals. This is estimated to be in May 2022.

The project schedule described above is contingent on two items. First, that a final agreement can be reached expeditiously. Second, Evoqua will need access to all basins incorporated in this project in order to take field measurements. All basins will need to be made available for measurements no later than November 1, 2021.

Please review the following proposal which explains the equipment being proposed and the layout of the new equipment to match the existing equipment layout.

Thank you for your time and we look forward to working with your team in replacing the equipment within these four collector basins.

N19 W23993 Ridgeview Parkway.
Suite 200
Waukesha, WI 53188 USA

Tel: +1 (262) 547-0141
Fax: +1 (262) 547-4120

www.evoqua.com

Evoqua
WATER TECHNOLOGIES

Sincerely,

RJ May
Technical Sales Engineer – Rectangular and Circular Clarifiers

Evoqua Water Technologies LLC
Tel: +1 (262) 521-8293
Mobile: +1 (262) 266-0275
ronald.may@evoqua.com

TABLE OF CONTENTS

SECTION 1

Evoqua Company Information

Evoqua Water Technologies was formed on March 28, 2013. The company employs approximately 4,000 people and conducts business globally, achieving annual sales in excess of US $1.3 billion.

Officers include:

Ronald C. Keating, President and Chief Executive Officer
Ben Stas, Executive Vice President, Chief Financial Officer and Treasurer
Herve Fages, Interim President, Applied Product Technologies

Evoqua Water Technologies is the global leader in helping municipalities and industrial customers protect and improve the world's most fundamental natural resource: water. Evoqua has a more than 100-year heritage of innovation and industry firsts, market-leading expertise, and unmatched customer service, where it continues to transform water and wastewater. Its cost-effective and reliable treatment systems and services ensure uninterrupted quantity and quality of water, enable regulatory and environmental compliance, increase efficiency through water reuse, and prepare customers for next-generation demands. Evoqua's unparalleled portfolio of proven brands, advanced technologies, mobile and emergency water supply solutions and service helps cities across the world provide and discharge clean water, and enable leisure and commercial industry to maximize productivity and profitability. For more information, visit www.evoqua.com.

While Evoqua is headquartered in the United States, we maintain experienced water specialists and offices in Australia, Canada, Germany, Italy, Singapore, and the United Kingdom. Globally, we are responsible for more than 200,000 installations.

Evoqua's Municipal Wastewater Treatment division provides support to consulting engineers and municipalities to deliver high-performance technologies for primary and secondary clarification, biological treatment, tertiary filtration, anaerobic digestion, order control, ultra-filtration, and disinfection. Our portfolio of trusted brands includes: USFilter®, Envirex®, Wallace & Tiernan®, Jet Tech, DAVCO™, RJ Environmental, JWI®, LYCO, Westates®, BioMag®, and CoMag®.

BRANDS YOU KNOW. PERFORMANCE YOU TRUST.

evoqua WATER TECHNOLOGIES

Envirex® MEMCOR® WALLACE & TIERNAN®
USFilter® JetTech RJ ENVIRONMENTAL LYCO
DAVCO™ DAVIS Westates® JWI™ STRANCO PFT

History and Advancements

For more than 100 years, Evoqua's Envirex product line has been in the business of providing solutions to the challenges of wastewater treatment. Envirex is an outgrowth of Chain Belt Company, Incorporated in Wisconsin, February 23, 1892, by Christopher William LeValley, Frederick William Sivyer, and William Draves. Mr. LeValley, Chain Belt's first president, designed a cast detachable link chain belt which he patented on July 20, 1886. These were assembled at the Pawling and Harnischfeger shop in West Milwaukee, Wisconsin, and sold under Mr. LeValley's name.

In 1908, Mr. LeValley designed a concrete mixer which he called Rex, Latin for king, and thus was born the trade name.

The start of Chain Belt's involvement in water and wastewater treatment came with the supply of traveling water screens sold in 1909 and installed in Commonwealth Edison's Fisk and California Avenue Stations in Chicago in 1910. These screens remained in service until 1978.

As a modification of traveling water screens, an inclined, perforated plate screen with a rotary brush for screenings removal was installed at the Milwaukee Jones Island sewage treatment plant in 1922. It was at this plant that a suction clarifier was developed in 1928 by Darwin Townsend, Milwaukee City Engineer, and James Brower, Plant Superintendent. This plant was the first activated sludge plant in the United States. It is from the inventors' names that the Envirex trade name "Tow-Bro" originated. The first 98 ft. diameter Tow-Bro was ordered October 5, 1928, and placed into service in June 1929.

In January 1927, the Conveying Equipment Division was established from which Envirex is an outgrowth.

In 1931, a completely new product line was introduced into the company and was known as "sanitation equipment". The country became aware of pollution problems in regard to below standard or non-existent municipal sewage plants and, at the time, Federal funds were made available to cities to either upgrade or construct new sewage treatment plants. This new product line lent itself to that need, and so with the loss of business due to the depressed industrial market, a municipal market was available and recognized. The division became active in pursuit of the business that was offered. The original units that were furnished were bar screens, grit collectors, and horizontal sludge collectors; all of which required chains, and Chain Belt Company's pintle chain was a major portion of the equipment required for these units.

In 1933, the name of the Conveying Equipment Division was changed to the Conveyor and Process Equipment Division.

The municipal market opened many new fields for the young division, and the product line on sanitation and process equipment extended rapidly to include such other products as Triturators and Slow-Mix flocculators in 1933-34. In 1937, the first scraper ever sold to a petroleum refinery was installed at what is now Atlantic Refining Company's Philadelphia, PA refinery, the first of many API separators which were to follow.

In 1944, A.C. Lind invented the Verti-Flo and the Strati-Flo clarifiers. The Verti-Flo found strong acceptance in water treatment fixed film biological treatment systems for efficient sedimentation.

In 1951, a new product line of dissolved air flotation separators was developed.

In 1968, the operation was split into a Conveyor Division and a Water Quality Control Division. In the latter part of 1968, the Pacific Flush Tank Company of Chicago was purchased. On February 13, 1973, the latter became incorporated in Nevada as Envirex Inc., a wholly owned subsidiary of the Rexnord Corporation.

During 1970, the Water Quality Control Division began construction of a 140,000 sq. ft. office and factory on a 28-1/2 acre site in the south industrial park in Waukesha, Wisconsin. The office was almost doubled in 1972 to provide a total of 200,000 sq. ft. of facilities, which were completed in September 1973.

Through new product development, we intend to remain in the position of having the most complete line of water and wastewater equipment available anywhere. A dedicated staff of engineers and support technicians are charged with the sole task of research and development. Continued emphasis is placed on energy, long life-cycles and improved product reliability.

Since the design and patenting of the cast detachable link chain belt in 1886 (the predecessor of today's high-strength, non-metallic "Loop Chain" for heavy duty sludge collector service and severe duty API and DGF separators), Evoqua's Envirex brand has been a leader in offering innovative equipment designs and services for water and wastewater treatment. Some of the more precedent setting, innovative equipment designs include:

1905	-	Rex Traveling Water Screens
1925	-	PFT Digester Floating Cover
1928	-	Tow-Bro Hydraulic Sludge Removal Arm
1931	-	Rex Bar Screen and Grit Collector
1937	-	Rex API Oil/Water Separator
1945	-	PFT External Digester Heater
1951	-	Rex Dissolved Air Flotation Separator
1955	-	Rim-Flo Peripheral-feed Secondary Clarifier
1957	-	Rex Dissolved Air Flotation Thickener
1968	-	PFT Orbal Aeration
1969	-	Rex Rotating Biological Contactor
1976	-	Rex Non-metallic Chain and Flight Sludge Collector
1985	-	PFT Dystor Digester Gas Storage System
1985	-	Omniflo SBR
1986	-	Rex-Flex Flexible Membrane Aeration
1986	-	Rex Loop Chain
1987	-	Rex Fluidized Bed Process
1990	-	Envirex Multipass Dryer
1990	-	Bionutre Process
1993	-	Kevlar Coated/Stainless Steel Pin Rex loop chain

1997	-	High Rate DAF Separator
2000	-	Memcor Membrane BioReactor
2005	-	Disc Filter
2005	-	MBBR
2010	-	LDC JetMix Hydraulic Mixing
2012	-	CWT BioMag/CoMag Advanced Separation
2015	-	Captivator High-Rate Biologically Enhanced Primary Clarification
2016	-	OX Orbal Disc Aerator

Innovation and reliability in wastewater treatment are synonymous with Evoqua, as evidenced by more than 130 patents on our equipment and processes, and the 8,000 plus installations at industries and municipalities worldwide. Throughout our history, our engineers have been involved with the daily intricacies of how to optimize equipment performance; the selection of proper ancillary support equipment; proper methods of equipment installation; start-up, and of course, how to provide the best post-installation service in the industry. Evoqua engineers have been answering questions on "how to" and "how not to" and on "what works" and "what does not work" for years. Dependable service to our clients is our number one goal.

The Envirex brand employs the resources of over 200 licensed professional engineers, mechanical designers, technicians, and support staff at the headquarters in Waukesha, Wisconsin, to offer a complete package of water and wastewater treatment system design and turnkey installation services. "Complete" means from beginning to end, starting with conceptual design and the development of cost-effective process designs, through bench-scale testing or longer term onsite pilot studies, through construction, and of utmost importance is that with Envirex, the project never really ends, we provide the best post-installation services in the business.

The key to the proper design of water and wastewater treatment processes or systems occurs up front, with the selection of an overall cost-effective treatment strategy that efficiently meets the treatment objectives. By offering more than sixty-five equipment components and processes, the Envirex brand is positioned to furnish and stand behind that technology and equipment that is best suited for our client's needs.

Pilot studies may prove helpful in demonstrating the effectiveness of innovative treatment strategies in their ability to perform as intended. Evoqua has extensive experience conducting pilot testing in the laboratory or in the field, using existing pilot equipment or custom fabricated equipment. This testing is accomplished by our dedicated team of field process engineers, working in conjunction with laboratory technicians who are experienced environmental engineers and scientists.

We also utilize our own Electrical Controls Group for detailed design of control systems. This group is experienced in providing controls and instrumentation that meet the requirements for the petroleum industry. The wide range of industries served keeps us current on state-of-the-art control technology, including computer and PC control systems.

With the growth in state-of-the-art water and wastewater treatment technology, it has become increasingly apparent that unless the equipment is installed properly, it will not perform to design expectations. As the equipment designer and manufacturer, Evoqua helps ensure the equipment is installed properly to make sure that the equipment performs as designed and that the end user will be the beneficiary of the most maintenance free equipment possible.

Finally, our process start-up services are normally performed by the Envirex engineers responsible for the design of the system. The Evoqua approach to system engineering is to assign project people at the treatability and design stage and keep that team on the project through completion. That continuity of personnel proves invaluable during the start-up, debugging, and optimization phases of a project.

Our efforts do not stop there. Evoqua continues to search for new ways to serve the needs of our customers and their consultants. Our long list of successful installations is testimony to our capabilities. The wide range of municipalities and industries served, including chemical, petroleum and refining, food, textile, manufacturing, steel transportation and public and private utilities, provides the technical and practical background that assures a successful project.

SECTION 2

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That Evoqua Water Technologies LLC, as Bidder,

and RLI Insurance Company, as Surety,

are held and firmly bound unto the Jordan Valley Water Conservancy District (hereinafter called "Owner") in the sum of $ Five Percent of Amount Bid (5%) dollars (not less than five percent of the total amount of the bid) for the payment of which sum, will and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Bidder has submitted a bid to Owner to perform all work required under the bidding Schedule of the Owner's Contract Documents entitled "Solids Handling Equipment Preselection Package", (hereafter called the "Project").

NOW THEREFORE, if Bidder is awarded Contract by Owner for the Construction of the Project and, within the time and in the manner required under the heading "Instructions to Bidders" enters into the written contract entitled "Agreement" bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond within 10 calendar days after receipt of such contract from Owner, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by Owner and judgment is recovered, Surety shall pay all costs incurred by Owner in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 29th day of July, 2021.

Evoqua Water Technologies LLC	RLI Insurance Company
By: James V. Haughian	By: Autumn Schneider
JAMES V. HAUGHIAN	
Its: SALES DIRECTOR, APT.	Its: Autumn Schneider, Attorney-in-Fact

(SEAL)

POWER OF ATTORNEY

RLI Insurance Company
Contractors Bonding and Insurance Company

9025 N. Lindbergh Dr. Peoria, IL 61615
Phone: 800-645-2402

Know All Men by These Presents:

That this Power of Attorney is not valid or in effect unless attached to the bond which it authorizes executed, but may be detached by the approving officer if desired.

That **RLI Insurance Company** and/or **Contractors Bonding and Insurance Company**, each an Illinois corporation, (separately and together, the "Company") do hereby make, constitute and appoint:

Richard C. Rose, Jeremy C. Rose, Aimee R. Perondine, Joshua Sanford, Tina Foster, Autumn Schneider, Amanda Loveday, Danielle D. Johnson, jointly or severally

in the City of Dallas, State of Texas its true and lawful Agent(s) and Attorney(s) in Fact, with full power and authority hereby conferred, to sign, execute, acknowledge and deliver for and on its behalf as Surety, in general, any and all bonds and undertakings in an amount not to exceed **Twenty Five Million** Dollars (**$25,000,000.00**) for any single obligation.

The acknowledgment and execution of such bond by the said Attorney in Fact shall be as binding upon the Company as if such bond had been executed and acknowledged by the regularly elected officers of the Company.

RLI Insurance Company and/or **Contractors Bonding and Insurance Company**, as applicable, have each further certified that the following is a true and exact copy of a Resolution adopted by the Board of Directors of each such corporation, and is now in force, to-wit:

"All bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation shall be executed in the corporate name of the Company by the President, Secretary, any Assistant Secretary, Treasurer, or any Vice President, or by such other officers as the Board of Directors may authorize. The President, any Vice President, Secretary, any Assistant Secretary, or the Treasurer may appoint Attorneys in Fact or Agents who shall have authority to issue bonds, policies or undertakings in the name of the Company. The corporate seal is not necessary for the validity of any bonds, policies, undertakings, Powers of Attorney or other obligations of the corporation. The signature of any such officer and the corporate seal may be printed by facsimile."

IN WITNESS WHEREOF, the **RLI Insurance Company** and/or **Contractors Bonding and Insurance Company**, as applicable, have caused these presents to be executed by its respective Vice President with its corporate seal affixed this 8th day of April, 2020.

CONTRACTORS BONDING AND INSURANCE COMPANY CORPORATE SEAL ILLINOIS

RLI INSURANCE COMPANY CORPORATE SEAL ILLINOIS

RLI Insurance Company
Contractors Bonding and Insurance Company

By: *B. H. W. D.*
Barton W. Davis — Vice President

State of Illinois }
} SS
County of Peoria }

On this 8th day of April, 2020, before me, a Notary Public, personally appeared Barton W. Davis, who being by me duly sworn, acknowledged that he signed the above Power of Attorney as the aforesaid officer of the **RLI Insurance Company** and/or **Contractors Bonding and Insurance Company** and acknowledged said instrument to be the voluntary act and deed of said corporation.

By: *Jacqueline M. Bockler*
Jacqueline M. Bockler — Notary Public

OFFICIAL SEAL
JACQUELINE M BOCKLER
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES JAN 14 2022

CERTIFICATE

I, the undersigned officer of **RLI Insurance Company** and/or **Contractors Bonding and Insurance Company**, do hereby certify that the attached Power of Attorney is in full force and effect and is irrevocable; and furthermore, that the Resolution of the Company as set forth in the Power of Attorney, is now in force. In testimony whereof, I have hereunto set my hand and the seal of the **RLI Insurance Company** and/or **Contractors Bonding and Insurance Company** this 29th day of July, 2021.

RLI Insurance Company
Contractors Bonding and Insurance Company

By: *Jeffrey D. Fick*
Jeffrey D. Fick — Corporate Secretary

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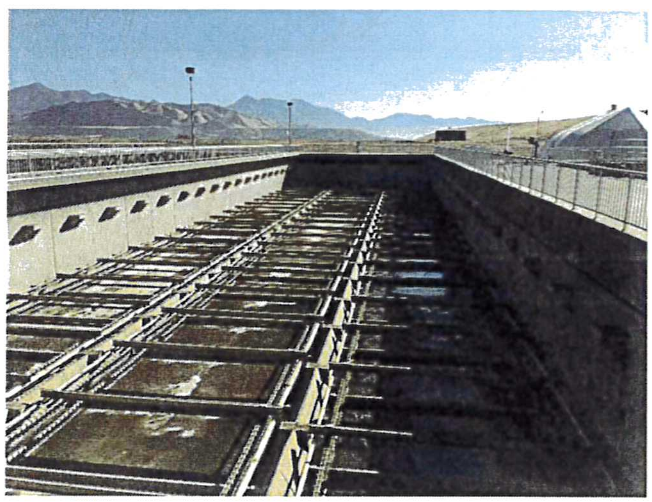
JORDAN VALLEY WATER TREAMENT PLANT - JVWCD
HERRIMAN, UT

REQUEST FOR PROPOSALS FOR SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

Proposal No.: 419383, 29 July 2021



Questions related to this Proposal should be directed to Evoqua's area sales representative.

TC Sales & Service

10132 S. 440 E.

Sandy, UT 84070-4318

Mr. Cory Firzlaff

Mobile 801-201-3121

To: Jordan Valley Water Conservancy District (JVWCD)
Bid Date/Time: 29 July 2021

1. SUMMARY

Evoqua Water Technologies LLC (Evoqua) proposes to furnish the equipment specified in this Proposal in accordance to the scope of supply described in this proposal and subject to the Clarifications/Exceptions and Standard Terms of Sale stated herein.

Addendum received: 1

The information in this proposal is confidential and/or proprietary and has been prepared solely for the recipient's use in considering the purchase of the equipment and/or services described herein. Transmission of all or any part of this information to others, or use by the recipient, for other purposes is expressly prohibited without Evoqua's prior written consent.

ITEM & DESCRIPTION	PRICE
Chain and Scraper Mechanisms	(See Bid Form)

Evoqua's price includes only the specific items detailed in this proposal. Items not specifically identified herein are to be furnished by others. Please refer to the excluded items in Section 4 of this proposal for a list of items to be furnished by others.

A. OPTIONS: The above items noted as Extra Cost Option will only be accepted only when included with the basic equipment order. *none*

B. FREIGHT: Pricing is FOB shipping point with standard freight allowed to the job site. Our price does not include any costs for unloading, transporting on the site, phased shipments other than described in this proposal, or storage.

C. PROPOSAL VALIDITY: This proposal is valid for a period of sixty (60) days unless extended in writing by Evoqua. Due to current raw material price fluctuation, Evoqua reserves the right to re-proposal the equipment proposed herein after that time.

Due to volatility in steel costs, prices proposal in this proposal will be adjusted to reflect changes in the Metal and Metal Products Index (MMPI) published by the U.S. Department of Labor, Bureau of Labor Statistics. The most recent published MMPI is 294.2 for June 2021. If the MMPI exceeds 300.2 at the time the Equipment is released for manufacture, then the price will be increased by the same percentage as the MMPI exceeds 300.2.

D. FIELD SERVICES: Evoqua's pricing includes the services of a factory field service technician for checking the installed equipment and instruction of Owner's personnel; all of which shall be performed over a total of

sixteen (16) trips **twenty-eight (28) days on site**

E. SERVICE MANUALS: Our pricing includes an electronic version of the operation and maintenance (O&M) manual as an Adobe PDF file only. Drawings will be supplied in an unchangeable TIF, bitmap, or Adobe PDF file format only. The rights to the content of Evoqua O&M manuals and drawings belong solely to Evoqua and Evoqua reserves the right to make changes to the content at any time.

F. PAYMENT AND PRICE TERMS: The terms of payment are net 30 in accordance with the following milestones:

- 10% on drawing submittal delivery;
- 85% on shipment of equipment, or offer to ship;
- 5% on startup of equipment or 120 days from final delivery, whichever occurs first.

G. CANCELLATION POLICY: If Evoqua is issued an order and the Buyer cancels or suspends its order for any reason other than Evoqua's breach, the Buyer shall promptly pay Evoqua for work performed prior to cancellation or suspension and any other direct costs incurred by Evoqua as a result of such cancellation or suspension. At a minimum, cancellation after executed contract will result in a cancellation fee of 10% of the total order value.

Evoqua's prices are exclusive of any taxes. If this project is not subject to sales or use tax, please issue a Tax-Exempt Certificate with any ensuing purchase order (P.O.). If applicable, please provide a copy of payment bond information with the P.O. With no exemption or if this project is subject to sales or use tax, the Purchaser will be invoiced for taxes at the then-current rate of sales, use or other tax for the jobsite location.

2. DRAWING AND SHIPPING INFORMATION

Evoqua will furnish shop drawing submittals and equipment per the following project schedule:

- Partial Submittal Drawings: Within three (3) weeks from the date of final agreement by both parties. Scope to include equipment specifications, materials, preliminary layouts, and cut sheets. **Submittal contingent on verification that all basins will be made available for field measurements no later than November 1, 2021 <u>and</u> a final agreement can be reached expeditiously.**
- Partial Submittal Drawing Reviews/Approvals are due within four (4) weeks from Evoqua's delivery of Partial Submittal Drawings.
- Final Submittal Drawings: Within twenty-one (21) weeks from the date of final agreement by both parties.
- Final Submittal Drawing Reviews/Approvals are due within four (4) weeks from Evoqua's delivery of Final Submittal Drawings.
- Shipment of Equipment: Within fifteen (15) weeks after approval of Final Submittal Drawings.

Evoqua has provided typical standard times and shipment dates. Actual times will be provided upon receipt of a Purchase Order based upon current backlog. Evoqua will work closely with the General Contractor and/or Engineer to provide delivery dates to meet the overall project schedule as possible.

If Submittal Drawing Reviews/Approvals are not received by Evoqua in accordance with the project schedule noted above, Evoqua shall be entitled to a reasonable extension of the *Shipment of Equipment* times and/or a reasonable increase in the contract price to cover costs incurred because of Submittal Drawing Review/Approval delays unless the delay is the fault of Evoqua.

3. EQUIPMENT SCOPE

As a named manufacturer of this item, Evoqua Water Technologies, LLC (Evoqua) proposes to furnish the following Envirex® equipment:

Twelve (12) 3-shaft primary chain and scraper sludge collector mechanisms for installation in four (4) existing concrete basins. Each collector mechanism will fit inside a channel 18.3 ft. wide x 123 ft. long x 12.1 ft. side wall depth.

Twelve (12) 3-shaft primary chain and scraper sludge collector mechanisms for installation in four (4) existing concrete basins. Each collector mechanism will fit inside a channel 18.3 ft. wide x 237 ft. long x 12.1 ft. side wall depth.

Four (4) 3-shaft cross collector mechanisms for installation in the primary basins.

EQUIPMENT WILL CONSIST OF THE FOLLOWING: (each Collector)

- Speed reducer with motor – dual output reducers will drive multiple collectors
- Drive base – 316SS
- Drive sprocket with overload devices – shear pin hub and ball detent torque limiter
- Driven sprocket
- Drive chain tightener
- Chain guard – 304SS
- Shafting – 316SS
- Sprockets
- Set collars
- Bearings – cast 316SS split housing, polyurethane hub ball
- Chains – NCS720 and NH78
- Flights – Sigma Plus 3x8
- Wear shoes
- Return tracks with 316SS brackets – 316SS J-tracks (no wear strips required)
- Wear strips for floor, field weld to existing embedded t-rail (if possible) – 316SS
- Grease fittings
- Grease lines – 316SS
- Associated attachment bolts and anchor bolts

ELECTRICAL CONTROLS

One (1) overload limit switch in a combination NEMA 4X / 7 enclosure for each collector mechanism.

All other controls, disconnect switches, conduit and wiring are not provided by Evoqua.

SPARE PARTS

Spare parts included in our price are per the engineer's specifications, Section 46 43 11, 1.09B.

SHIPPING INFORMATION FOR SLUDGE COLLECTORS

The equipment will be shipped as follows:

Drive unit – Motor assembled to speed reducer - Palletized.

Drive base – Palletized.

Drive sprocket, overload device, and base plate – Boxed and/or palletized.

Chain guard – Shipped loose.

Chain section lengths - Boxed and/or palletized.

Flights - Grouped and banded together.

Bearings, sprockets, wear shoes, return track supports, and chain tightener - Boxed.

Shafting, return tracks, and wear strips - Banded in bundles.

Anchors and assembly bolts - Bagged or boxed.

SURFACE PROTECTION

Evoqua's price is based on the following surface protection, unless stated otherwise in this proposal:

A. Submerged and non-submerged castings, steel plates and shapes: surfaces will be prepared by blast cleaning, then followed by one (1) shop coat of Tnemec Series FC20 (color 1211 Red), 2.0 to 6.0 mils DFT.

B. Stainless Steel shafting and exposed machined surfaces: solvent wiping, followed by one (1) coat of Evoqua's standard shop preservative. All other Stainless Steel materials to remain unpainted.

C. Wood, nonferrous materials, and galvanized surfaces: unpainted.

D. Drive units and controls: manufacturer's standard.

Touch-up and all additional coats shall be furnished and applied by others at the site.

Prices are based on paints and surface preparations as outlined in this proposal. In the event an alternate paint system is selected, purchaser's order must advise of its selection. Evoqua will, at its sole discretion, either adjust its price as necessary to comply or ship the material unpainted if compliance is not possible due to price considerations, application problems or environmental controls.

Evoqua does not guarantee primer's compatibility with purchaser's coating system unless approved by the coating system manufacturer. Primers will only protect for a minimal amount of time, usually thirty (30) days. Specific information should be obtained from coating system manufacturer.

4. EXCLUDED ITEMS

The price from Evoqua includes only those items listed in this Proposal. The items listed below are excluded:

- Fastener anti-seize lubricant.
- Verification of the condition of the tanks to receive equipment.
- Electrical, hydraulic, or pneumatic controls.
- Wiring of motors or controls, control panels, or panel supports.
- Junction boxes, motor disconnect switches, MCC, control panels, or panel supports.
- Piping, valves, gates, drains, weirs, baffles.
- Wall or floor sleeves.
- Floor grating, stairways, ladders, platforms, handrailing.

- Concrete, grout, mastic, sealing compounds, anchor templates or settling of anchor bolts.
- Lubricants, grease piping, grease gun.
- Machinery or bearing supports, shims.
- Detail shop fabrication drawings.
- Tools, except for the chain tool included with the collector chain.
- Equipment offloading and installation of any kind.
- Modifications to existing equipment or structures.
- Supervisory services; laboratory, shop, or field testing.
- Underwriters Laboratory inspection of electrical controls.
- Special written process performance or extended mechanical warranties other than 3-year proposed flight warranty.

5. CLARIFICATIONS/EXCEPTIONS

The equipment specified herein shall conform to the specification sections referenced in Section 1 of Evoqua's Proposal to the extent they are technically applicable to Evoqua's scope of supply as described in this Proposal and subject to the following clarifications:

Article, Section	Clarifications/Proposed Modifications
n/a	Evoqua Water Technologies LLC enters into this bid with the Evoqua terms of sale dated May 2015 attached hereto and incorporated by reference. If upon award of the contract, at the request of the customer, Evoqua will negotiate mutually agreeable terms between the parties. Evoqua reserves the right to revisit such terms and conditions with the customer.
n/a	Evoqua shall perform a site visit to take field dimensions required for final submittals. Condition of tanks and equipment will not be verified. Field dimensions are needed by November 1, 2021 in order to meet our schedule described in this proposal. All tanks must be drained and accessible for this visit.
n/a	Evoqua will furnish equipment as proposed for the Contractor to install. Labor, equipment necessary for alterations and/or installation of our equipment, repair and alterations or cleaning of the existing structures, is the responsibility of the Contractor. Evoqua is not responsible for the locations, condition or dimensions of existing concrete, anchors, or any equipment not furnished by Evoqua
Section 46 43 11, 1.08 A.1.b & c.	Flight warranty period shall be 3 years from shipment.
Section 46 43 11, 1.09 A.4.b.3.b.	Evoqua takes exception to this requirement. Chain elongation is a function of the operating environment, not the quality of the chain. We do not control the operating conditions and therefore cannot provide a warranty around chain elongation.
Section 46 43 11, 2.02 A.1.d.	The minimum modulus of elasticity for Sigma Plus flights is 3,830,000 pounds per square inch.
Section 46 43 11, 2.02 G.3.a.	Shaft tolerance shall be nominal shaft size as specified plus 0.005 inch to minus 0.005 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.

Section 46 43 11, 2.02 G.3.b.	Bearing tolerance shall be nominal size as specified plus 0.040 inch to minus 0.000 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.
Section 46 43 11, 2.02 G.3.c.	Sprocket tolerance shall be nominal shaft size as specified plus 0.040 inch to minus 0.000 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.
Section 46 43 11, 2.02 G.6.	Shearing stress shall not exceed 12,000 pounds per square inch for shafts with key seats and 12,000 pounds per square inch for shafts without key seats. Tolerance provided in specifications is typical of high speed machinery, which does not apply.
Section 46 43 11, 2.02 O.1.a.10.	Motors shall be severe duty only due to constant expected speeds.
Section 46 43 11, 3.04 A.3.a.	Sag for Sigma Plus flights shall not deviate more than ½" inch below straight line between bottom edge of flight at wearing shoes.
Bid Form, Alternative 1	The deduct total price is the result of the non-supply of brackets/supports used for Evoqua J-track return rails. Any/all brackets that are intended to be used for this alternative must be compatible with our design. Any other costs associated with this alternative are the responsibility of the contractor.

Evoqua's standard terms and conditions, including without limitation Evoqua's warranty obligations in Article 7 govern the purchase and sale of equipment, products, and related services, referred to in Evoqua's proposal. Evoqua's offer or acceptance is expressly conditioned on Buyer's assent to these terms. Evoqua rejects all additional or different terms in any of Buyer's forms or documents, Evoqua takes exception to all performance commitments, guarantees or obligations, unless provided for in Evoqua's proposal.

6. ADDITIONAL FIELD SERVICES

Should the Purchaser feel that additional services will be required, they can be purchased from Evoqua. Additional services may be purchased at the *per diem* rate stated below.

Evoqua's price does not include service of a factory field service technician during the time of installation of the equipment items.

In the event Purchaser wishes to videotape the Evoqua field service personnel during start-up and/or field service, Purchaser must execute Evoqua's standard "Videotape Agreement" in which the Purchaser shall expressly waive any claim against Evoqua, for injury or damage caused by inaccuracies or errors in such videotape(s), and acknowledge that such videotaping is done by Purchaser at its sole risk.

TERMS GOVERNING FIELD SERVICES: Services of a factory field service technician to inspect installation and/or first operation of the products specified in the proposal can be furnished by Evoqua at the following rates:

A. Supervision or consultation of a process service technician within the continental limits of the United States: $1,400 per eight (8) hour day, Monday through Friday inclusive.

B. Supervision or inspection of a field service technician within the continental limits of the United States: $1,200 per eight (8) hour day, Monday through Friday inclusive. Overtime Monday through Friday and Saturday work is charged at time and one-half. Time worked on Sunday will be charged double time; time worked on U.S. Holidays will be charged triple time.

C. Traveling, living and incidental expenses at cost, including shipping charges on tools and other equipment which the factory field service technician has shipped to the construction site.

D. Travel time will be charged to and from Purchaser's construction site, and weekend or holiday travel request or required by Purchaser will be charged at the overtime rates.

E. Rescheduling or cancellation of a field service trip once booked will incur the greater of either a $1,500 cancellation or re-scheduling charge, or actual costs.

Rates shown above apply only to additional services performed within twelve (12) months from the date of Proposal. Additional services performed after twelve (12) months from the date of Proposal shall be subject to Evoqua's current rates at the time such service is provided. Except for the direct acts or omissions of the factory field service technician, the responsibility for the installation and/or first operation shall be Purchaser's. Evoqua will assume responsibility for workmen's compensation coverage of Evoqua employees only and will provide umbrella liability coverage during installation. All other insurance coverage and necessary materials to accomplish installation shall be provided by Purchaser.

EVOQUA WATER TECHNOLOGIES LLC

STANDARD TERMS OF SALE

1. **Applicable Terms.** These terms govern the purchase and sale of equipment, products, related services, leased products, and media goods if any (collectively herein "Work"), referred to in Seller's proposal ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is expressly conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. **Payment.** Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation specifically provides otherwise, freight, storage, insurance and all taxes, levies, duties, tariffs, permits or license fees or other governmental charges relating to the Work or any incremental increases thereto shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. If Buyer claims a tax or other exemption or direct payment permit, it shall provide Seller with a valid exemption certificate or permit and indemnify, defend and hold Seller harmless from any taxes, costs and penalties arising out of same. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval by Seller. Back charges without Seller's prior written approval shall not be accepted.

3. **Delivery.** Delivery of the Work shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, delivery terms are Ex Works Seller's factory (Incoterms 2010). Title to all Work shall pass upon receipt of payment for the Work under the respective invoice. Unless otherwise agreed to in writing by Seller, shipping dates are approximate only and Seller shall not be liable for any loss or expense (consequential or otherwise) incurred by Buyer or Buyer's customer if Seller fails to meet the specified delivery schedule.

4. **Ownership of Materials and Licenses.** All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data, software and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Work. Buyer shall not disclose any such material to third parties without Seller's prior written consent. Buyer grants Seller a non-exclusive, non-transferable license to use Buyer's name and logo for marketing purposes, including but not limited to, press releases, marketing and promotional materials, and web site content.

5. **Changes.** Neither party shall implement any changes in the scope of Work described in Seller's Documentation without a mutually agreed upon change order. Any change to the scope of the Work, delivery schedule for the Work, any Force Majeure Event, any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Seller to an equitable adjustment in the price and time of performance.

6. **Force Majeure Event.** Neither Buyer nor Seller shall have any liability for any breach or delay (except for breach of payment obligations) caused by a Force Majeure Event. If a Force Majeure Event exceeds six (6) months in duration, the Seller shall have the right to terminate the Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed prior to the date of termination. "Force Majeure Event" shall mean events or circumstances that are beyond the affected party's control and could not reasonably have been easily avoided or overcome by the affected party and are not substantially attributable to the other party. Force Majeure Event may include, but is not limited to, the following circumstances or events: war, act of foreign enemies, terrorism, riot, strike, or lockout by persons other than by Seller or its sub-suppliers, natural catastrophes or (with respect to on-site work), unusual weather conditions.

7. **Warranty.** Subject to the following sentence, Seller warrants to Buyer that the (i) Work shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship and (ii) the Services shall be performed in a timely and workmanlike manner. Determination of suitability of treated water for any use by Buyer shall be the sole and exclusive responsibility

of Buyer. The foregoing warranty shall not apply to any Work that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. The Seller warrants the Work, or any components thereof, through the earlier of (i) eighteen (18) months from delivery of the Work or (ii) twelve (12) months from initial operation of the Work or ninety (90) days from the performance of services and thirty-six (36) months from delivery of the flights (the "Warranty Period"). If Buyer gives Seller prompt written notice of breach of this warranty within the Warranty Period, Seller shall, at its sole option and as Buyer's sole and exclusive remedy, repair or replace the subject parts, re-perform the Service or refund the purchase price. Unless otherwise agreed to in writing by Seller, (i) Buyer shall be responsible for any labor required to gain access to the Work so that Seller can assess the available remedies and (ii) Buyer shall be responsible for all costs of installation of repaired or replaced Work. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Work in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover (i) damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller) and (ii) media goods (such as, but not limited to, resin, membranes, or activated carbon media) once media goods are installed. THE WARRANTIES SET FORTH IN THIS SECTION 7 ARE THE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO THE LIMITATION OF LIABILITY PROVISION BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

8. **Indemnity.** Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

9. **Assignment.** Neither party may assign this Agreement, in whole or in part, nor any rights or obligations hereunder without the prior written consent of the other party; provided, however, the Seller may assign its rights and obligations under these terms to its affiliates or in connection with the sale or transfer of the Seller's business and Seller may grant a security interest in the Agreement and/or assign proceeds of the agreement without Buyer's consent.

10. **Termination.** Either party may terminate this agreement, upon issuance of a written notice of breach and a thirty (30) day cure period, for a material breach (including but not limited to, filing of bankruptcy, or failure to fulfill the material obligations of this agreement). If Buyer suspends an order without a change order for ninety (90) or more days, Seller may thereafter terminate this Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed, whether delivered or undelivered, prior to the date of termination.

11. **Dispute Resolution.** Seller and Buyer shall negotiate in good faith to resolve any dispute relating hereto. If, despite good faith efforts, the parties are unable to resolve a dispute or claim arising out of or relating to this Agreement or its breach, termination, enforcement, interpretation or validity, the parties will first seek to agree on a forum for mediation to be held in a mutually agreeable site. If the parties are unable to resolve the dispute through mediation, then **any dispute, claim or controversy arising out of or relating to this Agreement or the breach, termination, enforcement, interpretation or validity thereof, including the determination of the scope or applicability of this agreement to arbitrate, shall be determined by arbitration in Pittsburgh, Pennsylvania before three arbitrators** who are lawyers experienced in the discipline that is the subject of the dispute and shall be jointly selected by Seller and Buyer. **The arbitration shall be administered by JAMS pursuant to its Comprehensive Arbitration Rules and Procedures. The Arbitrators shall issue a reasoned decision** of a majority of the arbitrators, which shall be the decision of the panel. Judgment may be entered upon the arbitrators' decision in any court of competent jurisdiction. The substantially prevailing party as determined by the arbitrators shall be reimbursed by the other party for all costs, expenses and charges, including without limitation reasonable attorneys' fees, incurred by the prevailing party in connection with the arbitration. For any order shipped outside of the United States, any dispute shall be referred to and finally determined by the International Center for Dispute Resolution in accordance with the provisions of its International Arbitration Rules, enforceable under the New York Convention (Convention on the Recognition and Enforcement of Foreign Arbitral Awards) and the governing language shall be English.

12. **Export Compliance.** Buyer acknowledges that Seller is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal and usage of the Work provided under this Agreement, including any export license requirements. Buyer agrees that such Work shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by Seller of its obligations hereunder that compliance with such export laws and regulations be maintained at all times. BUYER AGREES TO INDEMNIFY AND HOLD SELLER HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

13. **LIMITATION OF LIABILITY.** NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE WORK, INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR ALL WARRANTY CLAIMS OR FOR ANY BREACH OR FAILURE TO PERFORM ANY OBLIGATION UNDER THE CONTRACT, SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE WORK. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

14. **Rental Equipment / Services.** Any leased or rented equipment ("Leased Equipment") provided by Seller shall at all times be the property of Seller with the exception of certain miscellaneous installation materials purchased by the Buyer, and no right or property interest is transferred to the Buyer, except the right to use any such Leased Equipment as provided herein. Buyer agrees that it shall not pledge, lend, or create a security interest in, part with possession of, or relocate the Leased Equipment. Buyer shall be responsible to maintain the Leased Equipment in good and efficient working order. At the end of the initial term specified in the order, the terms shall automatically renew for the identical period unless canceled in writing by Buyer or Seller not sooner than three (3) months nor later than one (1) month from termination of the initial order or any renewal terms. Upon any renewal, Seller shall have the right to issue notice of increased pricing which shall be effective for any renewed terms unless Buyer objects in writing within fifteen (15) days of issuance of said notice. If Buyer timely cancels service in writing prior to the end of the initial or any renewal term this shall not relieve Buyer of its obligations under the order for the monthly rental service charge which shall continue to be due and owing. Upon the expiration or termination of this Agreement, Buyer shall promptly make any Leased Equipment available to Seller for removal. Buyer hereby agrees that it shall grant Seller access to the Leased Equipment location and shall permit Seller to take possession of and remove the Leased Equipment without resort to legal process and hereby releases Seller from any claim or right of action for trespass or damages caused by reason of such entry and removal.

15. **Miscellaneous.** These terms, together with any Contract Documents issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. To the extent the Agreement is considered a subcontract under Buyer's prime contract with an agency of the United States government, in case of Federal Acquisition Regulations (FARs) flow down terms, Seller will be in compliance with Section 44.403 of the FAR relating to commercial items and those additional clauses as specifically listed in 52.244-6, Subcontracts for Commercial Items (OCT 2014). If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. The Agreement shall be governed by the laws of the Commonwealth of Pennsylvania without regard to its conflict of laws provisions. Both Buyer and Seller reject the applicability of the United Nations Convention on Contracts for the international sales of goods to the relationship between the parties and to all transactions arising from said relationship.

May 2015

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled "Solids Handling Equipment Preselection Package" drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda are only delivered by e-mail and through the internet via download.

The undersigned bidder acknowledges receipt of the following addenda:

No.	Date Received	No.	Date Received
1	July 22, 2021		

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: July 29, 2021

Bidder: Evoqua Water Technologies LLC

By: ______________________
(Signature)
Alexander R. Harris

Title: Director, Operational Finance

Bidder further agrees to complete all work required ~~within the time stipulated in the Contract Documents~~*, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

*See Evoqua's proposal for schedule

BID

BID SCHEDULE(S)

BASE BID:

Item	No. Units	Unit	Unit Price ($ numerals)	Total Price ($ numerals)
Special Services to prepare complete shop drawings and related submittals, and coordinate with Owner and Engineer during design. The Contract Price for the Special Engineering Services shall not exceed 5% of the total Contract Price.	1	LS	N/A	$120,000
Goods: Replace Chain and Flight Equipment in Basins 3, 4 ,5 and 6 as specified including all parts and appurtenances required for a complete and functional system.[1]	1	LS	N/A	$2,926,254
			Total ($ numerals)	$3,046,254

[1] Price to include all related costs including any bonds, insurance, shipping, lading at point of fabrication and Point of Destination, O&M Manuals, and start up field services as described in the Contract Documents. Excludes sales tax, to be paid by the Contractor.

BID ALTERNATE 1:

Item	No. Units	Unit	Unit Price ($ numerals)	Total Price ($ numerals)
Additive: 4-Axle System: For the three (3) long mechanisms in each basin (4 basins, 12 mechanisms total), provide a 4th shaft and all required parts to function as a return shaft at the east end of each basin.	12	EA	N/A	$170,341
Deductive: 4-Axle System: For the three (3) long mechanisms in each basin (4 basins, 12 mechanisms total), deduct the return track wall supports. The return rail will be hung from above by elevated supports (future tube-settler supports); the elevated supports will be provided by the Contractor.	12	EA	N/A	$51,316
			Total ($ numerals)	$119,025

BID

BID ALTERNATE 2:

Item	No. Units	Unit	Total Price ($ numerals)
Upgraded Chain: In place of the specified chain, provide an upgraded chain (first named manufacturer's model HS730, or equal)	1	LS	$458,046

BID ALTERNATE 3:

Item	No. Units	Unit	Total Price ($ numerals)
Upgraded Flight: In place of the specified flight, provide an upgraded flight (first named manufacturer's model Diamond, or equal)	1	LS	$102,332

The Bid may be awarded using the Base Bid or a combination of the Base Bid and any/all Bid Alternate(s).

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. **Bidder information:**

   Bidder's name: Evoqua Water Technologies LLC

   Bidder's address: N19 W23993 Ridgeview Pkwy., Suite 200
   Waukesha, WI 53188

   Bidder's Primary Contact: Dennis Kaiser

   Email address of Bidder's primary contact: dennis.kaiser@evoqua.com

   Bidder's telephone number: 262-521-8461

2. **Bidder must be qualified and meet the minimum requirements described in 46 43 11, Part 1.05 A.**

SECTION 3

REFERENCES

Vernal, UT
Central Utah Water Conservancy District – Ashley Valley Water Purification Plant
Brad Grammar – Plant Manager
N3550 W2500 Vernal Road
Vernal, UT 84078
435-789-0421
Two (2) tanks, two (2) bays per tank
Dimensions: 11.5 ft. wide x 55 ft. long x 15 ft. side water depth
Installed 2017

Pittsburgh, PA
Pittsburgh Water and Sewer Authority – Aspinwall Wall Water Treatment Plant
Mr. Bob Daniels – Maintenance Supervisor
900 Freeport Rd.
Pittsburgh, PA 15238
412-782-7552 ext. 5999
100-120 MGD
Four (4) tanks, four (4) bays per tank
Dimensions: 13.9 ft. wide x 270.5 ft. long x 16 ft. side water depth
Installed 2009

Milwaukee, WI
Milwaukee Water Works – Howard Avenue Water Treatment Plant
Mr. Leo Jankowski – Maintenance Supervisor
3929 S. 6th St.
Milwaukee, WI 53221
414-286-2646
105 MGD
Four (4) tanks, five (5) bays per tank
Dimensions: 19.7 ft. wide x 351 ft. long x 12 ft. side water depth
Installed 1990

Columbus, OH
City of Columbus - Hap Cremean Water Treatment Plant
Mr. Russ Allen – Plant Manager
4250 Morse Rd.
Columbus, OH 43230
614-645-3194
70-80 MGD
Four (4) tanks, five (5) bays per tank
Dimensions: 19 ft. wide x 190 ft. long x 18 ft. side water depth
Installed 1991

NSF International

789 N. Dixboro Road, Ann Arbor, MI 48105 USA

RECOGNIZES

Evoqua Water Technologies LLC

Facility: Waukesha, WI

AS COMPLYING WITH NSF/ANSI/CAN 61 AND ALL APPLICABLE REQUIREMENTS.
PRODUCTS APPEARING IN THE NSF OFFICIAL LISTING ARE
AUTHORIZED TO BEAR THE NSF MARK.

ISO/IEC 17065
Product Certification Body
#0215

Certification Program
Accredited by the
American National
Standards Institute

SCC Accredited
CB-P/S
OCPS
Accrédité CCN

Certification Program
Accredited by the
Standards Council
of Canada

Theresa Bellish

February 15, 2021
Certificate# C0435554 - 01

Theresa Bellish
General Manager, Water Systems

SECTION 07
SUBMITTAL – EVOQUA WATER TECHNOLOGIES

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EVOQUA
WATER TECHNOLOGIES

DOCUMENT TRANSMITTAL

DATE: 5/26/2022

TRANSMITTAL #: 419383-MTB
SENT VIA: Email
TRACKING #:

TO: Brown and Caldwell
Attn: Jake Himebaugh, P.E.
Salt Lake City, UT
Jhimebaugh@BrwnCald.com

REF: **Project Name:** Jordan Valley Water Treatment Plant Solids Handling Equipment
Installation Location: 15305 S 3200 W., Herriman, UT 84065
Customer PO#: Executed Order 9/8/2021, Executed Change Order Dated 9/13/2021
Job No.: 419383, Project 2033/001724

REP: TC Sales & Service
10132 S. 440E
Cory Frizlaff
Sandy, UT
cory@tcsalesco.com

We are sending you:

- ☒ Drawings
- ☒ Data Sheets
- ☐ Change Order
- ☐ Schedule
- ☐ CD
- ☐ Letter
- ☐ Preliminary OMM's
- ☐ Approval OMM's
- ☐ Final OMM's
- ☒ Specifications
- ☒ Other

Number/ Type Copies (Note 1)	Drawing/ Document #	Drawing/Document Title	Rev	Date	Transmittal Code (Note 2)	Required Return Date
1 (.pdf)	**419383-MTB**	**Mechanical Transmittal**	**A**	**5/26/2022**	**FA**	**6/10/2022**

RECIPIENT IS RESPONSIBLE FOR DESTROYING OR RETURNING SUPERSEDED DOCUMENTS

Note 1: Type: HC = Hard Copy, DC = Digital Copy
Note 2: Transmittal Code:

FA= For Approval
FI = For Your Information and Use
FR = For Record
RFC = Release for Construction

Remarks:

1. To keep the job on schedule, we are seeking an approved or approved as noted response to the submittal, by the required return date, which will allow us to move into fabrication as soon as possible. If you or the Engineer have any questions during the submittal process, please allow us to provide further information or answers rather than rejecting the submittal. This will allow us to get you the equipment as quickly as possible. We are available to answer questions or for a discussion at any time.

2. **Evoqua will need a signed confirmation of approval to proceed and release for manufacture to proceed**

Signed: Scott Wilson

cc: Cory Frizlaff – TC Sales & Service

Scott Wilson
Project Manager IV
2607 N. Grandview Blvd, Ste 130
Waukesha, WI 53188

Tel: 262-521-8271

WATER TECHNOLOGIES

MECHANICAL EQUIPMENT SUBMITTAL

FOR

JORDAN VALLEY WATER TREATMENT PLANT - JVWCD
HERRIMAN, UT

(12) CHAIN & SCRAPER LONGITUDINAL COLLECTORS - 3 SHAFT
(12) CHAIN & SCRAPER LONGITUDINAL COLLECTORS - 4 SHAFT
(4) CHAIN & SCRAPER CROSS COLLECTORS

(SECTION 46 43 11 - CHAIN AND FLIGHT EQUIPMENT)

Project 2033/001724.P.01 (419383-01)
Revision B
May 26, 2022

N19 W23993 Ridgeview Parkway
Suite 200
Waukesha, WI 53188

Tel: +1 (262) 547-0141
Fax: +1 (262) 547-4120

www.evoqua.com

Table of Contents

11. Gear Reducer, Longitudinal Single Output Drives – Nord, SK 9033.1-56C
12. Gear Reducer, Cross Collectors – Nord, SK 9023.1-56C
13. Motor – Baldor, Custom (1/2 HP)
14. Torque Limiters – Brunel, JSE1-0200
15. Limit Switch, Shear Pins – Honeywell, 11CX12
16. Anchor Adhesive – Simpson Strong-Tie, SET-XP

Section 6 Reference Forms

1. 43 05 21-A. Motor Data Form
2. Evoqua Chain and Scraper Passivation Proposal

Section 7 Drawings

419383-100 – GA – Cover Sheet & Drawing List
419383-101 – GA – Specifications
419383-102 – GA – Plan View
419383-103 – GA – Aft Bay Longitudinal Elevation View
419383-104 – GA – Fore Bay Longitudinal Elevation View
419363-105 – GA – Cross Collector Elevation View
419383-106 – GA – Shaft Sections & Details
419383-107 – GA – Installation Details
419383-108 – GA – Drive Arrangement Aft Bay Longitudinals
419383-109 – GA – Drive Arrangement Fore Bay Longitudinals
419383-110 – GA – Wear Strip Installation

Section 1
Certification

43 05 11-C. UNIT RESPONSIBILITY CERTIFICATION FORM

SOLIDS HANDLING EQUIPMENT PRESELECTION PACKAGE

CERTIFICATE OF UNIT RESPONSIBILITY
FOR SPECIFICATION SECTION 46 43 11
CHAIN AND FLIGHT EQUIPMENT

In accordance with Section 46 43 11 of the contract documents, the undersigned Bidder (Supplier) accepts unit responsibility for all components of equipment furnished to the Project under specification Section 46 43 11, and for related equipment.

We have reviewed the requirements for Section 46 43 11 where applicable and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by Supplier. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section 46 43 11 are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section 46 43 11 due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public

MY COMMISSION IS PERMANENT
Commission expiration date

Seal:
STATE OF WI
COUNTY OF WAUKESHA

AARON VANSELOW
NOTARY
PUBLIC
STATE OF WISCONSIN

SIGNED AND SWORN TO ME
BY JORDAN McDONALD ON
12/22/21

Evoqua Water Technologies, LLC
Name of Corporation

N19 W23993 Ridgeview Pkwy
Address

Waukesha, WI 53188

By:
Jordan McDonald
Duly Authorized Official

Legal Title of Official Project Manager

Date 12/22/2021

2. NSF/ANSI/CAN 61 Certificate

NSF International

789 N. Dixboro Road, Ann Arbor, MI 48105 USA

RECOGNIZES

Evoqua Water Technologies LLC

Facility: Waukesha, WI

AS COMPLYING WITH NSF/ANSI/CAN 61 AND ALL APPLICABLE REQUIREMENTS.
PRODUCTS APPEARING IN THE NSF OFFICIAL LISTING ARE
AUTHORIZED TO BEAR THE NSF MARK.

NSF®

ANSI ACCREDITED
ISO/IEC 17065
Product Certification Body
#0216

Certification Program
Accredited by the
American National
Standards Institute

SCC Accredited
CB-P/S
OCPS
Accrédité CCN

Certification Program
Accredited by the
Standards Council
of Canada

This certificate is the property of NSF International and must be returned upon request. This certificate remains valid as long as this client has products in Listing for the referenced standards. For the most current and complete Listing information, please access NSF's website (www.nsf.org).

Theresa Bellish

February 15, 2021
Certificate# C0435554 - 01

Theresa Bellish
General Manager, Water Systems

Section 2
Clarifications & Exceptions

EVOQUA WATER TECHNOLOGIES	CLARIFICATIONS AND EXCEPTIONS MECHANICAL			
	PROJECT:	419383-01 SAP No. 2033/001724.P.01	PREPARED BY:	A. Kluessendorf
	PAGE:	1 OF 15	DATE:	01-19-2022

Equipment: (12) Chain & Scraper Longitudinal Collectors – 3-Shaft
(12) Chain & Scraper Longitudinal Collectors – 4 Shaft
(4) Chain & Scraper Cross Collectors

Location: Jordan Valley Water Treatment Plant - JVWCD
Herriman, UT

The items listed below are presented to clarify, justify, or bring Project specification exceptions to your attention. A copy of this listing should be returned with the submittal drawings, marked or stamped accordingly, by the approving authority.

Please note that a marked copy of Section 46 43 11 (Chain-and-Flight Equipment) and Section 43 05 21 (Common Motor Requirements for Equipment) have been included with this submittal.

- Items with a check mark next to them indicate compliance with the adjacent specification section.
- Items with a numbered balloon next to them indicate need for clarification and/or exception with the adjacent specification, and will be addressed with the corresponding number below.

SECTION 46 43 11 – CHAIN-AND-FLIGHT EQUIPMENT

1. *Section 46 43 11-1.03.C.1.e pertains to the Design Requirements, which state, “Capable of operating under solids concentrations of up to 5 percent.”*

   Evoqua was provided the Polychem installation drawings from 1986. It was also confirmed that no changes have been made to the process sludge loading in providing new equipment with this project.

   The existing dual output Koellmann Gear reducers provide 14,660 in-lbs of torque at a SF of 1.5, per drawing 864529-3. This would work out to a calculated torque requirement of 4887 in-lbs of torque to operate each collector mechanism. The existing single, inline Koellman Gear reducers provide 8,000 in-lbs of torque at a SF of 1.5. This would work out to a calculated torque requirement of 5333 in-lbs of torque to operate each collector mechanism.

   For determining the existing sludge load, by using the 5333 in-lbs of torque value, the sludge load calculates to a value of 5.5 lbs/ft of flight length for the forebays and 2.1 lbs/ft of flight length for the aftbays.

The sludge load specified for this project, based on a 5 percent solids concentration, would be 4.5 lbs/ft of flight length. This is double the previous sludge loading value for the Polychem equipment in the aftbays, which is currently in operation.

In discussions with Brown & Caldwell during Evoqua's site visit on 11-03-2021, Evoqua identified that the larger than required specified sludge loads are pushing the equipment sizing outside of the specified values in Section 46 43 11 – Chain-and-Flight Equipment. It was discussed that this was not the intent of the specified sludge loads, noting that Evoqua should determine what the maximum sludge loading value would be for the specified drive chain.

Evoqua confirms that the specified non-metallic drive chain design with a minimum working load of 1,740 lbs would be usable for the following conditions:

- Forebay – 9.4 lbs/ft Sludge Load
- Aftbay – 3.5 lbs/ft Sludge Load

2. *Section 46 43 11-1.04.D pertains to the Quality Control Submittals.*

Evoqua has not included Quality Control Submittals with this Equipment Submittal Package.

Regarding the collector chain testing data, refer to Evoqua Clarification & Exception Item 29 for further detail.

Regarding the Manufacturer's Instructions, Evoqua has not included O&M Manual information with this Equipment Submittal Package. Once the equipment is approved, O&M Manuals will be created and submitted for review and approval.

3. *Section 46 43 11-1.04.E pertains to the Contract Closeout Submittals.*

Evoqua has not included Contract Closeout Submittals with this Equipment Submittal Package.

Regarding the Operations and Maintenance documentation, Evoqua has not included O&M Manual information with this Equipment Submittal Package. Once the equipment is approved, O&M Manuals will be created and submitted for review and approval.

4. *Section 46 43 11-1.05.B.1 pertains to the submittal of installation documents.*

   Evoqua has not included Installation Documents with this Equipment Submittal Package. These documents will be made available after the equipment has been installed and field service has been completed.

5. *Section 46 43 11-1.06.A pertains to Storage and Protection of the delivered equipment. Subsection 1 states, "Flight Chains and Collector Sprockets: Protect against corrosion and dust during shipment and storage until installed."*

   Evoqua confirms that chain and sprockets will be protected during shipment. Evoqua also confirms that storage recommendations will be included with the O&M Manuals, which will be submitted for approval after the equipment design has been approved. They are not included in this Equipment Submittal package.

   Please note, it is the Contractor's responsibility to protect the equipment in accordance with Evoqua's recommendations at the jobsite until the equipment is installed.

6. *Section 46 43 11-1.06.A pertains to Storage and Protection of the delivered equipment. Subsection 3 states, "Protect all fiberglass and plastic from sunlight."*

   Evoqua confirms that storage recommendations for the flights will be included with the O&M Manuals, which will be submitted for approval after the equipment design has been approved. They are not included in this Equipment Submittal package.

   Please note, it is the Contractor's responsibility to protect the equipment in accordance with Evoqua's recommendations at the jobsite until the equipment is installed.

7. *Section 46 43 11-1.08.A pertains to the Warranty for Flight Straightness.*

   Regarding the flight tolerances, refer to Evoqua Clarification & Exception Item 32 for further detail.

Regarding the Warranty Period, Evoqua agreed to a modified period from the specified value of 1-1/2 years. Evoqua's flight warranty will be 36 months from substantial completion or 48 months from shipment, whichever occurs first.

8. *Section 46 43 11-1.09.A.2.c pertains to Evoqua's Maintenance Service, specifically Operation Instructions. It states, "Bidder shall prepare a recording of field training."*

   Evoqua noted in Proposal No. 419383, 29 July 2021, Section 6 – Additional Field Services, "In the event Purchaser wishes to videotape the Evoqua field service personnel during start-up and/or field service, Purchaser must execute Evoqua's standard "Videotape Agreement" in which the Purchaser shall expressly waive any claim against Evoqua, for injury or damage caused by inaccuracies or errors in such videotape(s), and acknowledge that such videotaping is done by Purchaser at its sole risk."

9. *Section 46 43 11-2.02.A pertains to the Fiberglass Flights. Subsection 1 identifies the flight design as Evoqua's Sigma+ or equal.*

   Evoqua is providing our Diamond flight design, as listed in Proposal No. 419383, 29 July 2021, Bid Alternate 3. This is an upgrade to the Sigma+ flights that are specified.

10. *Section 46 43 11-2.02.A.1.d pertains to the minimum modulus of elasticity for the flights, listing a value of 4,323,000 pounds per square inch.*

    Evoqua noted in Proposal No. 419383, 29 July 2021, Section 5 – Clarifications / Exceptions, "The minimum modulus of elasticity for Sigma Plus flights is 3,830,000 pounds per square inch."

11. *Section 46 43 11-2.02.A.2 pertains to the Flight Attachments. Subsection "a" states, "Same material and strength as specified herein for the collector chains and shall be molded integrally with the link side bars."*

    The specified criteria for the flight attachments pertains to molded chains, such as Evoqua's NCS720S-NX collector chain. However, Evoqua is providing our HS730 loop chain, as listed in Proposal No. 419383, 29 July

2021, Bid Alternate 2. This is an upgrade to the collector chain being specified.

12. *Section 46 43 11-2.02.A.3 pertains to the Flight Wearing Shoes. Subsection “a.1” calls for UHMW polyethylene material that has a ASTM D 2240 durometer hardness of A/80/85.*

    Evoqua’s UHMW-PE flight wear shoes have a minimum hardness of 62 Shore D, per ASTM D 2240.

13. *Section 46 43 11-2.02.C pertains to the Collector Chain design. The specified criteria is for NCS720S collector chain.*

    Evoqua is providing our HS730 loop chain, as listed in Proposal No. 419383, 29 July 2021, Bid Alternate 2. This is an upgrade to the collector chain being specified. Refer to Evoqua’s Equipment Submittal Section _ – Product Data, specifically Item 1 for the HS730 collector chain product bulletin details.

14. *Section 46 43 11-2.02.D pertains to the Driven Bull Sprocket. Subsection 2 describes Alternative A for Evoqua’s Polyurethane design. Subsection “c” states, “The sprocket shall be held in place with 2 full width clamping bands which exert the compressive force around the full periphery of each shoulder. The shoulder shall include retainers to hold the band in place.”*

    This description is for Evoqua’s shallow dish style of driven sprocket, which is used in conjunction with low projection, solid bearing housings.

    Evoqua is providing split peak cap wall bearings, which require the use of Evoqua’s deep dish style of driven sprocket. This design complies with the material and replaceable sprocket tooth segment design that is specified. However, the body halves are assembled on the headshaft with four (4) studs that will clamp the hub portion of the sprocket to the shaft. The web arms, at the split line, will be assembled with six (6) studs that keep the sprocket halves in diametrical and lateral alignment.

15. *Section 46 43 11-2.02.D pertains to the Driven Bull Sprocket. Subsection 2 describes Alternative A for Evoqua’s Polyurethane design. Subsection “d” states, “The wedge dogs shall be located along the split line of the body to draw the sprocket body into diametrical and lateral alignment.”*

This description is for Evoqua's shallow dish style of driven sprocket, which is used in conjunction with low projection, solid bearing housings.

Evoqua is providing split peak cap wall bearings, which require the use of Evoqua's deep dish style of driven sprocket. This design complies with the material and replaceable sprocket tooth segment design that is specified. However, the body halves are assembled on the headshaft with four (4) studs that will clamp the hub portion of the sprocket to the shaft. The web arms, at the split line, will be assembled with six (6) studs that keep the sprocket halves in diametrical and lateral alignment.

16. *Section 46 43 11-2.02.E pertains to the Head Shaft Drive Sprockets. Subsection 1.a states, "Sprocket rims shall be chain saver type."*

    Evoqua is providing HS730 loop chain in lieu of the specified NCS720S collector chain. Chain saver rims on the sprockets are not applicable to high strength loop chain, as the side bars are flat and not contoured to mate with chain saver rims. The barrels in the HS730 loop chain links will not fully engage the sprocket teeth for chain saver rim sprockets, thereby allowing them to wear more rapidly or jump off of the teeth entirely, due to inadequate load absorption.

17. *Section 46 43 11-2.02.E pertains to the Head Shaft Drive Sprockets. Subsection 1.c states, "Sprocket rims shall be designed to match the collection chain and shall be 22.21-inch pitch diameter with 23 teeth."*

    Evoqua is providing HS730 loop chain in lieu of the specified NCS720S collector chain. Chain saver rims on the sprockets are not applicable to high strength loop chain, as the side bars are flat and not contoured to mate with chain saver rims. The barrels in the HS730 loop chain links will not fully engage the sprocket teeth for chain saver rim sprockets, thereby allowing them to wear more rapidly or jump off of the teeth entirely, due to inadequate load absorption.

    Also, Evoqua will provide headshaft sprockets that have a 23.18" pitch diameter and 12 teeth, which have been specifically designed for use with HS730 collector chain.

18. *Section 46 43 11-2.02.F pertains to the Idler Sprockets. Subsection 1.a states, "Sprocket rims shall be chain saver type."*

    Evoqua is providing HS730 loop chain in lieu of the specified NCS720S collector chain. Chain saver rims on the sprockets are not applicable to high strength loop chain, as the side bars are flat and not contoured to mate with chain saver rims. The barrels in the HS730 loop chain links will not fully engage the sprocket teeth for chain saver rim sprockets, thereby allowing them to wear more rapidly or jump off of the teeth entirely, due to inadequate load absorption.

19. *Section 46 43 11-2.02.F pertains to the Idler Sprockets. Subsection 1.b states, "Sprocket rims shall be designed to match the collector chain and shall be no less than 22.21-inch pitch diameter with 23 teeth."*

    Evoqua is providing HS730 loop chain in lieu of the specified NCS720S collector chain. Chain saver rims on the sprockets are not applicable to high strength loop chain, as the side bars are flat and not contoured to mate with chain saver rims. The barrels in the HS730 loop chain links will not fully engage the sprocket teeth for chain saver rim sprockets, thereby allowing them to wear more rapidly or jump off of the teeth entirely, due to inadequate load absorption.

    Also, Evoqua will provide cornershaft sprockets that have a 22.24" pitch diameter and 23 teeth.

20. *Section 46 43 11-2.02.F pertains to the Idler Sprockets. Subsection 1.d states, "2 sprockets shall be mounted on each cross shaft. 1 of the sprockets shall turn free. The other sprocket shall be keyed to the shaft."*

    Evoqua is providing live shafting for all cornershaft locations, which utilize sprockets that are clamped firmly to the shafting. These sprockets are timed to each other using torpedo levels across the sprocket teeth during installation of the equipment, thus preventing the possibility of flight skew as they rotate around the shafting during operation.

21. *Section 46 43 11-2.02.F pertains to the Idler Sprockets. Subsection 2.c states, "Secure free turning sprockets to the bearing sleeves by 2 clamping bands. The clamping bands shall be the same as for the driven bull sprocket."*

Evoqua is providing live shafting for all cornershaft locations, which utilize sprockets that are clamped firmly to the shafting. These sprockets are timed to each other using torpedo levels across the sprocket teeth during installation of the equipment, thus preventing the possibility of flight skew as they rotate around the shafting during operation.

Bearing sleeves are not used with this design.

22. *Section 46 43 11-2.02.F pertains to the Idler Sprockets. Subsection 2.f describes bearing sleeves.*

    Evoqua is providing live shafting for all cornershaft locations, which utilize sprockets that are clamped firmly to the shafting. These sprockets are timed to each other using torpedo levels across the sprocket teeth during installation of the equipment, thus preventing the possibility of flight skew as they rotate around the shafting during operation.

    Bearing sleeves are not used with this design.

23. *Section 46 43 11-2.02.G pertains to the Shafts and Bearings. Subsection 3 lists shafting and bearing tolerances.*

    Evoqua clarified the tolerances of the shafts, bearings, and sprockets in Proposal No. 419383, 29 July 2021, Section 5 – Clarifications / Exceptions.

    - Shaft tolerance shall be nominal shaft size as specified plus 0.005 inch to minus 0.005 in. Tolerance provided in specification is tyical of high speed machinery, which does not apply.

    - Bearing tolerance shall be nominal size as specified plus 0.040 inch to minus 0.000 inch. Tolerance provided in specifications is typical of high speed machinery, which does not apply.

    - Sprocket tolerance shall be nominal shaft size as specified plus 0.015 inch to minus 0.015 inch.

      Note: This value has been modified from the proposal verbiage, as the value listed was copied from the bearing tolerance and did not reflect the sprocket tolerance.

24. *Section 46 43 11-46 43 11-2.02.G pertains to the Shafts and Bearings. Subsection 4 states, "A combined shock and fatigue factor, in a dry tank, of 2 shall be applied to bending moment."*

    These factors are typical of high speed machinery, which do not apply. Evoqua utilizes a multi-strand imbalance factor of 1.2 and a moderate shock service factor of 1.2 with the collector chain design pulls.

25. *Section 46 43 11-46 43 11-2.02.G pertains to the Shafts and Bearings. Subsection 5 states, "A combined shock and fatigue factor, in a dry tank, of 1-1/2 shall be applied to the torsional moment."*

    These factors are typical of high speed machinery, which do not apply. Evoqua utilizes a multi-strand imbalance factor of 1.2 and a moderate shock service factor of 1.2 with the collector chain design pulls.

26. *Section 46 43 11-2.02.G pertains to the Shafts and Bearings. Subsection 6 states, "Shafts shall have an L/d ratio of no less than 360 under a load of 15 pounds per foot along the face of the flights in a wet basins condition."*

    Evoqua's shafting has been designed with a L/d ratio of no less than 360. However, the sizing of the shafts is based on the sludge loading calculations listed in Evoqua Clarification & Exception Item 1 above, in lieu of 15 pounds per foot sludge loading specified. Evoqua is already increasing the shaft sizing beyond what is currently in operation at the site, and using a 15 pound per foot sludge loading further increase the shaft sizes beyond these proposed values.

27. *Section 46 43 11-2.02.G pertains to the Shafts and Bearings. Subsection 7 states, "Shearing stress shall not exceed 6,000 pounds per square inch for shafts with key seats and 8,000 pounds per square inch for shafts without key seats."*

    Evoqua clarified the intended shaft stresses for use with the design in <u>Proposal No. 419383, 29 July 2021, Section 5 – Clarifications / Exceptions</u>. We identified that "Shearing stress shall not exceed 12,000 pounds per square inch for shafts with key seats and 12,000 pounds per square inch for shafts without key seats. Tolerance provided in specifications is typical of high speed machinery, which does not apply."

Please note, Evoqua's standard for shearing stresses in cornershafting is 24,000 psi in lieu of the identified 12,000 psi, which was copied from the headshaft shearing stresses.

28. *Section 46 43 11-2.02.N.2.b pertains to the optional supply of outboard bearings for use with Gear Reduction Units, to reducer overhung loads.*

Evoqua has reviewed the design calculation requirements, along with the impact of overhung loading, with the gear reducer manufacturer. It has been confirmed that the drive sprocket assemblies can be mounted directly on the gear reducer output shaft without the use of outboard bearings. This arrangement will not compromising the performance of the output shaft, bearings, or seals associated with the gear reducer.

29. *Section 46 43 11-2.03.A.1 pertains to the Chain Testing requirements for specified NCS720S collector chain.*

As noted in Evoqua Clarification & Exception Item 13 above, Evoqua is providing our HS730 loop chain, as listed in <u>Proposal No. 419383, 29 July 2021, Bid Alternate 2</u>. This is an upgrade to the collector chain being specified.

The specified chain testing for molded collector chains is not applicable to assembled HS730 collector chains. In lieu of the specified chain testing, Evoqua proposes that we provide six (6) proof load tests for the lot of HS730 loop chain being provided. The first two (2), middle two (2), and last two (2) strands will be proof load tested to 10,000 pounds, with reports being provided upon completion of the tests.

30. *Section 46 43 11-2.03.2.a pertains to the passivation requirements of stainless steel components. It also refers to passivation in accordance with Table A2.1 Part II of ASTM A380, which is Cleaning-Passivation with Nitric Acid Solution.*

This project requires submerged components to be compliant with NSF61. Evoqua requests that passivation requirements are revised to Table A2.1 Part III of ASTM A380, to allow for citric acid passivation in lieu of the more environmentally hazardous nitric acid passivation described in Part II.

Also, the stainless steel components being provided by Evoqua are either fabricated from stainless steel plates/rounds or are stainless steel castings.

Evoqua requests that passivation be limited to machined features in stainless steel materials, to ensure that these newly exposed surfaces are free from contamination.

31. *Section 46 43 11-3.03 pertains to the Installation of the equipment.*

    This section is applicable to the Contractor.

32. *Section 46 43 11-3.04.A.3 pertains to the flight straightness testing. Subsection "a" states, "Sag: While simply supported on wearing shoes, front bottom edge of flight is not to deviate more than 1/8 inch above nor 1/16 inch below straight line between bottom edge of flight at wearing shoes."*

    Evoqua noted in Proposal No. 419383, 29 July 2021, Section 5 – Clarifications / Exceptions, sag for flights shall not deviate more than ½" below a straight line between the bottom edge of the flight at wearing shoes.

SECTION 43 05 21 – COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

1. *Section 43 05 21-1.05.A.3 pertains to the submittal of "Routine Factory test data for polyphase motors." Subsection "a" calls for a High-Potential Test.*

    Baldor confirmed that they can provide their IEEE-841 standard test reports for the production motors. However, they noted that High Potential Tests are not part of the MG1 requirements for IEEE-841 motors.

    On behalf of Baldor, Evoqua requests removal of the requirement for conducting High Potential Test, as it is not a "Routine Factory Test". Evoqua confirms that Baldor will provide production motor testing in accordance with NEMA MG1 for IEEE-841 motors, in addition to vibration testing. Please confirm acceptance.

2. *Section 43 05 21-1.05.A.8 pertains to the submittal of "Motor bearing and winding RTDs (resistance temperature detector), where specified."*

    Section 43 05 21 calls for RTD's to be provided on motors larger than 250 horsepower, which is not applicable to the 0.50 horsepower motors being supplied for use with this project.

3. *Section 43 05 21-1.05.B.2 pertains to "Submittal requirements for operation and maintenance manuals as per requirements of Section 01 78 23."*

   Evoqua has not included any of the Operation and Maintenance Manual information with this Equipment Submittal Package for approval. Once the equipment is approved, O&M Manuals will be created and submitted in accordance with Section 01 78 23.

4. *Section 43 05 21-1.06.A.1 identifies Factory Testing in conformance with routine tests per NEMA MG1 and IEEE 112. Subsection .c identifies "Current input at rated frequency with rotor at standstill."*

   Baldor confirmed that they can provide their IEEE-841 standard test reports for the production motors. However, they noted that Current Input at Standstill testing is not part of the MG1 requirements for IEEE-841 motors.

   On behalf of Baldor, Evoqua requests removal of the requirement for conducting Current Input at Rated Frequency with Rotor at Standstill testing, as it is not a "Routine Factory Test". Evoqua confirms that Baldor will provide production motor testing in accordance with NEMA MG1 for IEEE-841 motors, in addition to vibration testing. Please confirm acceptance.

5. *Section 43 05 21-1.06.A.1 identifies Factory Testing in conformance with routine tests per NEMA MG1 and IEEE 112. Subsection .d identifies "High potential test."*

   Baldor confirmed that they can provide their IEEE-841 standard test reports for the production motors. However, they noted that High Potential Tests are not part of the MG1 requirements for IEEE-841 motors.

   On behalf of Baldor, Evoqua requests removal of the requirement for conducting High Potential Test, as it is not a "Routine Factory Test". Evoqua confirms that Baldor will provide production motor testing in accordance with NEMA MG1 for IEEE-841 motors, in addition to vibration testing. Please confirm acceptance.

6. *Section 43 05 21-1.06.B states, "Where specified for use in corrosive or hazardous locations, motor testing shall additionally be per IEEE 841." Subsection 1 pertains to motors larger than 100 horsepower.*

Evoqua is providing 0.50 HP, severe duty and inverter duty motors with the equipment specified in Section 46 43 11. Motor testing results for the production motors will be provided in accordance with NEMA MG1 and IEEE 841. However, as the motors are under 100 horsepower, the testing listed in 43 05 21-1.06.B.1 is not applicable.

7. *Section 43 05 21-2.04.A.4 pertains to motor requirements for General Purpose Type Motors.*

   This section is not applicable to the equipment being provided by Evoqua, as Section 46 43 11-2.02.O identifies the motors as being severe duty and inverter duty.

8. *Section 43 05 21-2.04.A.6 pertains to the motor requirements for Explosion Proof Type Motors.*

   This section is not applicable to the equipment being provided by Evoqua, as Section 46 43 11-2.02.O identifies the motors as being severe duty and inverter duty.

9. *Section 43 05 21-2.04.B pertains to the motor requirements for Motors Less Than 1/2 Horsepower.*

   This section is not applicable to the equipment being provided by Evoqua, as 0.50 HP, severe duty and inverter duty motors are being provided with the equipment specified in Section 46 43 11.

10. *Section 43 05 21-2.05.B pertains to Vertical Motors.*

    This section is not applicable to the equipment being provided by Evoqua, as the motors being supplied for use with Section 46 43 11 will be horizontally connected to the gear reducers the M1 mounting position.

11. *Section 43 05 21-2.05.D pertains to the Motor Nameplates. Subsection 2.f states, "UL frame temperature limit code for explosion proof motors."*

    This section is not applicable to the equipment being provided by Evoqua, as there are no requirements for explosion proof motors with the equipment specified in Section 46 43 11.

12. *Section 43 05 21-2.05.E.4 pertains to the Conduit Boxes, which states, "Provide separate conduit boxes for temperature devices and space heaters."*

    Baldor recommended exception to the specification for a separate conduit box for the space heaters being provided with the 0.50 HP, severe duty and inverter duty motors for use with the equipment specified in Section 46 43 11. The oversized conduit boxes specified in Section 43 05 21-2.05.E.1 are more than capable of handling the additional wiring for these motor. An additional conduit box would make for a bulkier motor without any performance improvement to the design.

    On behalf of Baldor, Evoqua requests removal of the requirement for a separate conduit box for the temperature devices and space heaters. Please confirm acceptance.

13. *Section 43 05 21-2.05.F.5 pertains to the Bearings, which states, "Belt loads not to exceed forces calculated from NEMA MG1 Table 14-1 and 14-1A."*

    This section is not applicable to the 0.50 HP, severe duty and inverter duty motors that Evoqua is providing with the equipment specified in Section 46 43 11, as they will be directly coupled to the gear reducers.

14. *Section 43 05 21-2.05.G pertains to the Bearing Lubrication requirements. Subsection 1 pertains to "Grease Lubricated Bearings" and Subsection 2 pertains to "Oil Lubricated Bearings".*

    The 0.50 HP, severe duty and inverter duty motors that Evoqua is providing with the equipment specified in Section 46 43 11 will be grease lubricated. Therefore, the oil lubricated bearing information outlined in Section 43 05 21-2.05.G.2 is not applicable to Evoqua.

15. *Section 43 05 21-3.01 pertains to the Examination / Delivery Inspection.*

    Evoqua recognizes this section as being applicable to the installing Contractor.

16. *Section 43 05 21-3.02 pertains to the Installation of the Motors.*

Evoqua recognizes this section as being applicable to the installing Contractor.

17. *Section 43 05 21-3.03 pertains to the Field Quality Control of the Motors.*

    Evoqua recognizes this section as being applicable to the installing Contractor.

18. *Section 43 05 21-3.04 pertains to the Closeout Activities for the Motors. Subsection A.1 states, "Provide the operation and maintenance manual of the motor(s). Include testing result information in the O&M manual."*

    Evoqua has not included any of the Operation and Maintenance Manual information with this Equipment Submittal Package for approval. Once the equipment is approved, O&M Manuals will be created and submitted in accordance with Section 01 78 23. They will include the Factory Testing results for the motors being provided.

End of Clarifications & Exceptions.

01 33 00-A. SUBMITTAL TRANSMITTAL FORM

Submittal Transmittal

Submittal Description: 419383-MT1	Submittal No: 002	Spec Section: 46 43 11

	Routing	Sent	Received
Owner: Jordan Valley Water Conservancy District	Evoqua/BC	01/25/22	01/25/22
Project: JVWTP Sedimentation Basin Equipment Replacement	BC /Evoqua		
Supplier: Evoqua			

We are sending you:

☐ Attached
☐ Under separate cover via _________
☒ Submittals for review and comment
☐ Product data for information only

Remarks: ____

Item	Copies	Date	Section No.	Description	Review action[a]	Reviewer initials	Review comments attached
1	1	1/25/22	46 43 11 46 05 21	Chain and Flight Equipment Common Motor Requirements for Equipment	A&R	JCH	See Attached Comments

[a]Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

Supplier

Certify either a or b:

a. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).

b. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by: ____

Supplier Signature: ____

Item	Page	Section No.	Description/Comment	Review action [a]	Reviewer initials
1	10 of 460 (Comment 1)	46 43 11-1.03.C.1.e	Evoqua provided the following response on February 11, 2022, pertaining to the 5% solids loading defined in Section 46 43 11-1.03.C.1.e: *At the specified sludge load of 4.5 lbs/ft of flight length in conjunction with the aforementioned collector chain pretensioning load, the drive chain would see a load of 2059 lbs (which would require the chain to change from NH78 non-metallic to ENV78B stainless steel). The Headshaft and Lower Influent Cornershaft would be 4.50", while the Effluent Cornershafts would remain at 4.00". The Gear Reducers for the single output could remain as submitted (torque requirement of 9279 in-lbs @ 1.0 SF; 12991 in-lbs @ 1.4 SF), but the dual output ones would have to increase in size.* All equipment shall meet the requirements listed in Section 46 43 11-1.03.C.1.e. As such, Evoqua shall supply components (metallic drive chain, properly sized gear reducers, shafts, etc.) designed to operate in solids concentrations up to 5%.	A&R	JCH
2	11 of 460 (Comment 2)	46 43 11-1.04.D	Evoqua to provide test data for chains (as further discussed in Item No. 29) and installation instructions prior to shipment of equipment. Evoqua to submit proposed Stainless-Steel cleaning and passivation procedure as defined in Section 2.03.A.2.	NET	JCH
3	11 of 460 (Comment 3)	46 43 11-1.04.E	Evoqua to submit O&M Manual and Project Record Documentation prior to BC issuing notice of substantial completion.	NET	JCH
4	12 of 460 (Comment 4)	46 43 11-1.05.B.1	Evoqua to provide installation certificate upon completion of initial test and field quality control Work. Documentation shall be submitted prior to BC issuing a notice of substantial completion.	NET	JCH
5	12 of 460 (Comment 5)	46 43 11-1.06.A	Owner will protect equipment in accordance with Evoqua's recommendations at the jobsite until a Contractor is selected for installation of equipment in the basins.	NET	JCH
6	12 of 460 (Comment 6)	46 43 11-1.06.A	Owner will protect equipment in accordance with Evoqua's recommendations at the jobsite until a Contractor is selected for installation of equipment in the basins.	NET	JCH
7	12 of 460 (Comment 7)	46 43 11-1.08.A	Per Item 4 of table found in Addendum 1 of Change Order #1 issued by JVWCD, Evoqua shall warranty flights as follows: *Per the meeting with Evoqua on August 10, 2021, flight warranty period shall be four (4) years from shipment or three (3) years from substantial completion, whichever is less.*	NET	JCH
8	13 of 460 (Comment 8)	46 43 11-1.09.A.2	BC acknowledges recording of Evoqua field service personnel during start-up and/or field service shall require execution of Evoqua's Videotape agreement prior to recording	NET	JCH
9	13 of 460 (Comment 9)	46 43 11-2.02.A	BC acknowledges the selection of Bid Alternate 3 as defined in Addendum 1 of Change Order #1. Evoqua shall provide diamond flight in lieu of Sigma + (or equal)	NET	JCH
10	13 of 460 (Comment 10)	46 43 11-2.02.A.1	Per Item 6 of table found in Addendum 1 of Change Order #1 issued by JVWCD, BC responded with the following: *Supply of flights with a modulus of elasticity of 3,830,000 pounds per square inch is acceptable.*	NET	JCH
11	13 of 460 (Comment 11)	46 43 11-2.02.A.2.a	BC acknowledges the selection of Bid Alternate 2 as defined in Addendum 1 of Change Order #1. Evoqua shall provide HS730 loop chain in which Section 46 43 11-2.02.A.2.a is not applicable.	NET	JCH
12	14 of 460 (Comment 12)	46 43 11-2.02.A.3.a.1	UHMW with a shore hardness of 62 (Shore D) is acceptable in lieu of a shore hardness of 80/85 (Shore A).	NET	JCH
13	14 of 460 (Comment 13)	46 43 11-2.02.C	BC acknowledges the selection of Bid Alternate 2 as defined in Addendum 1 of Change Order #1. Evoqua shall provide HS730 loop chain in which Section 46 43 11-2.02.C is not applicable.	NET	JCH

14	14 of 460 (Comment 14)	46 43 11-2.02.D	Use of a deep-dish style of driven sprocket is acceptable as long as sprocket and bearings fit within the parameters of the existing basin without modification to infrastructure.	NET	JCH
15	14 of 460 (Comment 15)	46 43 11-2.02.D	Use of a deep-dish style of driven sprocket is acceptable as long as sprocket and bearings fit within the parameters of the existing basin without modification to infrastructure.	NET	JCH
16	15 of 460 (Comment 16)	46 43 11-2.02.E.1.a	BC acknowledges the selection of Bid Alternate 2 as defined in Addendum 1 of Change Order #1. Evoqua shall provide HS730 loop chain in which Section 46 43 11.2.02.E.1.a is not applicable.	NET	JCH
17	15 of 460 (Comment 17)	46 43 11-2.02.E.1.c	A sprocket with a 23.18" pitch diameter and 12 teeth is acceptable as long as sprocket and bearings fit within the parameters of the existing basin without modification to infrastructure.	NET	JCH
18	16 of 460 (Comment 18)	46 43 11-2.02.F.1.a	BC acknowledges the selection of Bid Alternate 2 as defined in Addendum 1 of Change Order #1. Evoqua shall provide HS730 loop chain in which Section 46 43 11.2.02.E.1.a is not applicable.	NET	JCH
19	16 of 460 (Comment 19)	46 43 11-2.02.F.1.b	A sprocket with a 22.24" pitch diameter and 23 teeth is acceptable as long as sprocket and bearings fit within the parameters of the existing basin without modification to infrastructure.	NET	JCH
20	16 of 460 (Comment 20)	46 43 11-2.02.F.1.d	Use of a live shaft for all corner shaft locations with sprockets clamped firmly to the shafting is acceptable.	NET	JCH
21	16 of 460 (Comment 21)	46 43 11-2.02.F.2.c	Use of a live shaft for all corner shaft locations with sprockets clamped firmly to the shafting is acceptable.	NET	JCH
22	17 of 460 (Comment 22)	46 43 11-2.02.F.2.f	Use of a live shaft for all corner shaft locations with sprockets clamped firmly to the shafting is acceptable.	NET	JCH
23	17 of 460 (Comment 23)	46 43 11-2.02.G.3	Per Item 7,8,9 of table found in Addendum 1 of Change Order #1 issued by JVWCD, BC responded with the following: *Manufacturer shall provide shaft, bearing and sprocket tolerances based on load, velocity and application in lieu of tolerances specified in this paragraph.*	NET	JCH
24	18 of 460 (Comment 24)	46 43 11-2.02.G.4	A combined shock and fatigue factor of 2 shall apply to the bending moment in a DRY tank as specified in 46 43 11-2.02.G.4.	A&R	JCH
25	18 of 460 (Comment 25)	46 43 11-2.02.G.5	A combined shock and fatigue factor of 1.5 shall apply to the torsional moment in a DRY tank as specified in 46 43 11-2.02.G.4.	A&R	JCH
26	18 of 460 (Comment 26)	46 43 11-2.02.G.6	BC accepts reducing the 15 lbs/ft along the face of the flights in a wet basin condition (which pertains applies to calculating shaft deflection) to 9.4 lbs/ft in the forebay and 4.5 lbs/ft in the aft bay. However, Evoqua shall design all equipment to operate in 5% solids concentrations as discussed in Item 1 of this table.	A&R	JCH
27	18 of 460 (Comment 27)	46 43 11-2.02.G.7	Per Item 10 of table found in Addendum 1 of Change Order #1 issued by JVWCD, BC responded with the following: *A maximum allowable shear stress of 12,000 psi is permitted provided: [1] yield strength of material is equal to or exceed 36,000 psi; and [2] maximum shear stress does not exceed 12,0000 psi with stress concentrations factors included.* This applies to all shafts.	NET	JCH
28	19 of 460 (Comment 28)	46 43 11-2.02.N.2.b	No Comment. Outboard bearing was optional based on Manufacturer's recommendation.	NET	JCH
29	19 of 460 (Comment 29)	46 43 11-2.03.A.1	Evoqua to provide 10 proof load tests for the lot of HS730 loop chain provided. The first two (2), two (2) at 25%, middle two (2), two (2) at 75%, and the last two (2) strands shall be proof load tested to 10,0000 pounds, with reports provided upon completion of the tests and prior to shipment of equipment.	NET	JCH
30	19 of 460 (Comment 30)	46 43 11-2.03.A.2.a	Evoqua to submit proposed cleaning and passivation procedure for review as required in Section 46 43 11-1.04.D.2.	A&R	JCH

31	20 of 460 (Comment 31)	46 43 11-3.03	Manufacturer to submit precise installation instructions for positive location, alignment of all shafts to ensure uniform chain tension, and all other installation requirements for the Contractor to follow during installation of equipment. Evoqua to provide installation instructions prior to shipment of equipment. Evoqua to provide installation certificate upon completion of initial test and field quality control Work.	NET	JCH
32	20 of 460 (Comment 32)	46 43 11-3.04.A.3	Per Item 12 of table found in Addendum 1 of Change Order #1 issued by JVWCD, BC responded with the following: *A sag of less than ½" below the straight line between bottom edge of flight at wearing shoes is permitted. Manufacturer is responsible to ensure proposed sag limit will not interfere with operation of equipment.*	NET	JCH
33	20 of 460 (Comment 1)	43 05 21-1.05.A.3	Baldor offers high potential tests as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routine tests in accordance with IEEE 112 as defined in 46 5 21.1.06.A.1. Provide testing as defined in specification.	MCN	NDA/JCH
34	20 of 460 (Comment 2)	43 05 21-1.05.A.8	Proposed motors do not exceed 250 hp. As such, Section 43 05 21-1.05.A.8 does not apply.	NET	NDA/JCH
35	21 of 460 (Comment 3)	43 05 21-1.05.B.2	Evoqua to provide O&M Manual for all equipment components (including motor) prior to BC issuing a notice of substantial completion.	NET	NDA/JCH
36	21 of 460 (Comment 4)	43 05 21-1.06.A.1	Baldor offers testing of current input at rated frequency with rotor at standstill as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routine tests in accordance with IEEE 112 as defined in 46 5 21.1.06.A.1. Provide testing as defined in specification.	MCN	NDA/JCH
37	21 of 460 (Comment 5)	43 05 21-1.06.A.1	Baldor offers high potential tests as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routine tests in accordance with IEEE 112 as defined in 46 5 21.1.06.A.1. Provide testing as defined in specification.	MCN	NDA/JCH
38	21 of 460 (Comment 6)	43 05 21-1.06.B	Proposed motors do not exceed 100 hp. As such, Section 43 05 21-1.06.B does not apply.	NET	NDA/JCH
39	22 of 460 (Comment 7)	43 05 21-2.04.A.4	Proposed motors are Severe Duty Type Motors. As such, Section 43 05 21-2.04.A.4 does not apply.	NET	NDA/JCH
40	22 of 460 (Comment 8)	43 05 21-2.04.A.6	Proposed motors are Severe Duty Type Motors. As such, Section 43 05 21-2.04.A.6 does not apply.	NET	NDA/JCH
41	22 of 460 (Comment 9)	43 05 21-2.04.B	Proposed motors exceed 0.5 hp. As such, Section 43 05 21-2.04.B does not apply.	NET	NDA/JCH
42	22 of 460 (Comment 10)	43 05 21-2.05.B	Proposed motors are horizontally installed. As such, Section 43 05 21-2.05.B does not apply.	NET	NDA/JCH
43	22 of 460 (Comment 11)	43 05 21-2.05.D	Proposed motor is not explosion proof. As such, Section 43 05 21-2.05.D.2.f does not apply.	NET	NDA/JCH
44	23 of 460 (Comment 12)	43 05 21-2.05.E.4	Provide separate conduit boxes for temperature devices and space heaters as specified.	MCN	NDA/JCH
45	23 of 460 (Comment 13)	43 05 21-2.05.F.5	Proposed motor does not use belts. As such, Section 43 05 21-2.05.F.5 does not apply.	NET	NDA/JCH
46	23 of 460 (Comment 14)	43 05 21-2.05.G.2	Proposed motor uses grease lubricated bearings. As such, Section 43 05 21-2.05.G.2 does not apply.	NET	NDA/JCH

47	23 of 460 (Comment 15)	43 05 21-3.01	Electrical contractor shall be responsible to perform examination in accordance with this Section. However, Evoqua shall provide certificate of installation certifying installation meets these requirements.	NET	NDA/JCH
48	23 of 460 (Comment 16)	43 05 21-3.02	Electrical contractor shall be responsible to perform installation in accordance with this Section. However, Evoqua shall provide certificate of installation certifying installation meets these requirements.	NET	NDA/JCH
49	24 of 460 (Comment 17)	43 05 21-3.03	Electrical contractor shall be responsible to perform field quality control in accordance with this Section. However, Evoqua shall provide certificate of installation certifying installation meets these requirements.	NET	NDA/JCH
50	24 of 460 (Comment 18)	43 05 21-3.04	Evoqua shall provide O&M and testing information prior to BC issuing a notice of substantial completion.	NET	NDA/JCH
51	394,396, and 447 of 460	-	Confirm HP rating for motor. Design documents show these motors as 1HP. Submittal shows these motors as 0.5HP.	MCN	NDA
52	326,327,458, 459 and 460 of 460	-	Drawing #419383-108 Rev. A is in two places in submittal (pg. 326 and 458 of 460) and calls out different information on each dwg regarding switch locations. It also appears that the Torque Limiter limit switch might be mis-identified as 2nd shear pin limit switch. Similar issues occur on #419383-109 Rev.A (see 327 & 459 of 460). Please ensure switch information is consistent and correct.	A&R	DM
53	59	-	Importance Factor shall be 1.5 rather than 1.0 in Section titled Seismic Loads Nonbuilding Structures.	A&R	TG
54	60	-	Importance Factor shall be 1.5 rather than 1.25 as ASCE 7 overrules ACI 350.3.	A&R	TG
55	60	-	Impulsive Response Factor shall be 2.0 rather than 3.0 as ASCE 7 overrules ACI 350.3.	A&R	TG
56	60	-	ASCE 7 overrules ACI 350.3, use Sac or the new 350.3-20 version for the Period-dependent seismic response coefficient C_C	A&R	TG
57	60	-	Sloshing wave will be approximately 2x when using the ASCE 7 or new 350.3-20 criteria	A&R	TG

[a]Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

EVOQUA WATER TECHNOLOGIES	RESPONSE TO CONFERENCE CALL MEETING MINUTES			
	PROJECT:	419383-01 SAP No. 2033/001724.P.01	PREPARED BY:	A. Kluessendorf S. Wilson
	PAGE:	1 OF 5	DATE:	05-20-2022

Equipment: (12) Chain & Scraper Longitudinal Collectors – 3-Shaft
(12) Chain & Scraper Longitudinal Collectors – 4 Shaft
(4) Chain & Scraper Cross Collectors

Location: Jordan Valley Water Treatment Plant - JVWCD
Herriman, UT

The items listed below are presented in response to Submittal Return Comments received from Brown and Caldwell on 02-15-2022. Items that were marked "NET" for No Exceptions Taken, are understood to be resolved and are not addressed with the items listed below. A copy of this listing should be returned with the submittal drawings, marked or stamped accordingly, by the approving authority.

1. ***Evoqua provided the following response on February 11, 2022, pertaining to the 5% solids loading defined in Section 46 43 11-1.03.C.1.e:***

   "At the specified sludge load of 4.5 lbs/ft of flight length in conjunction with the aforementioned collector chain pretensioning load, the drive chain would see a load of 2059 lbs (which would require the chain to change from NH78 non-metallic to ENV78B stainless steel). The Headshaft and Lower Influent Cornershaft would be 4.50", while the Effluent Cornershafts would remain at 4.00". The Gear Reducers for the single output could remain as submitted (torque requirement of 9279 in-lbs @ 1.0 SF; 12991 in-lbs @ 1.4 SF), but the dual output ones would have to increase in size."

   All equipment shall meet the requirements listed in Section 46 43 11-1.03.C.1.e. As such, Evoqua shall supply components (metallic drive chain, properly sized gear reducers, shafts, etc.) designed to operate in solids concentrations up to 5%.

   Evoqua has updated the design calculations for the Aft Bay mechanisms for a sludge load of 4.5 lb/ft of flight length in lieu of the previously provided design that utilized 3.5 lb/ft of flight length. The updated calculation output pages can be found in the CSD Structural Calculations Appendix, specifically A3.

   As noted above, the impact of the increased sludge load required the drive chain in the Aft Bay mechanisms to change from NH78 to ENV78B, increased the Aft Bay lower influent cornershaft diameter from 4.00" to 4.50", and increased the Aft Bay dual output gear reducer size from SEW Eurodrive KA87B R57AM56C (23900 in-lbs torque capacity) to a Nord SK 9053.1-56C (42480 in-lbs torque capacity). These items have all been updated in this Mechanical Equipment Submittal, Rev. B package.

24. A combined shock and fatigue factor of 2 shall apply to the bending moment in a DRY tank as specified in 46 43 11-2.02.G.4.

Evoqua's design calculations review both Dry Tank and Wet Tank criteria, using the worst case scenario for equipment selection. The Dry Tank calculations use an increase friction factor for the equipment without a sludge load, and the Wet Tank calculations use a water lubricated friction factor with applied sludge load.

In all three of the mechanism designs (Fore Bay, Aft Bay, and Cross), the Wet Tank criteria with applied sludge loads drove the equipment design.

25. A combined shock and fatigue factor of 1.5 shall apply to the torsional moment in a DRY tank as specified in 46 43 11-2.02.G.4.

See Evoqua's response to Item 24 above.

26. BC accepts reducing the 15 lbs/ft along the face of the flights in a wet basin condition (which pertains applies to calculating shaft deflection) to 9.4 lbs/ft in the forebay and 4.5 lbs/ft in the aft bay. However, Evoqua shall design all equipment to operate in 5% solids concentrations as discussed in Item 1 of this table.

See Evoqua's response to Item 1 above.

30. Evoqua to submit proposed cleaning and passivation procedure for review as required in Section 46 43 11-1.04.D.2.

Evoqua has included a Passivation Proposal with this Mechanical Equipment Submittal, Rev. B. Please refer to *Section 6 – Reference Forms, Item 2 – Evoqua Chain and Scraper Passivation Proposal* for details.

Please confirm acceptance.

33. Baldor offers high potential tests as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routine tests in accordance with IEEE 112 as defined in 46 05 21.1.06.A.1. Provide testing as defined in specification.

Evoqua has confirmed with Baldor that the motors will be tested in accordance with IEEE 841 and IEEE 112. Testing results will be provided after the motors are fabricated.

36. ***Baldor offers testing of current input at rated frequency with rotor at standstill as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routine tests in accordance with IEEE 112 as defined in 46 05 21.1.06.A.1. Provide testing as defined in specification.***

Evoqua has confirmed with Baldor that the motors will be tested in accordance with IEEE 841 and IEEE 112. Testing results will be provided after the motors are fabricated.

37. ***Baldor offers high potential tests as part of their routine motor test (M33B) with very little additional time to provide. Specification requires routines routine tests in accordance with IEEE 112 as defined in 46 05 21.1.06.A.1. Provide testing as defined in specification.***

Evoqua has confirmed with Baldor that the motors will be tested in accordance with IEEE 841 and IEEE 112. Testing results will be provided after the motors are fabricated.

44. ***Provide separate conduit boxes for temperature devices and space heaters as specified.***

Evoqua inquired with Baldor about separate conduit boxes for temperature devices and space heaters. Per Baldor, “Auxiliary conduit boxes for accessories is not available.”

51. ***Confirm HP rating for motor. Design documents show these motors as 1HP. Submittal shows these motors as 0.5HP.***

Evoqua recognizes that the existing Koellmann gear reducers utilize a 1 HP motor. However, Evoqua has reviewed the torque requirements for each collector mechanism, with application of a 1.4 SF for AGMA Class II operational characteristics, and has determined that a 0.50 HP motor will be appropriate for each collector mechanism. Additional details of these calculations were provided in Evoqua’s Drive Assembly Submittal, Rev. A on April 12, 2022.

Evoqua further confirms that the motors being provided have been correctly designed for the specified altitude of 5000 ft, 6:1 Constant Torque inverter rating, Class 1, Division 2, Groups A, B, C & D area classification. Additional details of the motors can be found in *Section 5 – Product Data, Item 13 – Motor – Baldor, Custom*.

52. Drawing #419383-108 Rev. A is in two places in submittal (pg. 326 and 458 of 460) and calls out different information on each dwg regarding switch locations. It also appears that the Torque Limiter limit switch might be mis-identifies as 2nd shear pin limit switch.

Similar issues occur on #419383-109 Rev. A (see 327 & 459 of 460). Please ensure switch information is consistent and correct.

According to Section 46 43 11-2.02.K & L, only the mechanical type overload protection device was specified as having a high torque alarm. However, in discussions with Brown and Caldwell, it was determined that both the shear pin device and the mechanical overload protection device should have alarms. This additional scope was included in Evoqua's Change Order to Brown and Caldwell, and was approved by the Owner.

Evoqua confirms that the drive arrangements will include dual limit switch devices, one for the shear pin limit switch and one for the mechanical ball-detent torque limiter. Please refer to *Section 7 – Drawings*, specifically Evoqua General Arrangement drawings 419383-108 & -109, for additional details.

53. Importance Factor shall be 1.5 rather than 1.0 in Section titled Seismic Loads Nonbuilding Structures.

CSD Structural Engineers has updated their sealed structural calculations in accordance with these specified values. Please refer to *Section 4 – Calculations, Item 1 – Structural Calculations – CSD* for additional details.

54. Importance Factor shall be 1.5 rather than 1.25 as ASCE 7 overrules ACI 350.3.

CSD Structural Engineers has updated their sealed structural calculations in accordance with these specified values. Please refer to *Section 4 – Calculations, Item 1 – Structural Calculations – CSD* for additional details.

55. Impulsive Response Factor shall be 2.0 rather than 3.0 as ASCE 7 overrules ACI 350.3.

CSD Structural Engineers has updated their sealed structural calculations in accordance with these specified values. Please refer to *Section 4 – Calculations, Item 1 – Structural Calculations – CSD* for additional details.

56. ASCE 7 overrules ACI 350.3, use Sac or the new 350.3-20 version for the Period-dependent seismic response coefficient C_c.

CSD Structural Engineers has updated their sealed structural calculations in accordance with these specified values. Please refer to *Section 4 – Calculations, Item 1 – Structural Calculations – CSD* for additional details.

57. Sloshing wave will be approximately 2x when using the ASCE 7 or new 350.3-20 criteria.

CSD Structural Engineers has updated their sealed structural calculations in accordance with these specified values. Please refer to *Section 4 – Calculations, Item 1 – Structural Calculations – CSD* for additional details.

End of Responses.

Section 3
Check-Marked Specifications

SECTION 46 43 11

CHAIN-AND-FLIGHT EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Solids collector mechanisms for installation in rectangular sedimentation basins.

B. Related Sections:
1. Section 01 11 80: Environmental Conditions
2. Section 01 33 00: Submittal Procedures
3. Section 01 73 24: Non-structural Components and Non-building Structures
4. Section 01 78 23: Operation and Maintenance Data
5. Section 05 05 20: Anchor Bolts
6. Section 43 05 11: General Requirements for Equipment
7. Section 43 05 21: Common Motor Requirements for Equipment

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. D 570 - Test Method for Water Absorption of Plastics.
2. D 638 - Test Methods for Tensile Properties of Plastic.
3. D 785 - Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
4. D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.03 SYSTEM DESCRIPTION

A. General: Furnish a total of 28 mechanisms: 12 longitudinal (long), 12 longitudinal (short) and 4 cross collector solids collector mechanisms across 4 sedimentation basins with necessary appurtenances, modified as necessary, for complete installation as indicated on the Drawings and as specified in this Section.

B. Equip each sedimentation basin with longitudinal collectors and cross collectors as indicated on the Drawings.
1. Provide longitudinal collectors that are driven in combination by single output shafts from gear reducers and motor drive units, as indicated on the Drawings and as specified in this Section.
2. Provide cross collectors that are driven in combination by single output shafts from gear reducers and motor drive units, as indicated on the Drawings and as specified in this Section.
3. Provide each longitudinal solids collector consisting of 2 parallel endless strands of chain with scraping flights attached thereto and passing over 3 pairs of sprockets, as indicated on the Drawings (4-pair of sprockets for the long collectors if the Bid Alternate is selected).

4. Provide each cross collector consisting of 2 parallel endless strands of chain with scraping flights attached thereto and passing over 3 pairs of sprockets, as indicated on the Drawings.

C. Design Requirements:

1. Solids Collectors: Provide collectors that are:

a. Specifically designed for collection of concentrated solids in a municipal water treatment plant produced from Ferric Chloride, Ferric Sulfate, Aluminum Sulfate, or Polyaluminum Chloride (PACL).

b. Suitable for continuous duty and exposure to water and solids containing organic and inorganic solids including silt, sediment, plant matter, algae, grit, dirt, silica, polymer, chlorine, chlorine dioxide, caustic soda, and/or permanganate.

c. Capable of operating when water temperatures vary between 35 degrees and 80 degrees Fahrenheit.

d. Capable of operating under dry tank conditions, and in basins that are taken offline, drained each winter, and not refilled until the following spring.

1 e. Capable of operating under solids concentrations of up to 5 percent.

D. Performance Requirements:

1. Solids Collection Equipment: Provide equipment suitable for installation and operation in rectangular sedimentation basin, as indicated on the Drawings.

2. Basin Flow Rate: up to 54 mgd

3. Longitudinal and Cross Collector Speed Tolerances:

a. Linear speed tolerance not to exceed 4 percent, plus or minus.

b. Solids Collector Linear Speed:

1) Longitudinal Solids Collectors: 1 foot per minute.

2) Cross Collector: 2 feet per minute.

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's standard brochure showing flights, sprockets, chains, drive assemblies, and instrumentation.

B. Shop Drawings and Calculations: Prepare and submit the following:

1. Provide a copy of this specification and acknowledge each section with a check mark or an X to indicate acceptance or requests for deviation.

2. General: Submit shop drawings as specified in Section 01 33 00.

3. Details of Parts: Submit drawings showing details of each part individually and separately to show that equipment offered satisfies performance, structural strength, vibration, and other requirements of this Section.

4. Calculations: Submit structural and mechanical calculations showing that parts and equipment comply with specified requirements. It shall be detailed on the manufacturer's drawings.

5. Anchor bolt calculations for all wall connections as defined in Section 05 05 20, signed and stamped by a structural engineer licensed in the State of Utah.

C. Manufacturer's Drawings:
   1. Submit drawings that clearly and completely show the following:
      a. Complete details, size, make, type, duty, and catalog number of every piece of equipment to be provided.
      b. Type of alloy or material used, size, pitch, and speed of each type of sprocket and chain.
      c. No substitutes of inferior grade, type, design, or strength will be accepted.
   2. Setting Drawings: Submit drawings showing requirements for setting of anchor bolts and any other information required for setting of equipment.
   3. Chain Path Drawings: Submit drawings showing manufacturer's proposed chain path.
   4. Flight Path Drawings: Submit drawings showing manufacturer's proposed flight path. Include on drawing concrete walls, sump walls, and all submerged equipment including gates and valves so that potential conflicts are accounted for in final layout and positioning of collector shafts within the basins.

2 D. Quality Control Submittals:
   1. Test Data: Submit certified test data with chains supplied for use stating that chains, including flight attachment links, comply with specified load testing requirements.
   2. Stainless Steel cleaning and Passivation procedure as defined in Section 2.03.A.2
   3. Manufacturer's Instructions: Submit precise installation instructions for positive location and alignment of all shafts to ensure uniform chain tension.

3 E. Contract Closeout Submittals:
   1. Project Record Documents.
   2. Operation and Maintenance: Submit operation and maintenance manuals as specified in Section 01 78 23, and as specified in this Section.

F. Manufacturer’s Warranty

1.05 QUALITY ASSURANCE

A. Qualifications of Manufacturer of Solids Collector(s):
   1. Collector Manufacturers Qualifications:
      a. Provide collectors from manufacturer which has been regularly engaged in manufacture of non-metallic solids collectors for not less than the past 10 years.
      b. Provide collectors from manufacturer of non-metallic solids collectors that have been successfully used in municipal water treatment applications for not less than the past 10 years and that are currently in continuous operation.
   2. List of Manufacturer's Installations:
      a. Submit list of at least 5 installations for applications of comparable size (180-mgd facility) and requirements substantiating collector manufacturer's qualifications.
      b. Provide list that includes name, address, and telephone number of OWNER, average design flow of plant and each basin where solids collectors are being used, solids collector dimensions, and time in operation.

B. Certifications:

4 1. After initial test runs as specified in Article Field Quality Control, submit documents certifying that the equipment has been installed and adjusted in accordance with the manufacturer's requirements.
2. That all submerged equipment is NSF 61 compliant.

C. Unit Responsibility:
1. The Contractor shall assign unit responsibility as specified in Section 43 05 11-1.02 Unit Responsibility to the sedimentation tank collector chain manufacturer. A certificate of unit responsibility shall be provided.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:
5 1. Flight Chains and Collector Sprockets: Protect against corrosion and dust during shipment and storage until installed.
2. Ship flights so that there is no bending or warpage of the flights.
6 3. Protect all fiberglass and plastic from sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements as specified in 01 11 80.

1.08 WARRANTY

7 A. Flight Straightness:
1. Tolerances for Flight Straightness:
a. Warranty: Tolerances for flight straightness shall not be exceeded during warranty period. Flights that do exceed these tolerances during warranty period shall be replaced.
b. Warranty Period: 1-1/2 years, from final acceptance of the project.
c. Warranty Period for Replacement Flights: Is to start at time flights are replaced and extended for period of 1 year from that date.

B. Manufacturer shall warranty against defects in materials and workmanship for 1 year from acceptance.

1.09 MAINTENANCE

A. Maintenance Service:
1. Supervision: Furnish a Field Engineer experienced in erection and operation of equipment provided under this Section capable of complying with following requirements:
a. Minimum number of trips and time at site:
1) Minimum of 4 trips for total time of not less than 8 working days.
2) Not less than 2 days.
b. Duties at site:
1) Supervise installation and adjustment of equipment.
2) Supervise initial assembly and installation of equipment.

2. Operation Instructions:
   a. Provide training by a factory representative who has complete knowledge of proper operation and maintenance of equipment furnished under this and related Sections complying with following requirements:
      1) Minimum number of trips and time at site: Provided 2 trips of 1 working day each for startup of Basins 3 and 4 as a pair, and Basins 5 and 6 as a pair.
      2) Duties at site: Instruct representatives of OWNER and ENGINEER on proper operation and maintenance and cleaning of the equipment.
   b. Operation instruction may be given during same visit as for inspection of installation and testing required under Article “Field Quality Control” provided that testing is successful, and that operating and maintenance instructions have been previously furnished to and found acceptable by the ENGINEER.
   8 c. Bidder shall prepare a recording of field training.
3. Third Month Inspection and Service (this will occur in the Fall of 2022 after peak demand has subsided):
   a. Equipment Manufacturer:
      1) Inspect, realign, adjust tension, and lubricate solids collectors within three months after final acceptance.
      2) Service to include items required by manufacturer's maintenance instructions.
   b. Coordination: CONTRACTOR, in conjunction with equipment manufacturer, is to coordinate this work with OWNER and ENGINEER prior to initiating the work.
4. Eleventh Month Inspection and Service:
   a. Scheduling and Notification:
      1) Scheduling: 11 months following final acceptance, CONTRACTOR and equipment manufacturer are to schedule inspection with OWNER.
      2) Notification: CONTRACTOR is to notify OWNER at least 30 days prior to desired inspection date to enable OWNER to schedule removal of any sedimentation basin from service and to dewater basins.
   b. Inspection:
      1) Inspection to include same service as provided under subparagraph “Third Month Inspection and Service” and any other service required by manufacturer's maintenance instructions.
      2) Flights:
         a) Examine each longitudinal and cross collector flights for straightness.
         b) Each flight which fails to meet straightness requirements of specified under Article “Field Quality Control” is to be replaced with factory-finished flights.
      3) Collector Chain Strands:
         a) Each collector chain strands are to be inspected and adjusted.
         b) If any collector chain strands have elongated due to wear or stretch, more than 1.5 percent of total strand length, as determined by links removed to bring sedimentation basin into proper adjustment, complete strand is to be replaced.

4) Sprockets, bearings, shafts, and gear reduction: Each sprocket, bearing, shaft, and gear reduction is to be inspected, adjusted, and aligned as required.

B. Spare Parts:

1. Furnish following spare parts, including hardware and ancillary equipment necessary to make such spare parts operative:
   a. Longitudinal Fiberglass Flights: 10 flights
   b. Cross Collector Fiberglass Flights: 5 flights
   c. Flight Chain: 100-ft.
   d. Drive Chain: Sufficient length to drive one longitudinal collector.
   e. Drive and Flight Chain Sprockets: 1 of each size.
   f. Bearings: Sufficient number for sprockets supplied as spare parts.
   g. Shear Pins: 50 as specified in this Section.
2. Spare Parts List: Furnish complete list which includes spare parts unit prices and identification of local supplier.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Envirex, Inc. (Evoqua)
2. Polychem, a division of Brentwood Industries, Inc.

B. Tag Numbers

1. Refer to record drawings found in Exhibit A of preselection package.

2.02 MANUFACTURED UNITS

A. Fiberglass Flights:

9 1. Flight Design (Evoqua's Sigma+ or equal):
   a. Provide approximately 3-inch by 8-inch nominal size flights designed for solids collector service.
   b. Pultruded channel or rectangular shape having 45 percent minimum (by weight) continuous fiberglass filaments.
      1) Include a scraper lip on the leading edge to provide cleaning of the basin floor.
   c. Minimum moment of inertia along the major axis of 18.5 inch to the fourth power and 1.5 inch to the fourth power along the minor axis.
   10 d. Minimum modulus of elasticity of 4,323,000 pounds per square inch determined on full section bend tests used on actual flights to determine the modulus of elasticity.
   e. Maximum water absorption no greater than 0.5 percent in accordance with ASTM D 570 based on 24-hour exposure.
   f. Provide polypropylene filler blocks for bolting the flight to the chain attachment links.

g. Flight deflection and twist calculations:

1) Deflect below a level straight line no more than 1/16 of an inch when supported at the wearing shoes on the return rails under its weight.

2) Deflect no more than 1/60 of the spacing between sprocket centers when pushing a solids load of 15 pounds per foot distributed along the face of the flight in a wet basin condition.

2. Flight Attachments:

11 a. Same material and strength as specified herein for the collector chains and shall be molded integrally with the link side bars.

b. Extend practically the full depth of the flight. Flight fasteners shall be four 3/8-inch diameter Type 316 stainless steel hexagon head bolts, hexagon nuts, flat washers, and cut washers. Lock nuts in lieu of standard nuts and cut washers are also acceptable.

c. Associated flight to wear shoe fasteners shall be two Type 316 stainless steel flight attachment bolts.

3. Flight Wearing Shoes:

a. Material:

12 1) Alternative A - Ultra-high molecular weight polyethylene with minimum tensile strength of 6,000 pounds per square inch (psi) and ASTM D 2240 durometer hardness of A/80/85.

2) Alternative B - Nylon 6-6 with minimum tensile strength of 12,000 pounds per square inch and ASTM D 785 Rockwell hardness of R110.

3) Alternative C – Polyurethane

b. Provide minimum 1/2-inch thick shoes.

c. Fasten shoes which bear against the bottom rails at the chain attachment to reinforce the connectors to the flight.

d. Provide guide lugs on at least every second flight for shoes which bear on the return tracks.

e. Shoe fasteners shall be 3/8-inch diameter Type 316 stainless steel hexagon head bolts, hexagon nuts, flat washers, and cut washers.

B. Drive Chain:

1. Material:

a. Alternative A - Reinforced acetal resin.

b. Alternative B - Reinforced nylon resin.

2. Chain Pins: Type 303 or 304 stainless steel.

3. Service Factor: Minimum 1.2 for all chains and sprockets.

4. Pitch: 2.609 inches.

5. Minimum Work Load: 1,740 pounds.

6. Side Bars: Height shall not be less than 1-1/8 inches and have overall width not exceeding 3-1/4 inches.

7. Chain Pin Diameter: Not less than 7/16-inch diameter.

8. Chain Sprockets:

a. Chain Tighteners:

1) Provide adjustable chain tighteners on drive chains.

2) Provide tighteners that are adjustable laterally for alignment and vertically for lightening purposes.

9. Drive Chain Guards:
   a. Provide removable guards not less than 14 gauge 316 stainless steel that enclose moving parts above basin walkway slab.
   b. Provide guards that are close-fitting and constructed in neat, workmanlike fashion.
10. Provide tensioner sprockets having 7 teeth and of the same material as the driven sprocket or glass-reinforced Nylon 6-6.

13 C. Collector Chain and Pins:

1. Chain Material:
   a. Alternative A: Nonmetallic unfilled acetal resin thermoplastic material.
   b. Alternative B: Reinforced thermoplastic polyester resin.
2. Pin Material:
   a. Alternative A: Reinforced nylon resin.
   b. Alternative B: Reinforced acetal co-polymer.
3. Chain Characteristics: Provide chain complying with following:
   a. Pitch: 6 inches.
   b. Minimum Working Load: 2,400 pounds.
   c. Average Weight: Not less than 1.3 pounds per foot.
   d. Type: Non-metallic NCS-720S.
4. Side Bars:
   a. Shape: Provide bars that are curved to match rim of sprockets.
5. Chain Pins: Design to provide full dead load bearing capacity throughout full length of link side bar hubs.
   a. Pins shall have a T-head to engage a seat or retainer lug molded as part of the chain link.
   b. The lock shall be positioned and prevent rotation.
   c. Pins using separate pin locks or cotter keys are unacceptable, unless the locking clips provide a positive locking contact around the full periphery of the pin.
   d. Minimum Diameter: 0.866 inch.

D. Driven Bull Sprocket:

1. General:
   a. Sprockets shall be keyed to the shaft.
   b. Sprocket rims shall be designed to match the drive chain and shall be 33.25-inch pitch with 40 teeth.
   c. All fasteners and other hardware shall be Type 316 stainless steel.
2. Alternative A:
   a. Material: Polyurethane having Durometer hardness of not less than Shore 70D determined in accordance with ASTM D 2240 and a water absorption rate not to exceed 1.3 percent as determined in accordance with ASTM D 570.
   b. The rim shall be a 4-segment rim mounted on a split body.

14 c. The sprocket shall be held in place with 2 full width clamping bands which exert the compressive force around the full periphery of each shoulder. The shoulder shall include retainers to hold the band in place.

15 d. The wedge dogs shall be located along the split line of the body to draw the sprocket body into diametrical and lateral alignment.

e. Each rim segment shall be mounted to the sprocket body by four 5/8-inch bolts.

3. Alternative B:

   a. Material: Nylon 6-6 or Cast Nylon-6 with a Rockwell hardness of R110 determined in accordance with ASTM D 785 and a water absorption rate not to exceed 0.6 percent as determined in accordance with ASTM D 570.

   b. The body shall be held in place with set screws.

   c. The body shall have bolts located along the split line to draw the 2 halves into diametrical and lateral alignment.

E. Head Shaft Drive Sprocket:

1. General:

16 a. Sprocket rims shall be chain saver type.

b. Sprocket rims shall be keyed to the shaft.

17 c. Sprocket rims shall be designed to match the collection chain and shall be 22.21- inch pitch diameter with 23 teeth.

d. All fasteners and hardware shall be Type 316 stainless steel.

e. Material: Same material as the driven bull sprocket.

f. Sprockets shall be split construction with double life tooth profile.

g. Clamping Bands: Same as for the driven bull sprocket.

h. Wedge Dogs: Same as for the driven bull sprocket.

F. Idler Sprockets:

1. General:

18 a. Sprocket rims shall be chain saver type.

19 b. Sprocket rims shall be designed to match the collector chain and shall be no less than 22.21- inch pitch diameter with 23 teeth.

c. Use Type 316 stainless steel for all fasteners and other hardware.

20 d. 2 sprockets shall be mounted on each cross shaft. 1 of the sprockets shall turn free. The other sprocket shall be keyed to the shaft.

2. Alternative A:

a. Material: Same as the driven bull sprocket.

b. The fixed sprocket shall be clamped to the shaft same as the driven bull sprocket.

21 c. Secure free turning sprockets to the bearing sleeves by 2 clamping bands. The clamping bands shall be the same as for the driven bull sprocket.

d. Sprockets shall be split construction with double life tooth profile.

e. Wedge Dogs: Same as for the driven bull sprocket.

22 f. Bearing Sleeves:

   1) Material: Same as for sprocket.

   2) Split construction.

3) The sleeves shall be secured to the shaft by 2 clamping bands which exert compressive force around the full periphery of each shoulder.

4) Each shoulder shall have retainer rings to contain the clamping band.

G. Shafts and Bearings:

1. Shafts shall be 316 Stainless Steel. Shafts shall be full-width live shafts with bearings mounted to the walls.

2. Regardless of shaft size requirements determined by the loads and safe working stresses, steel shaft size shall not be less than indicated in the following table:

Description	Diameter (inches)
Longitudinal collector head shaft	3-15/16
Longitudinal collector idler shafts	3-7/16
Cross collector head shaft	2-7/16
Cross collector idler shaft	2-7/16

23 3. The shafting and bearing tolerances shall be as follows:

a. Shafts: Nominal shaft size as specified plus 0.000 inch to minus 0.006 inch.

b. Bearings: Nominal size as specified plus 0.006 inch to plus 0.001 inch.

c. Sprockets: Nominal shaft size as specified plus 0.003 inch to plus 0.001 inch.

24 4. A combined shock and fatigue factor, in a dry tank, of 2 shall be applied to bending moment.

25 5. A combined shock and fatigue factor, in a dry tank, of 1-1/2 shall be applied to the torsional moment.

26 6. Shafts shall have an L/d ratio of no less than 360 under a load of 15 pounds per foot along the face of the flights in a wet basins condition.

27 7. Shearing stress shall not exceed 6,000 pounds per square inch for shafts with key seats and 8,000 pounds per square inch for shafts without key seats.

8. Shafts shall have a keyway as required for the sprockets.

9. Shaft bearing housings shall be 316 SS.

10. Shaft bearing shall be split type made of UHMW polyethylene or polyurethane.

11. All bearings shall be mounted to the wall with a minimum of two 3/4-inch anchor bolts. Anchor calculations shall be provided as required in Section 1.04 of this document.

12. All bearings shall be tapped for lubrication fittings. Lubrication fittings shall be buttonhead type and shall be connected to the bearing with 1/4-inch Type 316 stainless steel tubing. Brackets shall be furnished to mount the fittings at the walkway level. Lubricant shall be in accordance with Section 43 05 11.

13. All miscellaneous hardware and fasteners shall be Type 316 stainless steel.

H. Return Rail (Evoqua's J Track or equal), Support and Hardware:

1. Wall Bracket Assembly: Return tracks and supporting brackets shall be 316 stainless-steel fastened by 316SS anchor bolts to the basin or channel divider walls. Each bracket shall be designed to cantilever the return track approximately 9 inches off the wall. 316SS support brackets shall be spaced maximum 10 ft apart. Systems that require separate wear strips and mounting hardware will not be allowed.

a. Return tracks shall be 12-gauge, type 316 SS, in the shape of an inverted capital J with dimensions of 4 inches (Long Leg), 1 inch (short leg) and 2 inches (wear shoe riding surface). Material finish shall be 2B polished finish to allow for the smooth travel of the flight wear shoe with the need for any additional wearing strips.
b. Contractor shall field butt weld joined ends of return track and grind the top surface smooth. Stainless steel tracks, brackets, stainless steel anchors, stainless steel attachment hardware are to be furnished by the equipment manufacturer.
c. In additional to the weight of the return tracks, Supports shall be designed to support a minimum uniform load of 2.5 pounds per foot or the 8 pound concentrated load at mid span.
d. Material: 316 Stainless Steel.
e. Assembly shall consist of wall bracket, and hardware.
f. All mounting holes shall be predrilled.
g. All hardware shall be Type 316 stainless steel.

2. If the Bid Alternate is selected, wall brackets are not required, but return tracks are and hardware are still required.

I. Bottom Wear Strips and Hardware:

1. 316 stainless-steel wear strips shall be provided for the floor consisting of 3/8-inch thick sections with countersunk holes for attachment to the floor. The floor shall have two (2) lines of wear strips which are secured with Type 316 stainless-steel anchors. Anchors shall be set in pre-drilled holes.

J. Driver Sprocket:

1. Sprockets shall be designed to match the drive chain and shall be 9.26-inch pitch diameter and have 11 teeth.
2. Material:
    a. The driver sprocket and driving assembly shall be cast nylon-6 with a 316 SS shear pin hub.
        1) Alternate Method: A polymeric plate section bolted to a 316 Stainless Steel driving hub. The sprocket plate section shall be molded of polyurethane as described under the collector chain sprocket section.
    b. All hardware shall be Type 316 stainless steel.

K. Shear Pin:

1. Shear Pin:
    a. Material: Aluminum.
    b. Provide polymeric gasket between shear faces.
    c. Sized to protect equipment from failure or excessive loads.

L. Overload Protection:

1. In addition to shear pins installed in the sprocket, a mechanical type overload protection device shall be provided.
    a. The overload mechanism shall be adjustable with a manual reset.
    b. Shall activate overload alarm contacts which represents the high torque alarm.

1) Normally closed contact that opens on high torque

c. The mechanical type overload protection device shall be Bibbigard or equal.

M. Collector Drives: Provide collector drives consisting of drive units, drive and driven sprockets, chain, chain guards, and other equipment necessary and as required for driving longitudinal solids collectors and cross collectors with separate drive units in the sedimentation basins and as required for safely guarding all rotating parts at work center.

1. Provide longitudinal solids collectors and cross collector as indicated on the Drawings that are driven by variable speed drives. For each basin, five independent drives shall be provided to drive each of the following:
   a. Two longitudinal collectors (long)
   b. One longitudinal collector (long)
   c. Two longitudinal collectors (short)
   d. One longitudinal collector (short)
   e. One cross collector

N. Gear Reduction Units:

1. Provide units of quadruple or quintuple reduction, helical or herringbone type with anti-friction bearings as specified in Section 43 05 11.
2. Shafts of Motors, Gear Reduction Units, Right Angle Drives (If applicable), Drive Sprockets, and Other Units as Required:
   a. Are to be proportioned to provide for overhung loads imposed by chain linkage.
   28 b. Outboard Bearings:
      1) If required, provide bearings to reduce overhung loads.
      2) Provide bearings of sealed self-aligning, antifriction type, mounted on common base.

O. Motors:

1. Provide collector drive motors for longitudinal solids collectors and cross collector having following characteristics in addition to those specified in Section 43 05 21.
   a. Variable Speed Motors:
      1) Speed: Not more than 1,750 revolutions per minute.
      2) Horsepower: Not less than 0.5.
      3) Volts: 460.
      4) Phase: 3.
      5) Hertz: 60.
      6) Enclosure: TEFC.
      7) Service Factor: 1.15.
      8) Insulation: Class F.
      9) Ambient Temperature: 40 degrees Celsius.
      10) Duty: Severe Duty and Inverter Duty
   b. Show characteristics listed above on motorplate.
2. Collector Drive Motor Horsepower:

a. Provide motors having horsepower capacity capable of driving collectors without overloading under any operating conditions.
b. Provide horsepower sufficient for dragging flights and for power losses through gear boxes, reduction units, bearings, and other mechanical devices which absorb power.
c. At any time during operation, rated full load current to motors is not to be exceeded.

2.03 SOURCE QUALITY CONTROL

A. Tests:
1. Chains and Flight Attachment Links:
29 a. Test strands consisting of 6 pitches each, including flight attachment link, to 5,000 pounds without failure as part of manufacturer's quality assurance procedure during manufacture. Test no less than 1 percent of the total length supplied. Discard tested strands. Submit test results to Engineer.
2. Stainless Steel Components
30 a. Stainless steel components shall be protected from carbon steel contamination during fabrication and assembly as defined in Paragraph 8 of ASTM A380. Surfaces shall be descaled and cleaned in accordance with Paragraph 5 and Paragraph 6 of ASTM A380, respectively. Components shall then receive final cleaning-passivation in accordance with the requirements of Table A2.1 Part II of ASTM A380. Testing to ensure proper passivation and cleaning has occurred shall be in accordance with Paragraph 7.2.5 of ASTM A380. The manufacturer shall supply a cleaning, passivation and testing procedure outlining the procedure followed by the manufacturer to ensure proper cleaning and passivation has occurred along with test results upon completion of the testing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
1. Verify that rails are level and straight before installing chain and flights.

3.02 PREPARATION

A. Basins are existing, and were constructed in 1987. As part of Bidder's inspections to field verify dimensions, observe and provide comments on the condition of the existing basins that may need additional preparation by Contractor.

31 3.03 INSTALLATION

A. Sprockets:
1. General:
a. Set chains and sprockets in alignment so that chain is centered on sprocket teeth.
b. Install chain links such there is no touching or rubbing between inside of chain link and outside of sprocket teeth.

c. Center driving sprockets on true plane passing through true center of driven sprockets.

B. Rails and Guides:
1. Return Rail Brackets:
a. Install brackets for return rails as follows:
1) At columns: On column center line.
2) At walls: Not more than 10 feet center to center.

C. Flight Guides:
1. Set anchor bolts in cross walls for anchoring of guides.

D. Tolerances:
1. Tolerances of Concrete Floor Slabs:
a. Finish concrete slabs so that straightedge will ride only on wear strips and never on concrete slab.
b. At no location shall the concrete be higher than the wear strips.
2. Sprockets: Alignment of sprockets is not to vary from true plane more than 1/16 inch.
3. Shafting:
a. Longitudinal: Set to within 1/8 inch of true line and level.
b. Collector: Set to within 1/16 inch of true line and level.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Cost of Testing: Cost of testing is to be borne by Bidder.
2. Chain Proof Load Testing: At ENGINEER's discretion, 5 strands consisting of 6 pitches each, including flight attachment link, will be randomly selected by ENGINEER from chain shipped to project site for 5,000-pound proof load testing, by independent testing laboratory.
3. Straightness Testing: Select minimum of 10 flights randomly from flights manufactured specifically for this project. Test each of these flights at project site to determine flight's straightness as follows:
32 a. Sag: While simply supported on wearing shoes, front bottom edge of flight is not to deviate more than 1/8 inch above nor 1/16 inch below straight line between bottom edge of flight at wearing shoes.
b. Bow: Horizontal displacement of front bottom edge from straight line is not to exceed 1 inch.

B. Required Results:
1. Chain Proof Load Testing: Should any:
a. 1 of samples fail proof load testing, additional 5 strands will be selected and subjected to test procedures.
b. If additional strands fail, entire lot of chain will be rejected and stored on project site until receipt of acceptable chain from manufacturer.

2. Collector Drive Motors: When equipment is tested with basins dry or with water in basins, no overloading of motors or other mechanical gear is allowed.

C. Manufacturer's Field Service:

1. Coordination: CONTRACTOR, in conjunction with equipment manufacturer, is to coordinate field service work with OWNER and ENGINEER prior to initiating such work.
2. Equipment Manufacturer: Furnish factory-trained service engineer to instruct CONTRACTOR's personnel as to proper installation of equipment, supervise initial installation, check complete installation, make necessary adjustments prior to initial operation and supervise initial operation of equipment.
3. CONTRACTOR: Furnish all necessary oil and grease in accordance with the manufacturer's installation instructions prior to initial operation.
4. Service Engineer:
    a. Make certain that each bearing and contact surfaces between sprockets and shafts, and guide rails, both upper and lower, have been properly lubricated prior to testing of equipment.
    b. Do not apply power to any equipment until, in service Engineer verifies that each part to be in motion has been thoroughly and carefully checked for alignment, smoothness of operation, and lubrication.
    c. Test Runs:
        1) Dry Startup: Run the equipment without water in the basins to check for alignment of sprockets, chain, flights, wearing surfaces, and binding and excessive heat buildup in the drive units.
        2) Wet Startup: Fill the basins with water at a slow rate so the solids collectors do not rotate. Run the equipment to verify smooth operation.
        3) Solids Startup: Run the equipment with wastewater in the basins to verify proper operation.
        4) Inspection:
            a) After each startup, each and every bearing, sprocket, chain, shaft, and drive shall be carefully inspected by the service engineer for tightness,
            b) heating, vibration, binding, unusual noisiness, wobbling, eccentricity, overloading, and any other maladjustment or fault.
            c) Repair or adjust any such fault immediately to satisfaction of the ENGINEER.
        5) During test runs, allow sufficient time for any heating, binding, or eccentricity by virtue of tight or loose connections to develop.
5. Third and Eleventh Month Inspection and Service:
    a. Inspection and Service: Perform as specified in subparagraphs “Third Month Inspection and Service,” and “Eleventh Month Inspection and Service.”
    b. Inspection and Services: Equipment manufacturer to inspect, realign, adjust tension and lubricate solids collectors once at 3 and 11 months after initial start-up and testing.

3.05 ADJUSTING

A. Repair and Replacement: Any equipment damaged or broken from improper installation, material defects, or incorrect adjustment are to be replaced.

END OF SECTION

SECTION 43 05 21

COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Squirrel cage type, AC induction motors, up to 500 HP, for up to 4 poles (3600 or 1800 rpm nominal), or up to 250 HP for over 6 poles (1200 rpm or slower) shall be per NEMA MG1, Small or Medium.
2. Special purpose motors with features or ratings which are not specified herein, are specified in the particular equipment specifications.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry- Premium-Efficiency, Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
Department of Energy	Energy Policy and Conservation Act, Final Rules EERE-2010-BT-STD-0027-0117
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

1.03 DEFINITIONS

A. Terminology used in this Section conforms with NEMA MG-1. Motors covered in this specification are those defined in NEMA MG1 as Small (Fractional) and Medium (Integral) AC induction motors.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Unit Responsibility: Where Unit Responsibility is specified in the driven equipment sections of these specifications, the motor supplier shall coordinate with the provider of the driven equipment to verify that the motor provided under this section is fully compatible with and meets the specified performance requirements for that equipment.

1.05 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
   - a. Copy of this Section, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
   - b. Check-marks (✓) to denote full compliance with a paragraph as a whole. Underline deviations and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance. Include a detailed, written justification for each deviation.
   - c. Failure to include a copy of the marked-up specification sections with justification(s) for any requested deviation will cause rejection of the entire submittal with no further consideration.
2. Motor Data Sheets specified in this Section and Division 01.
   - a. Motors in conformance with IEEE 841: Manufacturers to complete IEEE Standard 841 Data Sheet for AC Induction Motors.
   - b. Motors not in conformance with IEEE 841: Motor supplier to complete Form 43 05 21-A in Section 01 99 90 with required factory data.
   - c. Motor Speed-Torque curve, where specified.
3. Routine Factory test data for polyphase motors.
   - 1 a. High-potential test.
4. Factory test data, from required dynamometer tests, where specified.
5. Vibration level when measured in accordance with NEMA MG 1, for all IEEE 841 motors, and where elsewhere specified.
6. Motor heating curve, where specified,
7. Motor mounting, outline, dimensions, and weight.
8. 2 Motor bearing and winding RTDs (resistance temperature detector), where specified.
9. Motor winding thermostat or thermistor, where specified.
10. Motor winding space heaters, where specified.
11. Motor nameplate data.

B. Informational Submittals:

1. Procedures: Section 01 33 00 and 01 78 23.
2. 3 Submittal requirements for operation and maintenance manuals as per requirements of Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Factory Testing:

1. All polyphase motors shall be factory tested in conformance with routine tests per NEMA MG1 and IEEE 112. Provide the following tests:
   - a. Measurement of winding resistance.
   - b. No-load readings of current and speed at normal voltage and frequency.
   - 4 c. Current input at rated frequency with rotor at standstill.
   - 5 d. High potential test.

B. Where specified for use in corrosive or hazardous locations, motor testing shall additionally be per IEEE 841. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.

6 1. For motors larger than 100 horsepower, test and submit results for the following:

a. Routine tests per NEMA MG1 and IEEE 112. Provide tests as noted in paragraph 1.06 Factory Testing. Test report shall be certified by the motor manufacturer's test personnel and submitted to the Engineer.

b. For motors larger than 200 horsepower, efficiency and power factor by Test Method B, IEEE 112. Submit Form B and B-2.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. The manufacturer's standard product may require modification to conform to specified requirements:

1. Baldor
2. General Electric
3. Siemens
4. US Motors
5. WEG
6. Approved Equal

2.02 PERFORMANCE/DESIGN CRITERIA

A. Service Conditions:

1. Temperature: -25-degree C to +40 degree C.
2. Altitude: 5000 feet above sea level minimum.
3. Derate motors for higher ambient temperature and for higher altitude with motor size based on brake-horsepower.

B. Design Requirements:

1. Operation: Continuous.
2. Compliance: Energy Policy Act of 1992 (EPAct), Final Rule 2014.
3. Tolerance: +/- 10-percent of rated voltage at rated frequency; +/- 5-percent of rated frequency at rated voltage.
4. Standard design: NEMA Design B.

C. Service Factor (percent of additional horsepower):

1. 1.15 for Sine-wave motors.
2. Dual rating: 1.15 Sine-wave and 1.0 Inverter Duty for Inverter Duty motors.

D. Motor Efficiency:

1. NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole (1-250 HP),

squirrel cage induction motors, NEMA Design B, continuous rated. NEMA Standards Publication MG 1 2011, in Table 12-12.

Table 12-12

Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors

Rated 600 Volts or Less (Random Wound)

Open Motors								
	2 Pole		4 Pole		6 Pole		8 Pole	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84	81.5	86.5	84.0	86.5	84.0	77.0	74.0
2	85.5	82.5	86.5	84.0	87.5	85.5	86.5	84.0
3	85.5	82.5	89.5	87.5	88.5	86.5	87.5	85.5
5	86.5	84.0	89.5	87.5	89.5	87.5	88.5	86.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5	89.5	87.5
10	89.5	87.5	91.7	90.2	91.7	90.2	90.2	88.5
15	90.2	88.5	93.0	91.7	91.7	90.2	90.2	88.5
20	91.0	89.5	93.0	91.7	92.4	91.0	91.0	89.5
25	91.7	90.2	93.6	92.4	93.0	91.7	91.0	89.5
30	91.7	90.2	94.1	93.0	93.6	92.4	91.7	90.2
40	92.4	91.0	94.1	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	91.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	93.0	91.7
75	93.6	92.4	95.0	94.1	94.5	93.6	94.1	93.0
100	93.6	92.4	95.4	94.5	95.0	94.1	94.1	93.0
125	94.1	93.0	95.4	94.5	95.0	94.1	94.1	93.0
150	94.1	93.0	95.8	95.0	95.4	94.5	94.1	93.0
200	95.0	94.1	95.8	95.0	95.4	94.5	94.1	93.0
250	95.0	94.1	95.8	95.0	95.8	95.0	95.0	94.1
300	95.4	94.5	95.8	95.0				
350	95.4	94.5	95.8	95.0				
400	95.8	95.0	95.8	95.0				
450	96.2	95.4	96.2	95.4				
500	96.2	95.4	96.2	95.4				

Table 12-12

Full-Load Efficiencies for 60 HZ Premium Efficiency Electric Motors

Rated 600 Volts or Less (Random Wound)

Enclosed Motors								
	2 Pole		4 Pole		6 Pole		8 Pole	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5	78.5	75.5
2	85.5	82.5	86.5	84.0	88.5	86.5	84.0	81.5
3	86.5	84.0	89.5	87.5	89.5	87.5	85.5	82.5
5	88.5	86.5	89.5	87.5	89.5	87.5	86.5	84.0
7.5	89.5	87.5	91.7	90.2	91.0	89.5	86.5	84.0
10	90.2	88.5	91.7	90.2	91.0	89.5	89.5	87.5
15	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
20	91.0	89.5	93.0	91.7	91.7	90.2	90.2	88.5
25	91.7	90.2	93.6	92.4	93.0	91.7	90.2	88.5
30	91.7	90.2	93.6	92.4	93.0	91.7	91.7	90.2
40	92.5	91.0	94.2	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	94.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.5	95.0	94.1	94.5	93.6	92.4	91.0
75	93.6	92.4	95.4	94.5	94.5	93.6	93.6	92.4
100	94.1	93.0	95.4	94.5	95.0	94.1	93.6	92.4
125	95.0	94.1	95.4	94.5	95.0	94.1	94.1	93.0
150	95.0	94.1	95.8	95.0	95.8	95.0	94.1	93.0
200	95.4	94.5	96.2	95.4	95.8	95.0	94.5	93.6
250	95.8	95.0	96.2	95.4	95.8	95.0	95.0	94.1
300	95.8	95.0	96.2	95.4				
350	95.8	95.0	96.2	95.4				
400	95.8	95.0	96.2	95.4				
450	95.8	95.0	96.2	95.4				
500	95.8	95.0	96.2	95.4				

2.03 MATERIALS

A. Motor frames:
   1. TEFC motors shall be cast iron.
   2. Aluminum frame motors are not permitted.

B. Stator windings:
   1. Shall be copper with Class F minimum insulation not to exceed Class B temperature rise of 80-degree C at rated load and with Design B torque /current characteristics for all Medium (Integral) motors.
   2. Small (fractional) motors shall be supplied with Class F insulation where available.

C. Rotor material shall be aluminum or copper.

D. Fans shall be non-sparking fan blades.

E. Motor leads shall be non-hygroscopic.

2.04 MOTOR TYPES

A. General Requirements for motors 1/2 horsepower through 500 horsepower:
   1. Three phase, squirrel cage, with copper windings.
   2. Rated for full voltage starting and continuous duty.
   3. Rating shall be:
      a. 460/ 230 volts, three-phase, 60-Hertz, as shown on the contract drawings.
   4. General Purpose Type motors, which may also be called Type 1 per the project equipment specifications shall be:
      a. Open Drip Proof Motors, shall be as defined per NEMA MG1, self-cooled by convection air.
      b. Weather-Protected Type I Motors (WP-I), shall be as defined per NEMA MG1, similar to ODP construction with addition of screens to prevent entry of rain, snow, and particles, or objects into the motor. Suitable for clean indoor and protected outdoor installations.
      c. Weather Protected Type II Motors (WP-II) shall be as defined per NEMA MG1, with maximum protection from entry of airborne particles, moisture and high velocity air. Suitable for unprotected outdoor installations.
   5. Severe Duty Type Motors, which may also be called Type 2 per the project equipment specifications, shall be in accordance with IEEE 841.
      a. Totally Enclosed Fan-Cooled Motors (TEFC) shall be defined per NEMA MG1.
      b. Enclosure: totally enclosed, fan cooled, with external fan blowing air to the motor frame cooling fins for cooling.
      c. Applications: severe duty and most outdoor installations.
   6. Explosion Proof Type Motors, which may also be called Type 3 per the project equipment specifications.
      a. Enclosures: UL listed explosion proof
      b. Applications: hazardous locations including Class I and Class II (Division 1 and 2), and Class III classified areas.

B. Motors Less Than 1/2 Horsepower:
   1. Type shall be:
      a. Squirrel cage, capacitor start with Class F insulation and copper windings.
      b. Fan motors rated 1/8 horsepower or less: split-phase or shaded-pole type.
   2. Rating shall be:
      a. 115Volts, single phase, 60 Hz.
      b. 208 Volts, single phase, 60 Hz.
      c. 230 Volts, single phase, 60 Hz.

2.05 COMPONENTS

A. Inverter-Fed Polyphase Motors per NEMA MG1 Part 31:
   1. Applications: variable torque or constant torque loads, for vertical or horizontal motors with variable frequency drive controllers (VFD).

2. Features shall include:
   a. Insulation design to meet 2000-Volt peak at a minimum of 0.1 micro-second rise time.
   b. Built-in motor winding protection as specified.
   c. Electrically insulated bearings or,
   d. Provide Electro Static Technology's AEGIS Shaft Grounding Ring for Bearing Protection or equal. The shaft grounding ring shall be solidly bonded per manufacturer's recommendations.

10 B. Vertical Motors:
   1. Features: Inverter duty or non-inverter duty with solid shaft P-base and high thrust bearing compatible with loads imposed by the driven equipment.

C. Thermal Protection:
   1. Inverter duty motors:
      a. Motors up to 50 horsepower:
         1) Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type.
         2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
   2. Motors larger than 50 horsepower up to and including 250 horsepower:
      a. Unless another form of thermal protection is specified in the driven equipment specification, provide a NEMA Type 1 temperature sensing device embedded in the motor winding which is sensitive to motor running over temperature.
      b. Sensor: Wired to a temperature relay in a NEMA 4 box located near or on the motor, or to the variable frequency drive controller.
      c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
   3. Motors larger than 250 horsepower:
      a. Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.
      b. RTDs shall be brought out to a separate control terminal box mounted on the motor.
      c. Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.
   4. Explosion proof motors:
      a. Protection to be NEMA Type 2 bi-metallic thermal switch (Klixon) type:
         1) Constant speed motors (non-explosion proof).
      b. Motors up to 50 horsepower:
         1) Where thermal protection is specified in the driven equipment specifications, provide NEMA Type 2 bi-metallic thermal switch (Klixon) type.
         2) Motor Nameplate: Marked "OVER TEMP PROT 2" in accordance with NEMA MG 1 12.43.
      c. Motors larger than 50 horsepower up to 250 horsepower:
         1) Where thermal protection is specified in the driven equipment specifications, provide a NEMA Type 1 temperature sensing device embedded in the motor

winding which is sensitive to both motor running over temperature and with fast response to rate of temperature rise for locked rotor protection.

2) Sensor: Wired to a NEMA 4 temperature monitor box located near or on the motor

3) Temperature Sensing System: Automatic reset, normally closed contact, rated 2A at 115 VAC.

4) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.

d. Motors larger than 250 horsepower:

1) Unless another form of thermal protection is specified in the driven equipment specification, provide 100 ohm platinum RTDs, two per phase embedded in each winding phase.

2) RTDs shall be brought out to a separate control terminal box mounted on the motor.

3) Motor Nameplate: Marked "OVER TEMP PROT 1" in accordance with NEMA MG 1 12.43.

D. Motor Nameplates:

1. Materials: Engraved or stamped stainless steel.

2. Features shall be as follows:

a. NEMA Standard MG 1 motor data.

b. Permanently fastened to the motor frame.

c. ABMA bearing identification number for motors meeting IEEE 841.

d. NEMA nominal efficiency for all motors.

e. NEMA nominal and minimum efficiency for motors meeting IEEE 841.

11 f. UL frame temperature limit code for explosion proof motors.

g. Space heater data.

h. Over Temperature Protection Type Number.

i. Temperature device rating and alarm and shutdown setpoint.

j. Provide motor nameplates for motors with space heaters located in Class I, Division 2, Groups C, and D areas in accordance with NEC 501.125(B).

E. Conduit Boxes:

1. Provide oversized boxes, with split construction with threaded hubs and petroleum-resistant gaskets.

2. Conduit boxes can be rotated in order to permit installation in any of four positions 90 degrees apart.

3. Provide grounding lug located within the conduit box for ground connection.

12 4. Provide separate conduit boxes for temperature devices and space heaters.

5. Separate terminal box for any signal leads (RTD, thermistor, vibration transmitter, etc.).

F. Bearings:

1. Provide oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads.

2. Rated for a minimum L-10 life of 50,000 hours for direct-connected loads.
3. Cartridge type bearings will not be accepted.
4. Fitted with lubricant fill and drain or relief fittings.
13 5. Belt loads not to exceed forces calculated from NEMA MG 1 Table 14-1 and 14-1A.

G. Bearing lubrication shall be either grease or oil as per the requirements in either 1 or 2:
1. Grease lubricated bearings:
a. Shall be for electric motor use only.
b. Grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
c. Provide grease fittings, similar to Alemite™ type (or equivalent).
d. Shielded bearings with regreasable provisions are permissible.
14 2. Provide oil lubricated bearings with externally visible sight glass to view oil level.
3. All lubricants shall be in accordance with Section 43 05 11.

H. Lifting Eyes:
1. Provide lifting eyes with a safety factor of 5.
2. Provide one lifting eye for motors more than 50 pounds.
3. Provide two lifting eyes for motors over 150 pounds.

I. Winding Space Heaters:
1. Provide winding space heaters to prevent condensation.
2. Rating: 120 volts, single phase, 60 Hertz.
3. Motor nameplate to show space heater rating in watts and volts.
4. Provide terminal block in motor conduit box for heater leads termination.

2.06 FINISHES

A. Paint Finish:
1. Provide standard manufacturer paint finish.
2. Provide motors with semi-gloss finish, scratch and heat resistance electric motor paint.

PART 3 EXECUTION

15 **3.01 EXAMINATION**

A. Delivery Inspection:
1. Inspect driven equipment-motor assembly and components immediately upon delivery and unloading at the job site for damages.
2. Take photos of damage(s) if any, to substantiate the delivery inspection report.

16 **3.02 INSTALLATION**

A. Grounding of Motors:
1. Connect the motor feeder ground cable (green) to the grounding lug terminal in the conduit terminal box.

B. Supplemental Grounding of Motors: Provide for motors fed from VFDs, all motors above 100 horsepower, and all motors in classified areas, where feasible.

1. Bond the motor frame to the grounding grid/electrode system to provide supplemental grounding.

17 **3.03 FIELD QUALITY CONTROL**

A. Field Testing:

1. Measure winding insulation resistance of motors to no less than 10-megohm with a 1000-Vac megohmmeter.
2. Perform motor phases current imbalance testing for motors 20 horsepower and larger.
3. Test motors for proper rotation prior to connection to the driven equipment.
4. Perform thermographic survey per NETA ATS, for motors over 100 horsepower.

B. Field Inspection:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify the installation of breather/drain fittings as specified herein.
5. Check for proper connections of space heaters, winding and RTDs and or thermostats.
6. Visually check for correct phase and ground connections:

3.04 CLOSEOUT ACTIVITIES

A. Operation and Maintenance:

18 1. Provide the operation and maintenance manual of the motor(s). Include testing result information in the O&M manual.

END OF SECTION

Section 4
Calculations

Herriman, UT WTP

Chain and Scraper Sludge Collection Equipment

Structural Calculations

Prepared for:

Evoqua Water Technologies
N19W23993 Ridgeview Pkwy, Suite 200
Waukesha, WI 53188

Prepared by:

CSD
STRUCTURAL ENGINEERS
EXPERTISE • INNOVATION • EXCELLENCE

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Phone: (414) 351-5588

CSD Project No. J211052MAM

Date: May 27, 2022

Reference: Longitudinal Collectors, Cross Collectors, Return Tracks, and Drives

REGISTERED PROFESSIONAL ENGINEER
No. 6315932-2202
MICHAEL P. RYER
STATE OF UTAH

5-26-22

Table of Contents

Design Summary

1. Aft Bay (4) Shaft Longitudinal Collector
   a. All Shafts (Head, Lower Influent, Lower Effluent, Tail): 3/4-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 6 inches.

2. Fore Bay (4) Shaft Longitudinal Collector
   a. All Shafts (Head, Lower Influent, Lower Effluent, Tail): 3/4-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 6 inches.

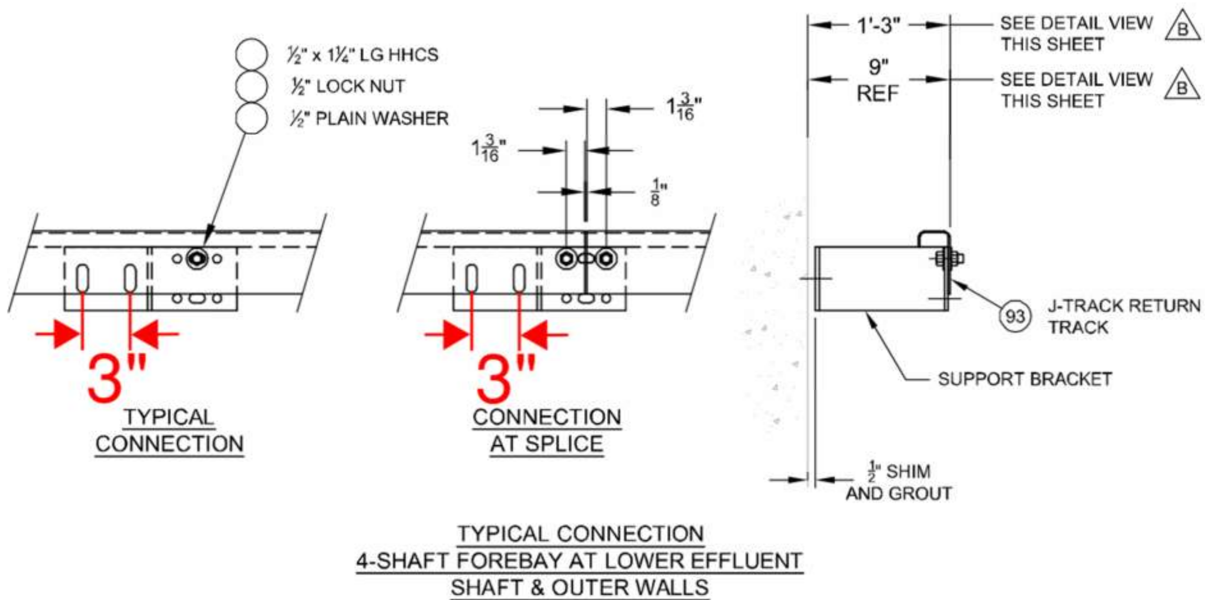
3. (3) Shaft Cross Collector
   a. All Shafts (Head, Lower Influent, Tail): 3/4-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 6 inches.

4. Return Track Anchors at Lower Effluent Shaft and Outer Walls
   a. 5/8-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 5 inches.
   b. Increase anchor spacing to 3 inches. See page S2.

5. Aft Bay (4) Shaft Longitudinal Collector – Dual and Single Output Drive
   a. 5/8-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 5 inches.

6. Fore Bay (4) Shaft Longitudinal Collector – Dual and Single Output Drive
   a. 5/8-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 5 inches.

7. (3) Shaft Cross Collector – Drive
   a. 5/8-inch diameter 316 SS threaded rods set in Simpson Strong-Tie SET-XP epoxy with an effective embedment of 5 inches.



Increase anchor spacing of return track anchors at lower effluent shaft and outer walls to 3 inches, typical.

Project Scope

The CSD Scope of work is limited to the Anchorage for the Chain and Scraper Sludge Collection equipment provided by Evoqua Water Technologies to the Jordan Valley WTP for four (4) basins.

Project Location

Herriman, UT

Building Code

Use International Building Code (IBC) 2018 which is based on ASCE 7–16

Dead Loads

Weight of equipment, weights provided by Evoqua, See Appendix 3.

Seismic Loads

Per the project specification section 01 73 24 “Design Requirements for Non-Structural Components and Non-Building Structures” Part 2, 2.02.B.6

Risk Category	IV
S_s	1.177g
S_1	0.430g
Site Class	D
Ie	1.5
S_{DS}	0.950g
S_{D1}	0.550g
Seismic Design Category	D
Ip	1.5
a_p	1.0 from ASCE 7-16 Table 13.6-1
R_p	2.5 from ASCE 7-16 Table 13.6-1
Ω_o	2.0 from ASCE 7-16 Table 13.6-1

Wind Loads

Per the project specification section 01 73 24 “Design Requirements for Non-Structural Components and Non-Building Structures” Part 2, 2.02.B.5

Basic Wind Speed, V_{ult}	115 MPH
Exposure Category	C
Importance Factor	1.0

Load Combinations

1.4 D
1.2 D + 1.6 L
1.2 D + 1.0 W
0.9 D + 1.0 W
$(1.2 + 0.2\ S_{DS})\ D \pm 1.0\ \Omega_o E$ (Including Sloshing)
$(0.9 - 0.2\ S_{DS})\ D \pm 1.0\ \Omega_o E$ (Including Sloshing)

Additional Performance and Design Requirements

- See Appendices 3 to 5 for chain and scraper equipment operating loads. Operating loads are live loads.
- All anchor rods to be 316 SS rods material ASTM A193 grade B8/B8M.
- Adhesive for all anchors: Simpson Strong-Tie® SET-XP®, ICC ESR-2508.
- The concrete tanks are existing. Assume they were built post 1970 and use f’c = 3000 psi per ACI 562-16 Table 6.3.1a.

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S_1	0.43
S_{DS}	0.95
Occupancy Category =	IV

SEISMIC LOADS NON STRUCTURAL COMPONENTS

ASCE 7-10 SECTION 13.3

						z (ft)	Fp
a_p	1	Per ASCE 7-16 Table 13.6-1					
R_p	2.5	Per ASCE 7-16 Table 13.6-1				1	0.684
I_p	1.5					to	
z	0	ft				7	0.684
h	1	ft				8	0.684
F_p	0.228	Wp	Eq. 13.3-1			9	0.684
	$\leq F_p$	2.280	Wp	Eq. 13.3-2		10	0.684
	$\geq F_p$	0.428	Wp	Eq. 13.3-3		11	0.684
						12	0.684
Use F_p =	0.428	Wp	Section 13.3.1			13	0.684
						14	0.684
			Use this for Component Design/Anchors			15	0.684
						16	0.684

SEISMIC LOADS NONBUILDING STRUCTURES

ASCE 7-16 SECTION 15.4

R	2	Per ASCE 7-16 Table 15.4-2 (All Other Self-Supporting Structures not similar to buildings)	
I	1.50	1	
C_s	0.063	(15.4-1)	
C_s	NA	(15.4-2)	
C_s	0.713	(12.8-2)	
Use C_s =	0.713		Use this for Anchorage and Pier Design

For Rigid Nonbuilding Structures (T<0.06s) Section 15.4.2
C_s = 0.428

WIND LOAD ON OTHER STRUCTURES

ASCE 7-10 SECTION 29.5

Ht. z at the centroid of area Af =	2	ft	$F = q_z G C_f A_f$	(29.5-1)
Building Exposure =	C			
Exposure coefficient K_z =	0.85		29.3.1, Table 29.3-1for MWFR	
Topography factor K_{zt} =	1.00		26.8.2	
Directionality factor K_d =	0.85		26.6	
Wind Speed V =	115	mph		
Importance factor I_w =	1.00			
q_z =	24.46	psf	$.00256\ K_z\ K_{zt}\ K_d\ V^2\ I$	(6-15)
Gust Effect factor G =	0.85		26.9	
Force coeff C_f =	1.6		Square members (Cf from Table 29.5-1)	
Design wind pressure, F/A_f =	33.27	psf	For Square Members	
Force coeff C_f =	0.65		Round Smooth, D > 0.51 ft	
Design wind pressure, F/A_f =	13.51	psf	Larger Round Members	
Force coeff C_f =	1		Round, D <= 0.51 ft	
Design wind pressure, F/A_f =	20.79	psf	Small Round Members	

SEISMIC LOADS FOR TANKS CONTAINING WATER

Using ACI 350.3-20 1

Tank Type:	**Rectangular**	
H_L = height of water in tank =	**15.1**	ft
D or L = Diameter or Length of tank =	**353**	ft
B = Width of tank (if applicable) =	**60**	ft
Tank Use	**Tanks containing hazardous materials (in some cases, for tanks containing hazardous materials, engineering judgment may require a factor I>1.5.**	
I = Importance factor =	1.50	Table 4.1.1(a) 1
Tank Type:	**Fixed or hinged-base tanks**	
Tank Location:	**Buried***	
S_{DS} =	**0.95**	
S_{D1} =	**0.55**	
T_L =	**8**	s

R_i = Impulsive Response Factor	2.00	Table 4.1.1(b) 1
R_c = Convective Response Factor	1.00	Table 4.1.1(b)
L / H_L or D / H_L =	23.377	
W_i / W_L =	0.049	(9.2.1a) or (9.3.1a)
W_c / W_L =	0.829	(9.2.1b) or (9.3.1b)

Heights to Centers of Gravity EBP

EBP - Excluding Base Pressure (datum line just above the base of the tank wall)

h_i / H_L =	0.375	(9.2.2a or b), or (9.3.2a or b)
h_c / H_L =	0.501	(9.2.2c) or (9.3.2c)
h_i =	5.663	
h_c =	7.561	

Heights to Centers of Gravity IBP

Including Base Pressure (datum line at the base of the tank including the effects of the tank bottom supporting structure)

$h_{i'} / H_L$ =	9.997	(9.2.3a or b) or (9.3.3a or b)
$h_{c'} / H_L$ =	55.610	(9.2.3c) or (9.3.3c)
$h_{i'}$ =	150.962	
$h_{c'}$ =	839.704	
l =	3.696	(9.2.4e) or (9.3.4g)
T_c = natural period of 1st (convective) mode for sloshing		
T_c =	31.943	(9.2.4f) or (9.3.4h)

C_i =	0.950	(9.4.1a) (Conservative)
T_S =	0.579	(9.4.1c)
C_c =	0.006	(9.4.2a or b)
C_T =	0.950	(9.4.3a) (Conservative)

d_{max} = Maximum Sloshing Wave Height =	**1.713**	(7.1a) or (7.1c)
Impulsive Coefficient C_iI/R_i =	**0.713**	
Convective Coefficient, C_cI/R_c =	**0.010**	

Determine Seismic Coefficent including Sloshing Effects

C_iI/R_i	x	W_i / W_L =	0.035
C_cI/R_c	x	W_c / W_L =	0.008
			0.043

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IMPULSIVE, INERTIAL AND DRAG FORCES ON ITEMS IN SLOSHING WATER

Based on water velocity * $v = 2\pi \cdot \sqrt{\frac{3}{8}} \cdot \frac{d\max}{T} \cdot \left[1 - \left(\frac{x}{R}\right)^2\right] \cdot \cosh\left(\sqrt{\frac{27}{8}} \cdot \frac{y}{R}\right) \cdot \cos\left(\frac{2nt}{T}\right) \div \sinh\left(\sqrt{\frac{27}{8}} \cdot \frac{H}{R}\right)$

Based on water acceleration * $a = (2\pi)^2 \cdot \sqrt{\frac{3}{8}} \cdot \frac{d\max}{T^2} \cdot \left[1 - \left(\frac{x}{R}\right)^2\right] \cdot \cosh\left(\sqrt{\frac{27}{8}} \cdot \frac{y}{R}\right) \cdot \sin\left(\frac{2nt}{T}\right) \div \sinh\left(\sqrt{\frac{27}{8}} \cdot \frac{H}{R}\right)$

*Derived from TID7024 Nuclear Reactors and Earthquakes August 1963, Appendix F: Dynamic Analysis of Fluids in Containers Subjected to Acceleration

d_{max} = Maximum Sloshing Wave Height =	1.713	ft	H = height of water in tank =	15.1	ft
ρ = mass of water =	1.938	$lb \cdot sec^2 / ft^4$	R = D / 2 or L / 2 =	176.5	ft
T = period of first sloshing mode =	31.943	s	C_c = Convective coefficient =	0.006	
C_m = Mass coefficient =	2		C_iI/R_i = Impulsive Coefficient =	0.713	

v @ center = 1.307 ft/sec @ top — a @ center = 0.2571 ft/sec^2 @ top

v @ center = 1.323 ft/sec @ bottom — a @ center = 0.2603 ft/sec^2 @ bottom

For Individual Components

C_d = Drag coefficient = 1 — 1.0 for round column, 1.6 for wide flange shapes

D_c = Equiv. diameter of column = 0.375 ft -----> 4.5 inch shaft

$F_d = C_d{*}\rho{*}D_c{*}v^2/2$ — $F_i = C_m{*}\rho{*}\pi{*}D_c^2{*}a/4$

F_d @ top =	0.62	plf	F_i @ top =	0.11	plf
F_d @ bot. =	0.64	plf	F_i @ bot. =	0.11	plf

2nt/T	0	30	60	90	F_{imp}		RMS maximums with F_{imp}		
F_{di} top	0.62	0.52	0.25	0.11	4.91	plf	**F(top max)**	**4.95**	**plf**
F_{di} bot.	0.64	0.53	0.26	0.11	4.91	plf	**F(bot.max)**	**4.95**	**plf**

^H_2O inside diam.^

For Typical Angle Members using same procedure as above

For Individual Components	C_d	D_c (ft)	**F(top max)**	**F(bot.max)**
			RMS maximums with F_{imp}	
L 5 Angle	1.6	0.59	**12.22**	**12.23**
L 4 Angle	1.6	0.47	**7.86**	**7.86**
L 3 1/2 Angle	1.6	0.41	**6.04**	**6.05**
L 3 Angle	1.6	0.35	**4.46**	**4.47**
L 2 1/2 Angle	1.6	0.29	**3.13**	**3.13**
L 2 Angle	1.6	0.24	**2.04**	**2.04**
L 1 3/4 Angle	1.6	0.21	**1.58**	**1.59**
L 1 1/2 Angle	1.6	0.18	**1.19**	**1.19**

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3/18/2022 8:29 AM

For Individual Components

C_d = Drag coefficient = 1.0 — 1.0 for round column, 1.6 for wide flange shapes

D_c = Equiv. diameter of column = 0.333 ft -----> 4 inch shaft

$F_d = C_d*\rho*D_c*v^2/2$ | $F_i = C_m*\rho*\pi*D_c^{2}*a/4$

F_d @ top = 0.55 plf | F_i @ top = 0.09 plf

F_d @ bot. = 0.56 plf | F_i @ bot. = 0.09 plf

2nt/T	0	30	60	90	F_{imp}		RMS maximums with F_{imp}		
F_{di} top	0.55	0.46	0.21	0.09	3.87	plf	**F(top max)**	**3.91**	**plf**
F_{di} bot.	0.56	0.47	0.22	0.09	3.87	plf	**F(bot.max)**	**3.91**	**plf**

^H_2O inside diam.^

For Individual Components

C_d = Drag coefficient = 1.0 — 1.0 for round column, 1.6 for wide flange shapes

D_c = Equiv. diameter of column = 0.208 ft -----> 2.5 inch shaft

$F_d = C_d*\rho*D_c*v^2/2$ | $F_i = C_m*\rho*\pi*D_c^{2}*a/4$

F_d @ top = 0.34 plf | F_i @ top = 0.03 plf

F_d @ bot. = 0.35 plf | F_i @ bot. = 0.03 plf

2nt/T	0	30	60	90	F_{imp}		RMS maximums with F_{imp}		
F_{di} top	0.34	0.28	0.12	0.03	1.51	plf	**F(top max)**	**1.55**	**plf**
F_{di} bot.	0.35	0.28	0.12	0.03	1.51	plf	**F(bot.max)**	**1.55**	**plf**

^H_2O inside diam.^

For Individual Components

C_d = Drag coefficient = 1.6 — 1.0 for round column, 1.6 for wide flange shapes

D_c = Equiv. diameter of column = 0.333 ft -----> Return Track

$F_d = C_d*\rho*D_c*v^2/2$ | $F_i = C_m*\rho*\pi*D_c^{2}*a/4$

F_d @ top = 0.88 plf | F_i @ top = 0.09 plf

F_d @ bot. = 0.90 plf | F_i @ bot. = 0.09 plf

2nt/T	0	30	60	90	F_{imp}		RMS maximums with F_{imp}		
F_{di} top	0.88	0.70	0.30	0.09	3.87	plf	**F(top max)**	**3.97**	**plf**
F_{di} bot.	0.90	0.72	0.30	0.09	3.87	plf	**F(bot.max)**	**3.98**	**plf**

^H_2O inside diam.^

For Individual Components

C_d = Drag coefficient = 1.6 — 1.0 for round column, 1.6 for wide flange shapes

D_c = Equiv. diameter of column = ft ----->

$F_d = C_d*\rho*D_c*v^2/2$ | $F_i = C_m*\rho*\pi*D_c^{2}*a/4$

F_d @ top = 0.00 plf | F_i @ top = 0.00 plf

F_d @ bot. = 0.00 plf | F_i @ bot. = 0.00 plf

2nt/T	0	30	60	90	F_{imp}		RMS maximums with F_{imp}		
F_{di} top	0.00	0.00	0.00	0.00	0.00	plf	**F(top max)**	**0.00**	**plf**
F_{di} bot.	0.00	0.00	0.00	0.00	0.00	plf	**F(bot.max)**	**0.00**	**plf**

^H_2O inside diam.^

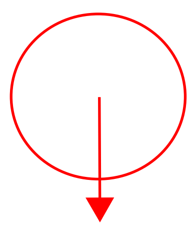
Title: (4) Shaft Aft Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/24/2022

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.042		9.521	1030.553 lbs
Shaft Sprocket 1			32	1.875	32 lbs
Shaft Sprocket 2			32	17.21	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	18.875	60 lbs
					0 lbs
					0 lbs
				Total:	**1307.553 lbs**

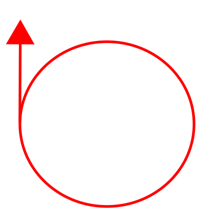


Dead loads all act vertically.

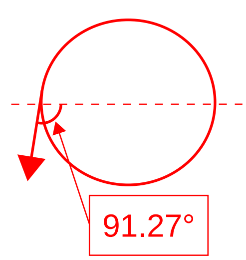
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	2059	90	0.3	2059	0	lbs
Collector CP (1/2 per side)	1407	-91.27	1.875	-1407	-31	lbs
Collector CP (1/2 per side)	1407	-91.27	17.21	-1407	-31	lbs
Weight of chain and (2) flights	80	-24	1.875	-33	73	lbs
Weight of chain and (2) flights	80	-24	17.21	-33	73	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 20'				0	0	lbs
W=20'*1.78plf+2*18.2'*2.4plf/2				0	0	lbs
W=80lbs				0	0	lbs
				0	0	lbs

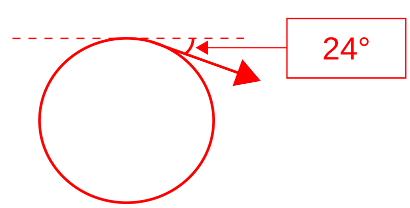
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp
= **559.6 lbs**

Ev = $0.2 * S_{DS} * Wp$
= **248.4 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 4.95 plf
L = 19.042 ft
F_{slosh} = **94.2579 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	699	0	609	0	
Live	-591	-42	1410	-42	
Seismic	133	346	116	308	
1.4D	978	0	852	0	
1.2D+1.6L	-107	-67	2987	-67	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	971	692	846	615	<-- Controls
$(0.9-0.2S_{DS})D\pm E$	496	692	432	615	<-- Controls
1.2D+1.6L+E	381	651	2256	573	

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
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Version 2.9.7376.0

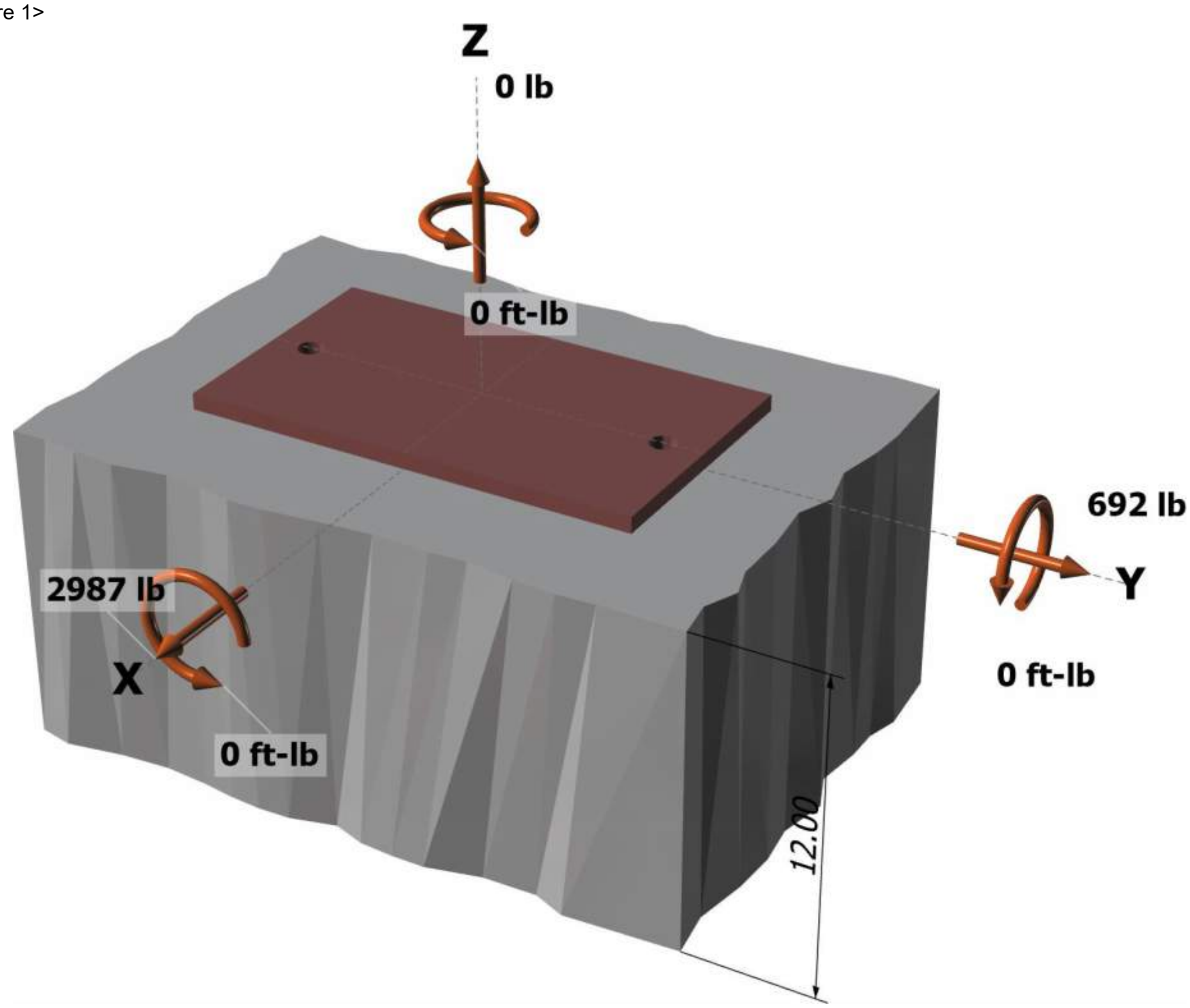
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 2987
V_{uay} [lb]: 692
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



SIMPSON Strong-Tie®

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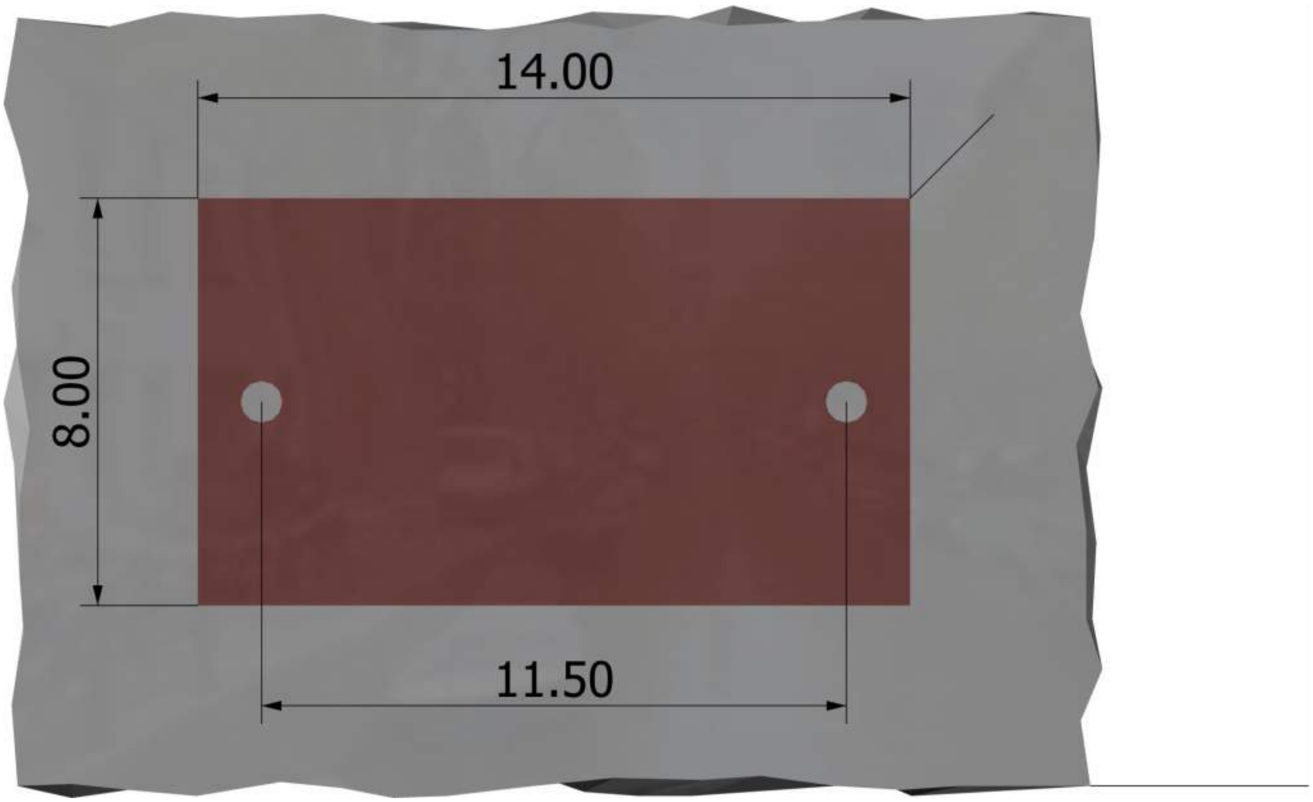
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

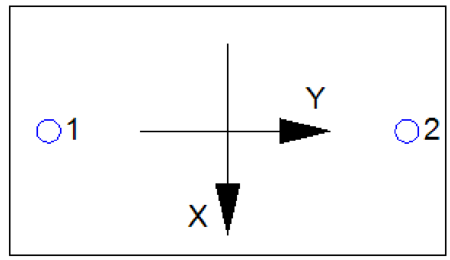


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	1493.5	346.0	1533.1
2	0.0	1493.5	346.0	1533.1
Sum	0.0	2987.0	692.0	3066.1

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi\ \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi\ \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**1533**	**5570**	**0.28**	**Pass (Governs)**
Pryout	3066	13086	0.23	Pass

SIMPSON Strong-Tie®

Anchor Designer™
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Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	5/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

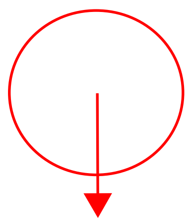
Title: (4) Shaft Aft Bay - Unbalanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/24/2022

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.042		9.521	1030.553 lbs
Shaft Sprocket 1			32	1.875	32 lbs
Shaft Sprocket 2			32	17.21	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	18.875	60 lbs
					0 lbs
					0 lbs
				Total:	**1307.553 lbs**

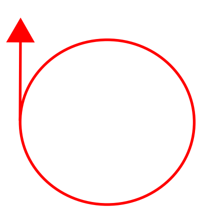


Dead loads all act vertically.

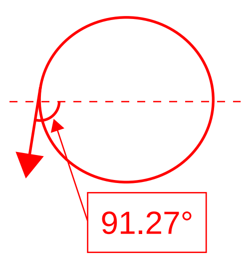
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	2059	90	0.3	2059	0	lbs
Collector CP (Single Strand)	2025	-91.27	17.21	-2025	-45	lbs
				0	0	lbs
Weight of chain and (2) flights	80	-24	1.875	-33	73	lbs
Weight of chain and (2) flights	80	-24	17.21	-33	73	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 20'				0	0	lbs
W=20'*1.78plf+2*18.2'*2.4plf/2				0	0	lbs
W=80lbs				0	0	lbs
				0	0	lbs

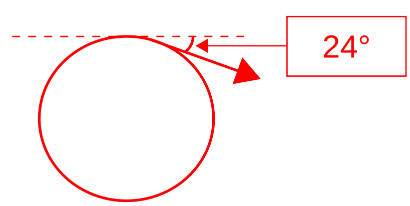
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp
= **559.6 lbs**

Ev = 0.2*S_{DS}*Wp
= **248.4 lbs**

S_{DS} = 0.95

Sloshing on shaft

f = 4.95 plf
L = 19.042 ft
F_{slosh} = 94.2579 lbs

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	699	0	609	0	
Live	-1799	-69	1830	-33	
Seismic	133	346	116	308	
1.4D	978	0	852	0	
1.2D+1.6L	-2040	-110	3658	-52	<-- Controls
$(1.2+0.2S_{DS})D \pm E$	971	692	846	615	<-- Controls
$(0.9-0.2S_{DS})D \pm E$	496	692	432	615	<-- Controls
1.2D+1.6L+E	-828	624	2676	583	

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

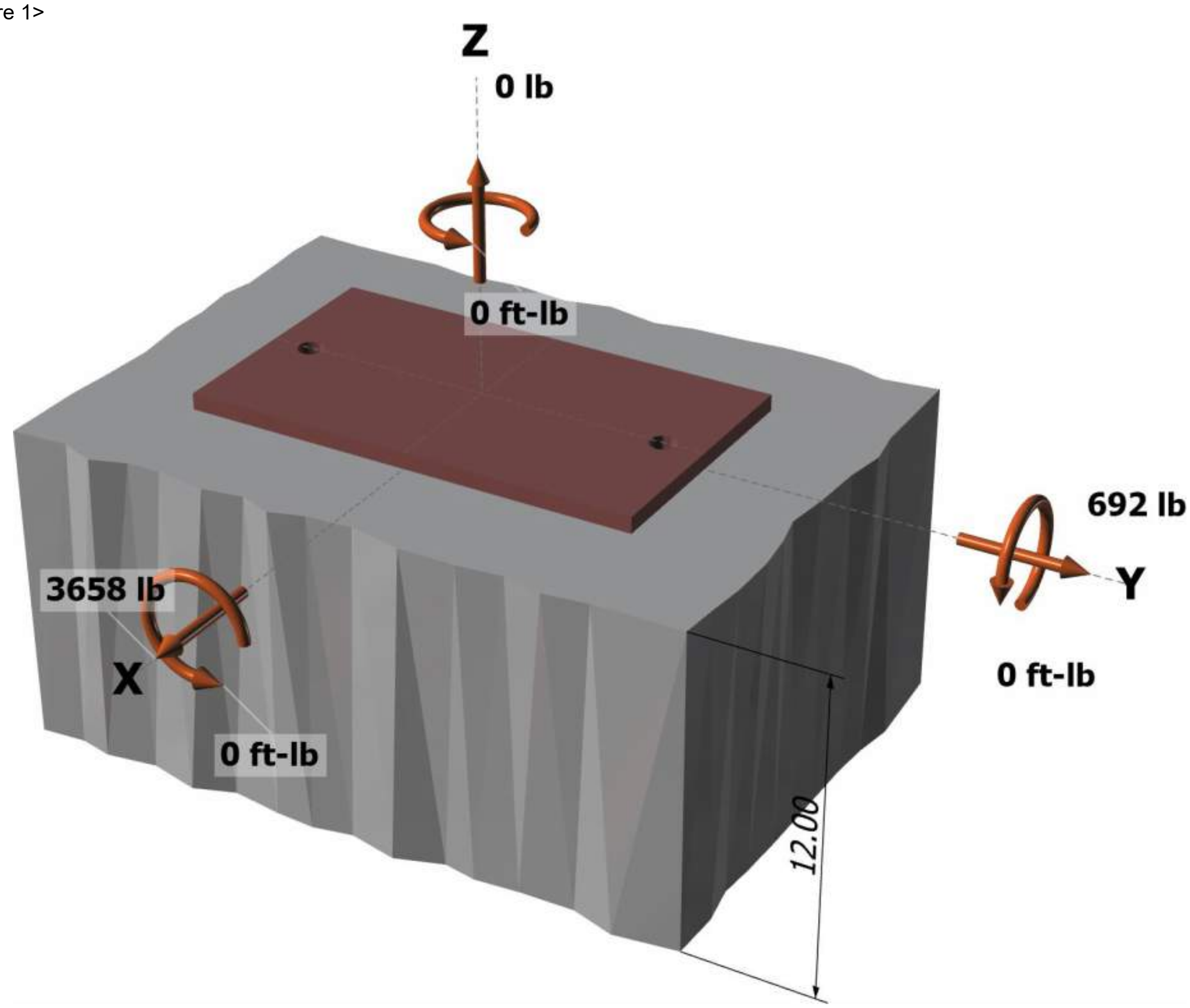
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 3658
V_{uay} [lb]: 692
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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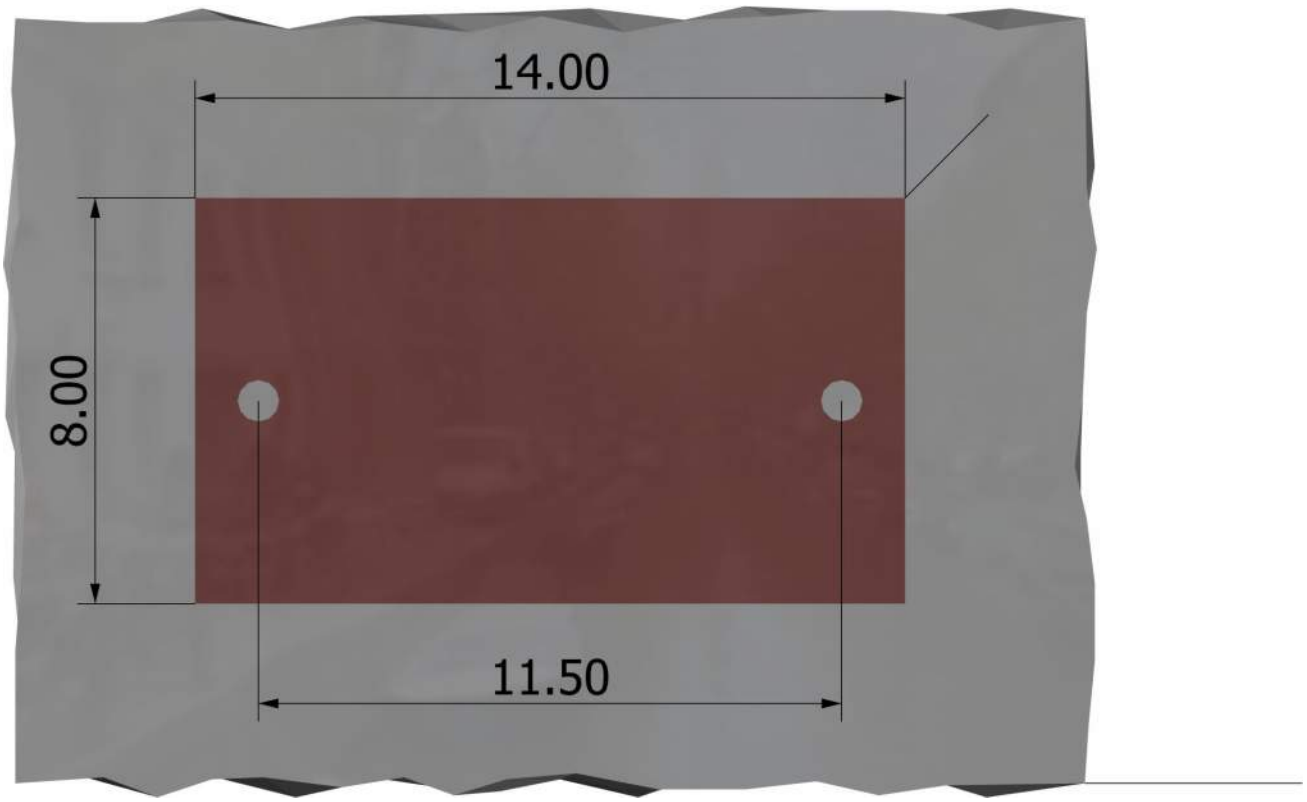
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



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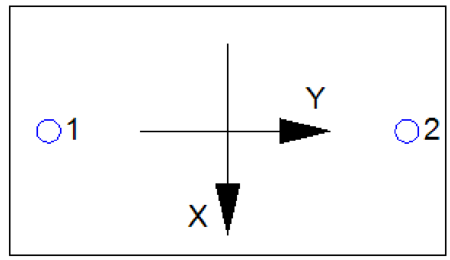
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	1829.0	346.0	1861.4
2	0.0	1829.0	346.0	1861.4
Sum	0.0	3658.0	692.0	3722.9

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\, ;\, k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\, ;\, k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**1861**	**5570**	**0.33**	**Pass (Governs)**
Pryout	3723	13086	0.28	Pass

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	5/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

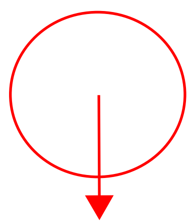
Title: (4) Shaft Aft Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/24/2022

Lower Influent Shaft (Shaft below head shaft)

Dead Loads

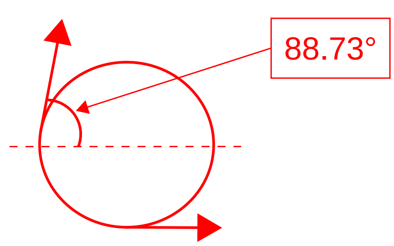
Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.17		9.585	1037.48 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1221.48 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	1407	88.73	1.667	1407	31	lbs
Vert Collector CP (1/2 per side)	1407	88.73	17.333	1407	31	lbs
Horiz Collector CP (1/2 per side)	1407	0	1.667	0	1407	lbs
Horiz Collector CP (1/2 per side)	1407	0	17.333	0	1407	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **522.8 lbs**

Ev = $0.2*S_{DS}*Wp$
= **232.1 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 4.95 plf
L = 19.17 ft
F_{slosh} = 94.8915 lbs

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	612	0	610	0
Live	-1419	-1451	-1394	-1425
Seismic	116	309	116	308
1.4D	856	0	854	0
1.2D+1.6L	-1537	-2322	-1499	-2281
$(1.2+0.2S_{DS})D\pm E$	850	618	848	617
$(0.9-0.2S_{DS})D\pm E$	434	618	433	617
1.2D+1.6L+E	-569	-833	-546	-808

<-- Controls (1.2D+1.6L)

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Influent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

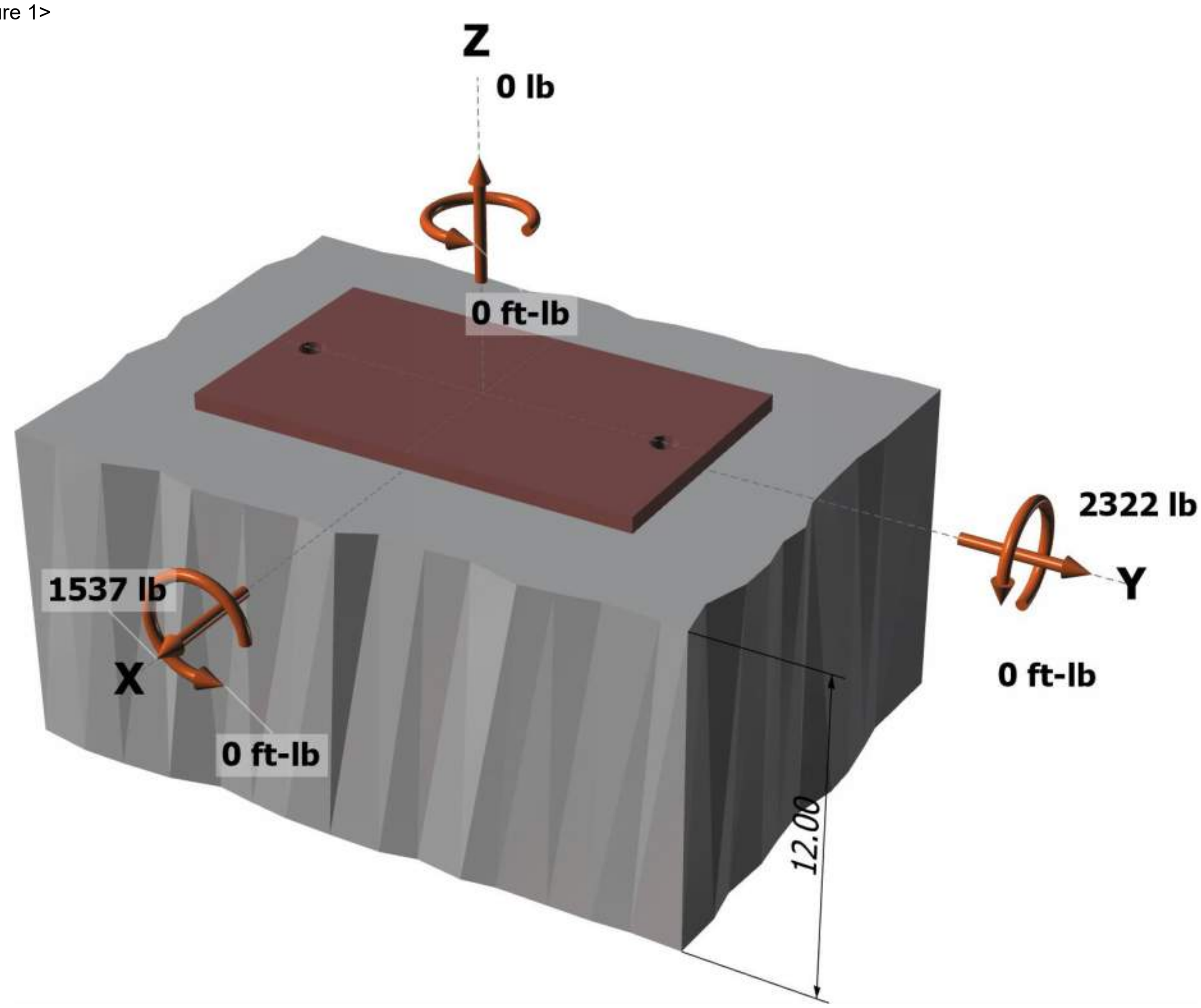
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

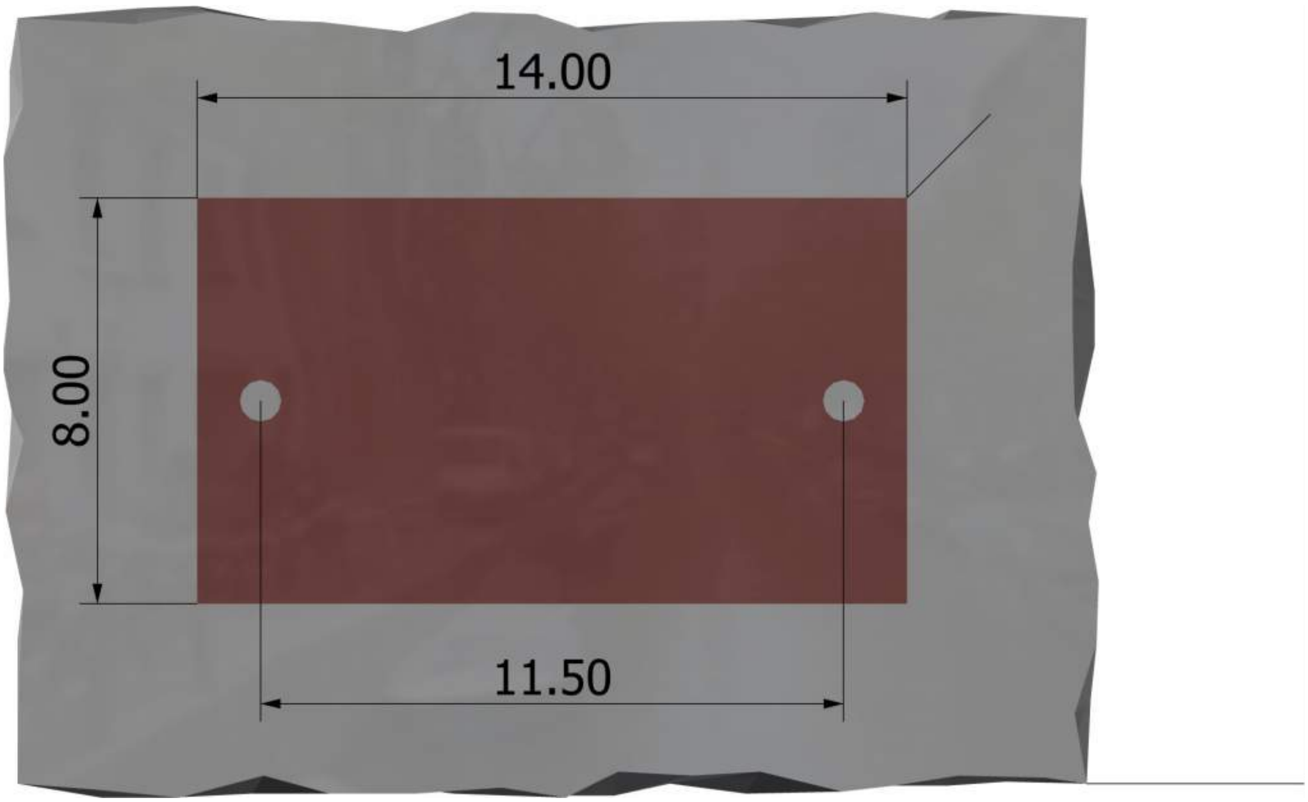
Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1537
V_{uay} [lb]: 2322
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>

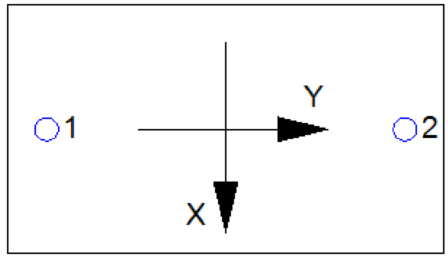


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	768.5	1161.0	1392.3
2	0.0	768.5	1161.0	1392.3
Sum	0.0	1537.0	2322.0	2784.6

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	1392	7426	0.19	Pass

Pryout	**2785**	**13086**	**0.21**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

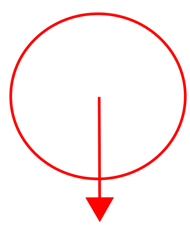
Title: (4) Shaft Aft Bay - Unbalanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/24/2022

Lower Influent Shaft (Shaft below head shaft)

Dead Loads

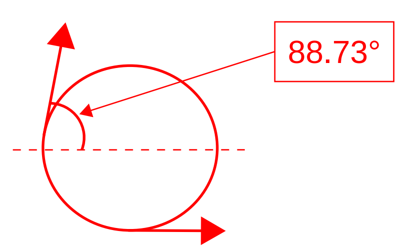
Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.17		9.585	1037.48 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1221.48 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	2025	88.73	1.667	2025	45	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	2025	0	1.667	0	2025	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

$F_p =$ 0.428 Wp
= 522.8 lbs

$E_v = 0.2 \cdot S_{DS} \cdot W_p$

$S_{DS} =$ 0.95

= 232.1 lbs

Sloshing on shaft
f = 4.95 plf
L = 19.17 ft
F_{slosh} = 94.8915 lbs

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	612	0	610	0
Live	-1848	-1890	-176	-180
Seismic	116	309	116	308
1.4D	856	0	854	0
1.2D+1.6L	-2224	-3024	450	-288
$(1.2+0.2S_{DS})D\pm E$	850	618	848	617
$(0.9-0.2S_{DS})D\pm E$	434	618	433	617
1.2D+1.6L+E	-998	-1272	672	437

<-- Controls (1.2D+1.6L)

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Influent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

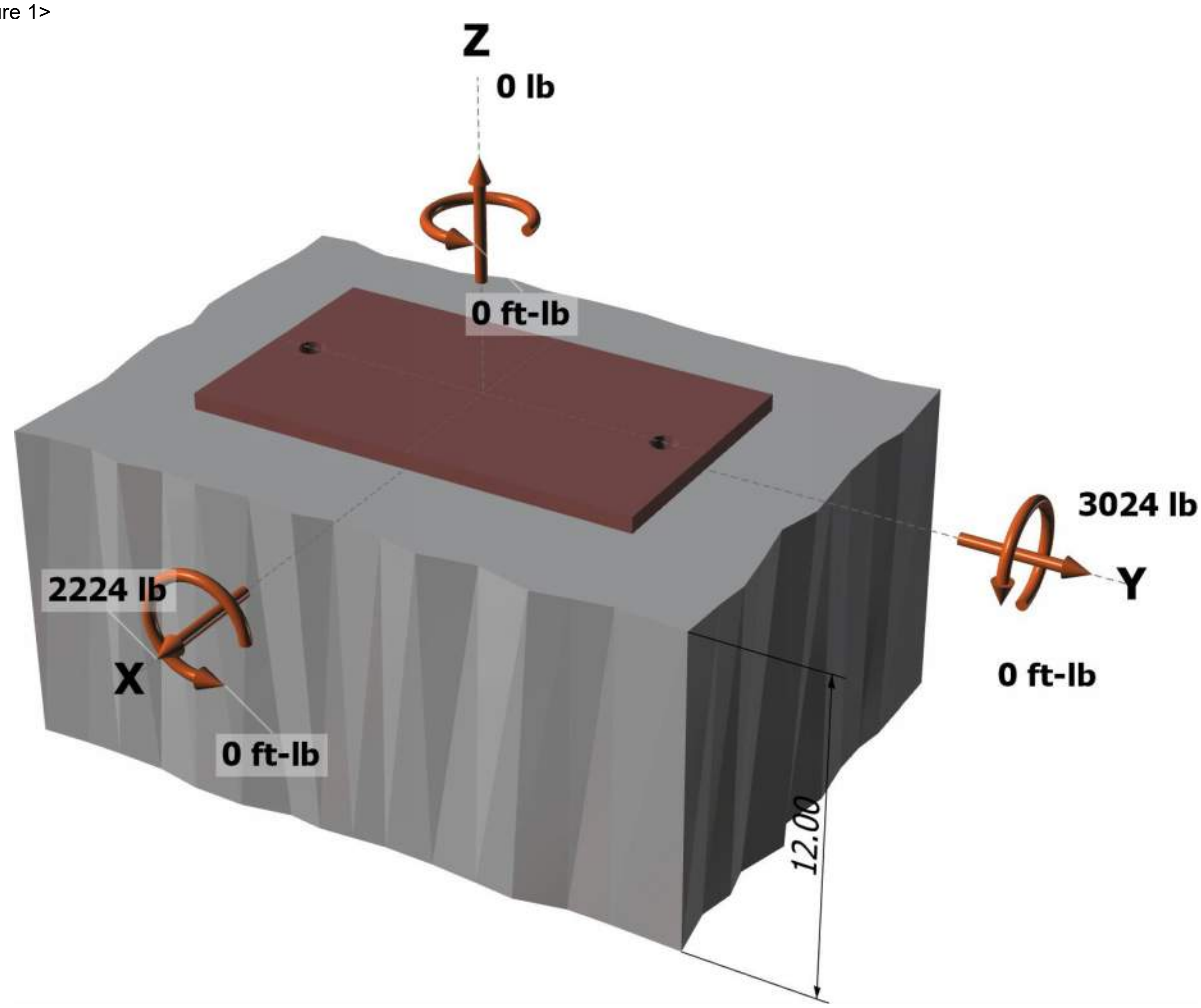
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 2224
V_{uay} [lb]: 3024
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>

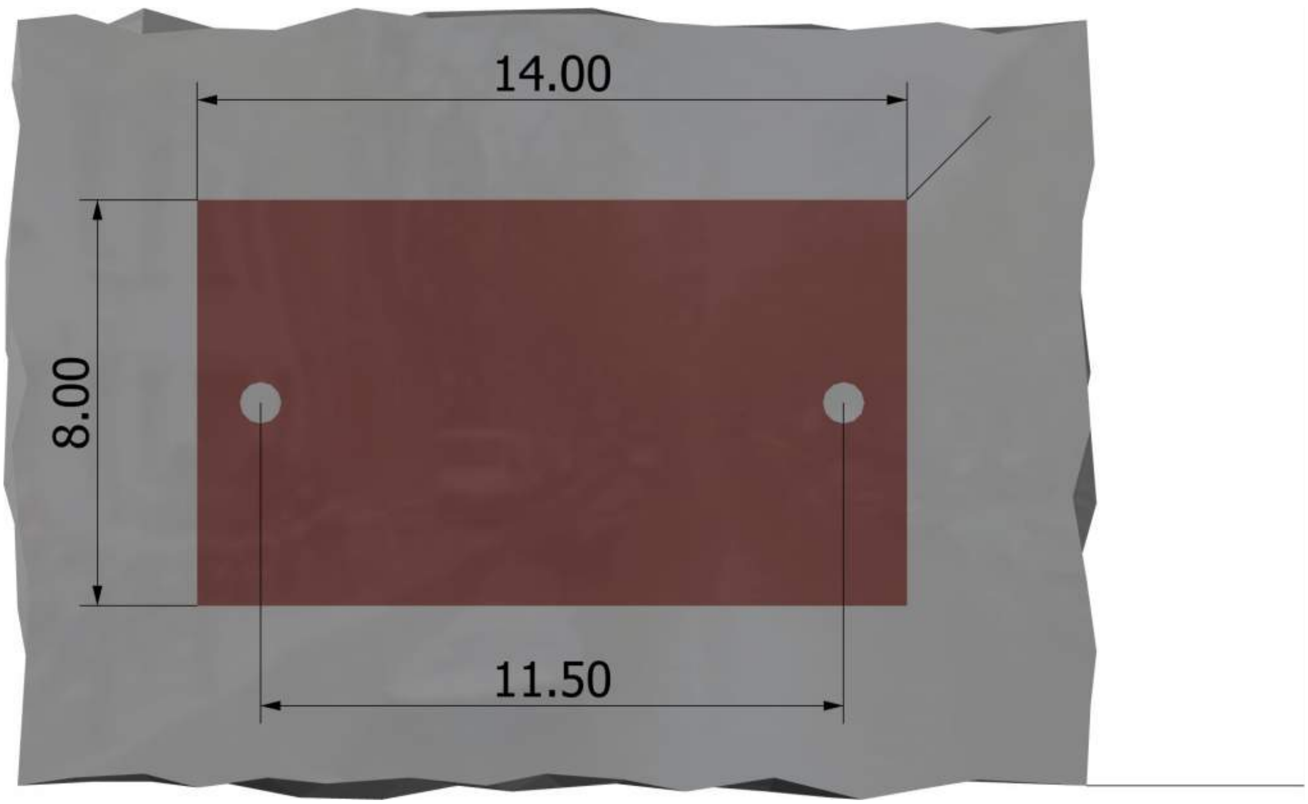


SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



Anchor Designer™
Software
Version 2.9.7376.0

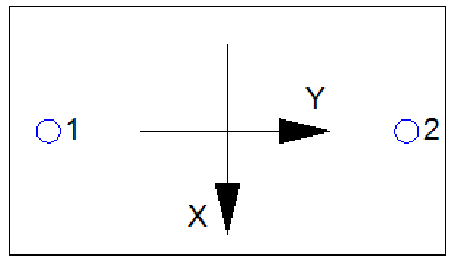
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	1112.0	1512.0	1876.9
2	0.0	1112.0	1512.0	1876.9
Sum	0.0	2224.0	3024.0	3753.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag} ; k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} ; k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	1877	7426	0.25	Pass

Pryout	**3754**	**13086**	**0.29**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

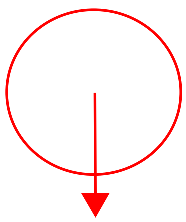
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (4) Shaft Aft Bay - Balanced Chain Pull | By: GJE
Project: Herriman UT WTP | Date: 5/24/2022

Lower Effluent Shaft

Dead Loads

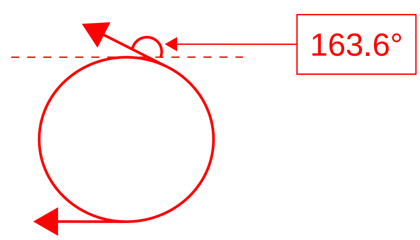
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	1407	163.6	1.667	397	-1350	lbs
Vert Collector CP (1/2 per side)	1407	163.6	17.333	397	-1350	lbs
Horiz Collector CP (1/2 per side)	1407	180	1.667	0	-1407	lbs
Horiz Collector CP (1/2 per side)	1407	180	17.333	0	-1407	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **429.6 lbs**
Ev = $0.2*S_{DS}*Wp$
= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
F_{slosh} = **74.9547 lbs**

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-401	2781	-394	2732
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	-38	4450	-29	4372 <-- Controls
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	298	3286	303	3236

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Effluent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

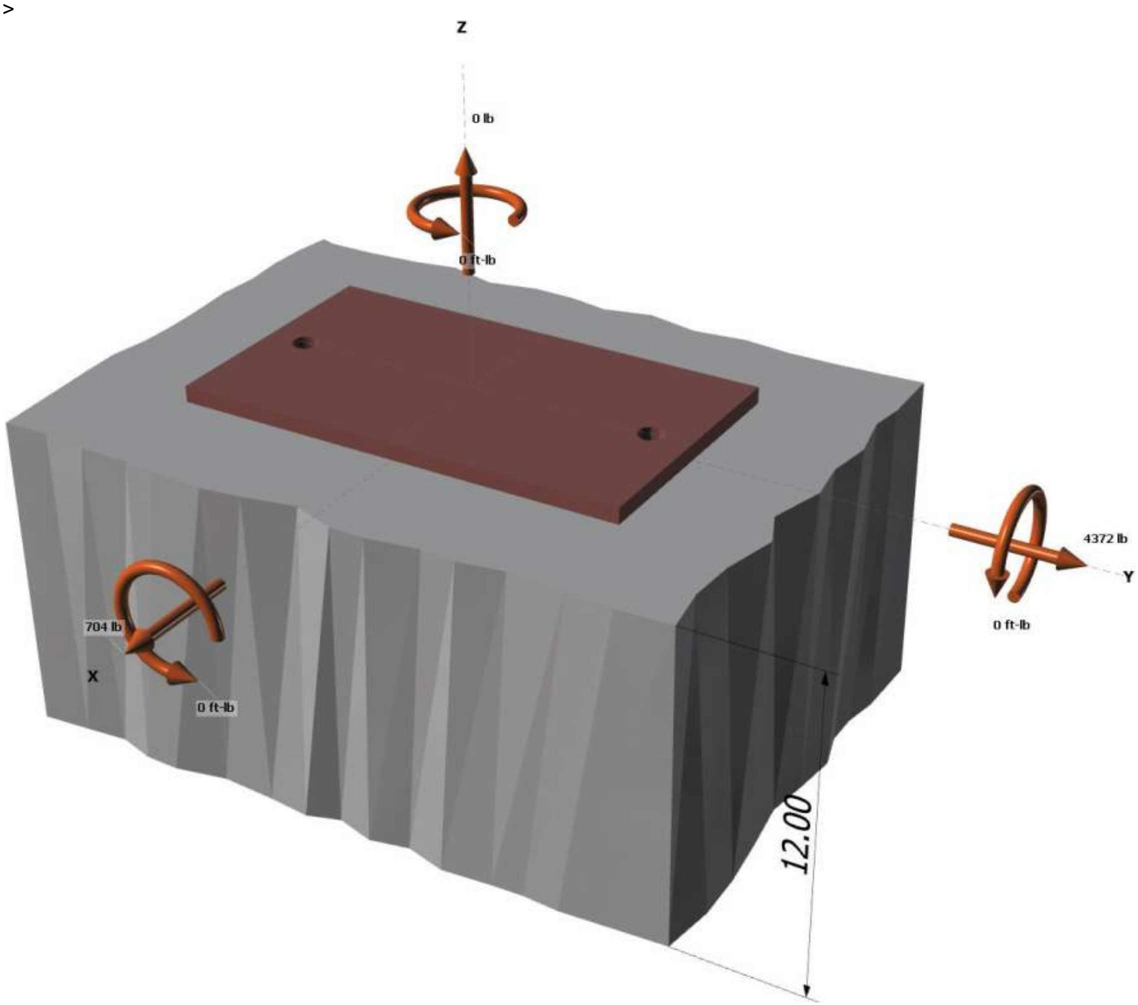
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 704
V_{uay} [lb]: 4372
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

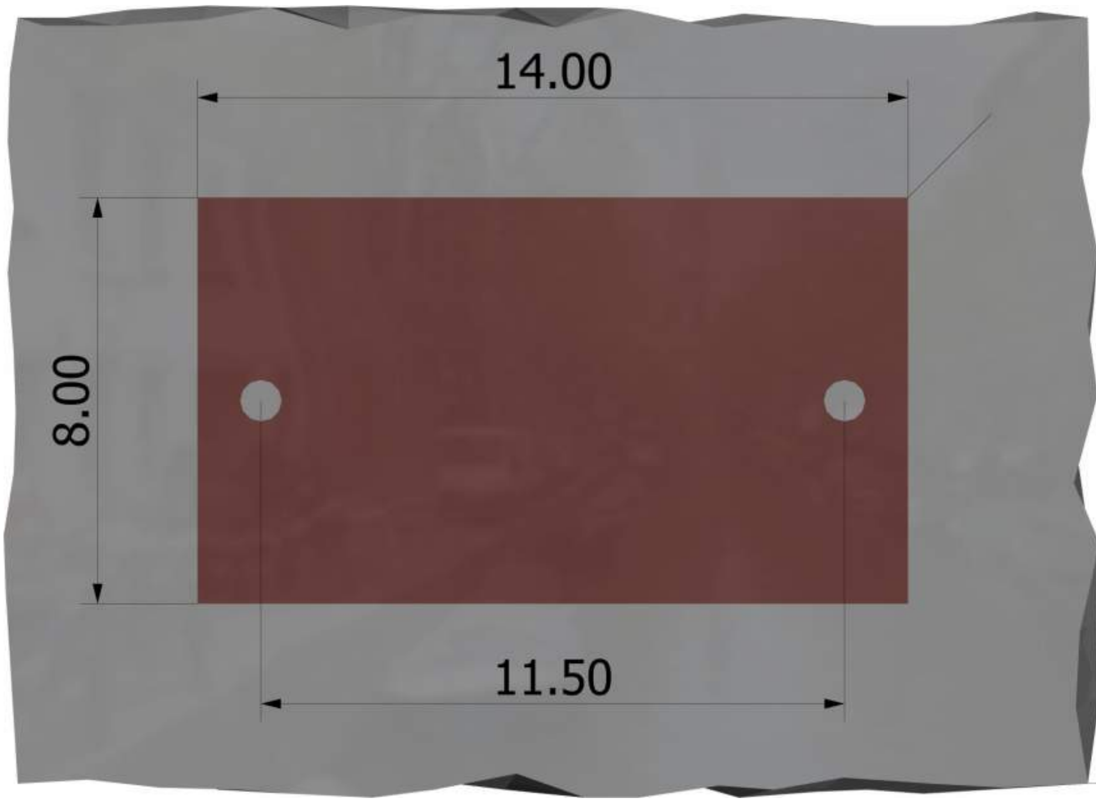
<Figure 1>



SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

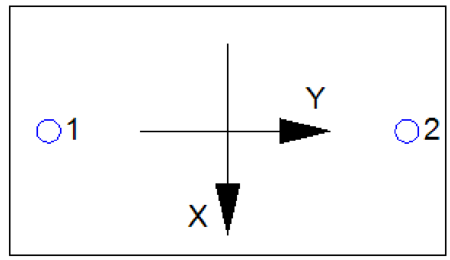
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	352.0	2186.0	2214.2
2	0.0	352.0	2186.0	2214.2
Sum	0.0	704.0	4372.0	4428.3

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\,;\, k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\,;\, k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	2214	7426	0.30	Pass

Pryout	**4428**	**13086**	**0.34**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

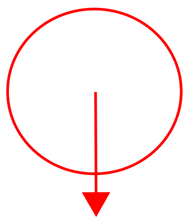
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (4) Shaft Aft Bay - Unbalanced Chain Pull
Project: Herriman UT WTP
By: GJE
Date: 5/24/2022 1

Lower Effluent Shaft

Dead Loads

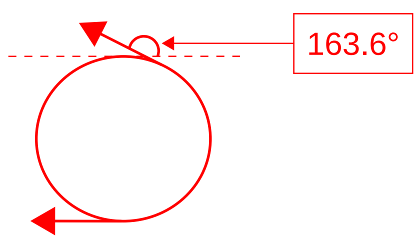
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	2025	163.6	1.667	572	-1943	lbs 1
				0	0	lbs
Horiz Collector CP (Single Side)	2025	180	1.667	0	-2025	lbs 1
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **429.6 lbs**
Ev = $0.2 * S_{DS} * Wp$
= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 3.91 plf 1
L = 19.17 ft
F_{slosh} = **74.9547 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-522	3623	-50	345
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	-232	5796	522	552
$(1.2+0.2S_{DS})D \pm E$	699	505	696	504
$(0.9-0.2S_{DS})D \pm E$	357	505	356	504
1.2D+1.6L+E	177	4128	647	849

<-- Controls (1.2D+1.6L)

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Effluent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

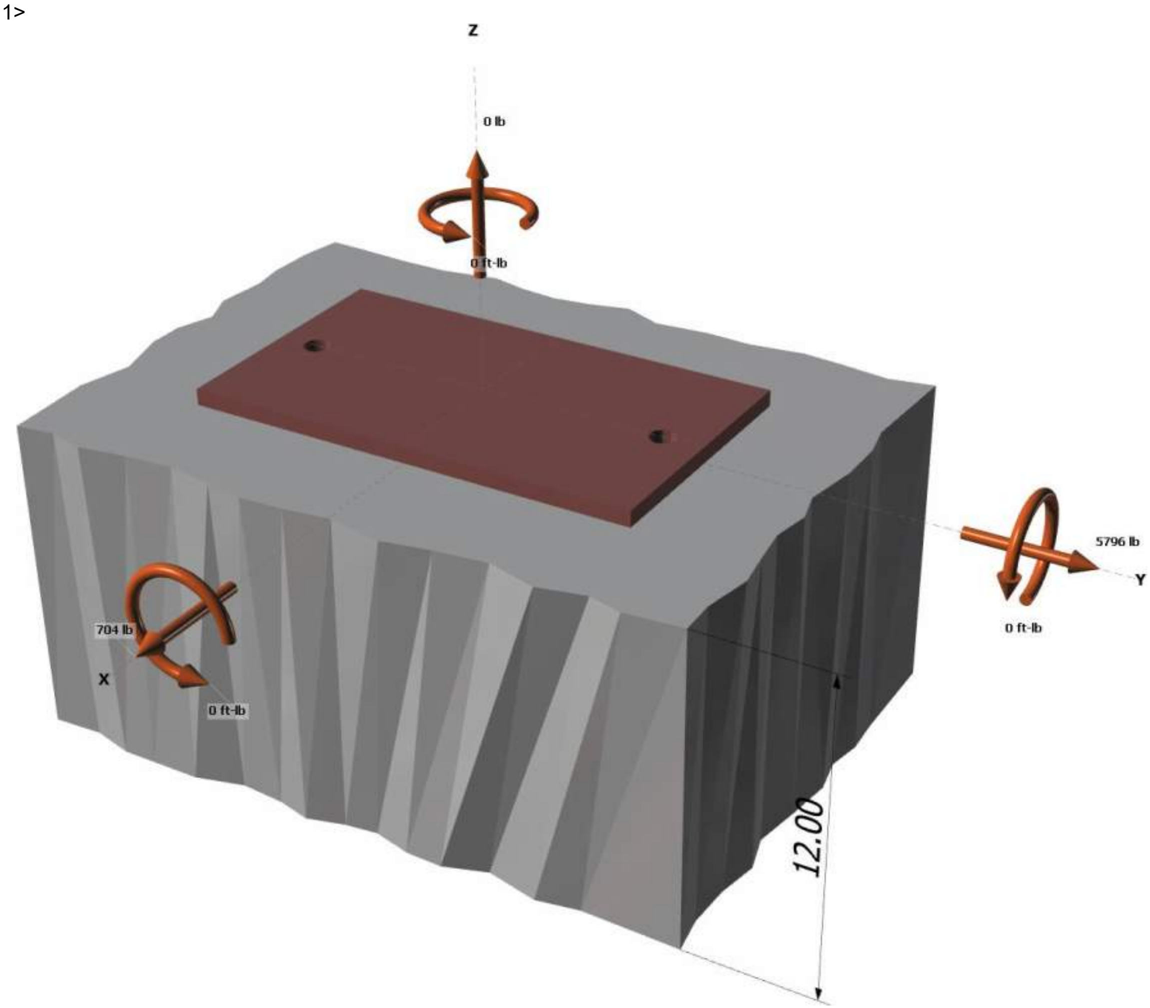
Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 704
V_{uay} [lb]: 5796
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

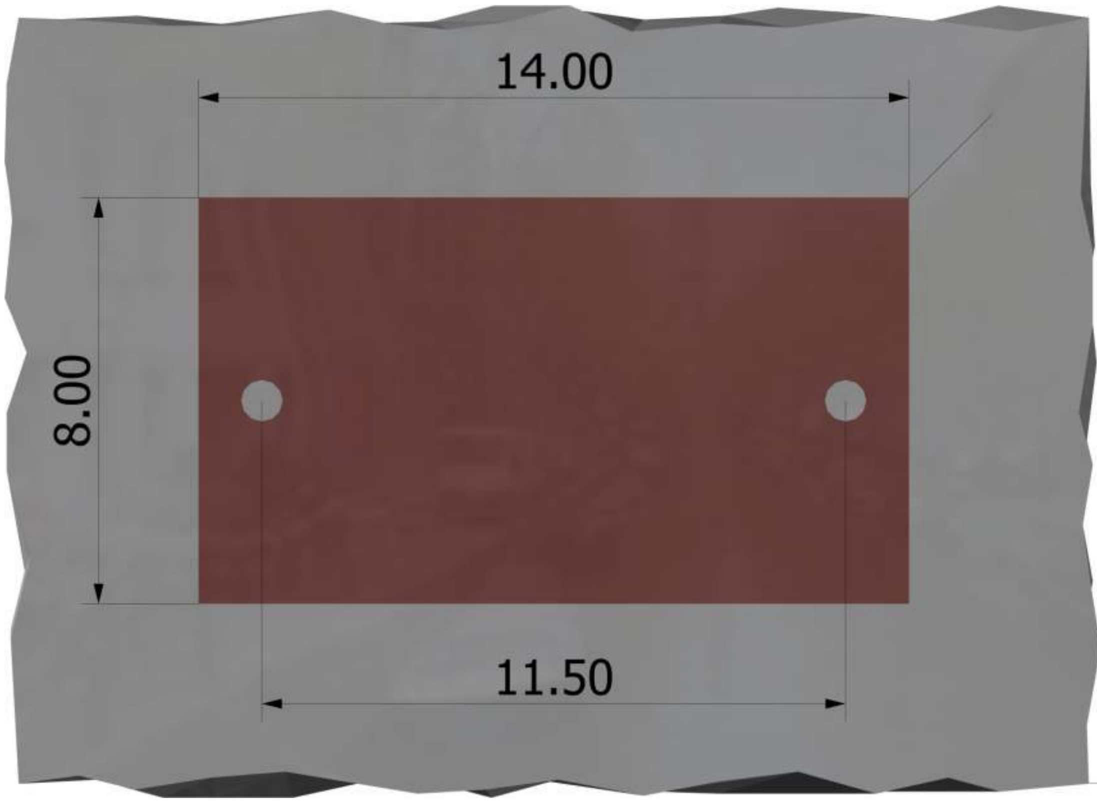
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

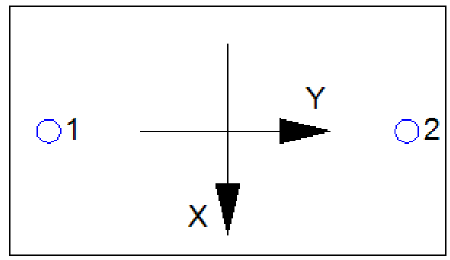
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	352.0	2898.0	2919.3
2	0.0	352.0	2898.0	2919.3
Sum	0.0	704.0	5796.0	5838.6

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag} ; k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} ; k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	2919	7426	0.39	Pass

Pryout	**5839**	**13086**	**0.45**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

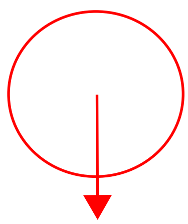
Title: (4) Shaft Aft Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/24/2022

Tail Shaft

Dead Loads

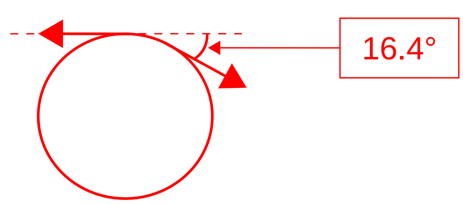
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	1407	-16.4	1.667	-397	1350	lbs
Vert Collector CP (1/2 per side)	1407	-16.4	17.333	-397	1350	lbs
Horiz Collector CP (1/2 per side)	1407	180	1.667	0	-1407	lbs
Horiz Collector CP (1/2 per side)	1407	180	17.333	0	-1407	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

$F_p =$ 0.428 Wp
= 429.6 lbs

$E_v = 0.2 * S_{DS} * W_p$
= 190.7 lbs

$S_{DS} =$ 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
F_{slosh} = 74.9547 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	503	0	501	0	
Live	401	58	394	57	
Seismic	96	253	95	252	
1.4D	704	0	701	0	
1.2D+1.6L	1244	92	1231	91	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504	
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504	
1.2D+1.6L+E	1099	563	1090	561	<-- Controls

$\Omega_0 =$ 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Tail Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

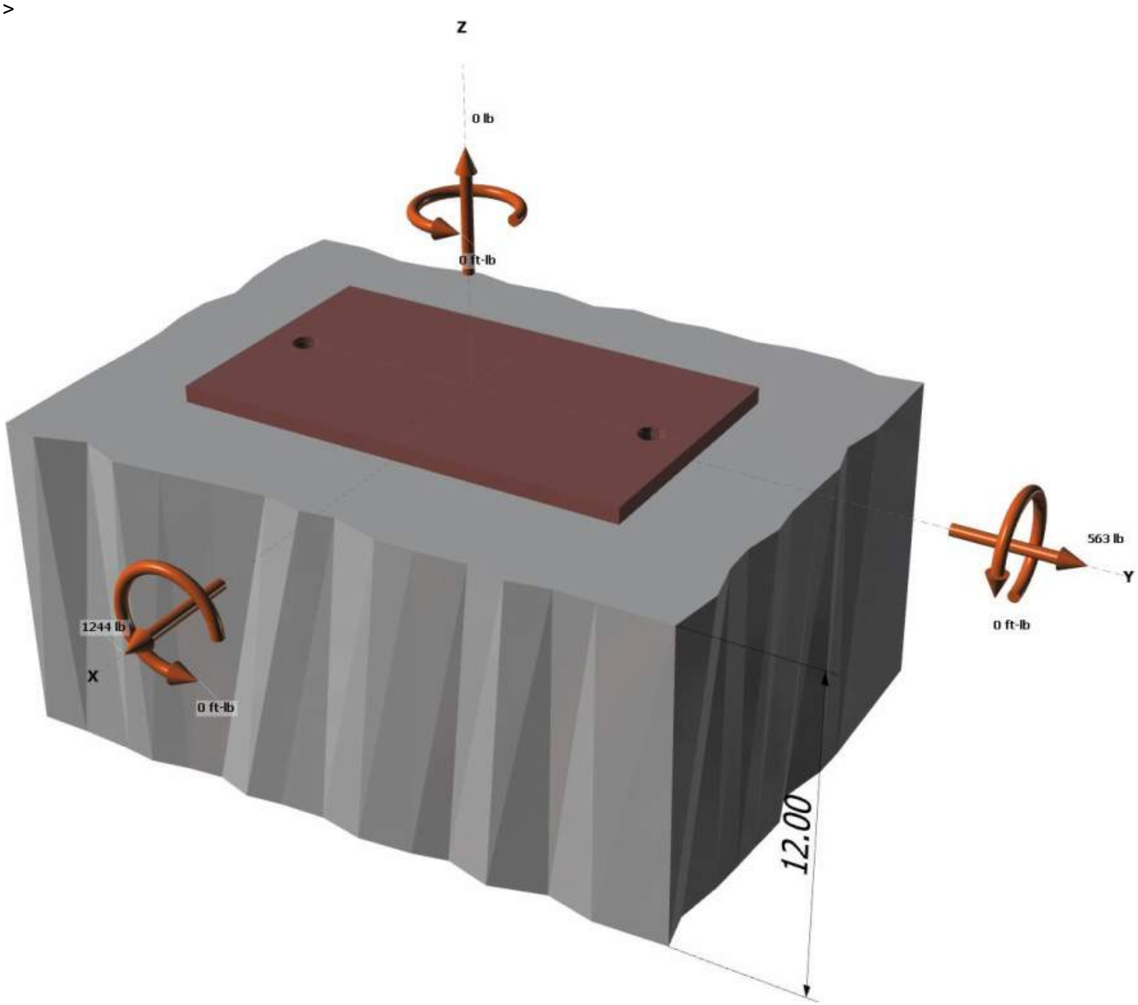
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1244
V_{uay} [lb]: 563
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

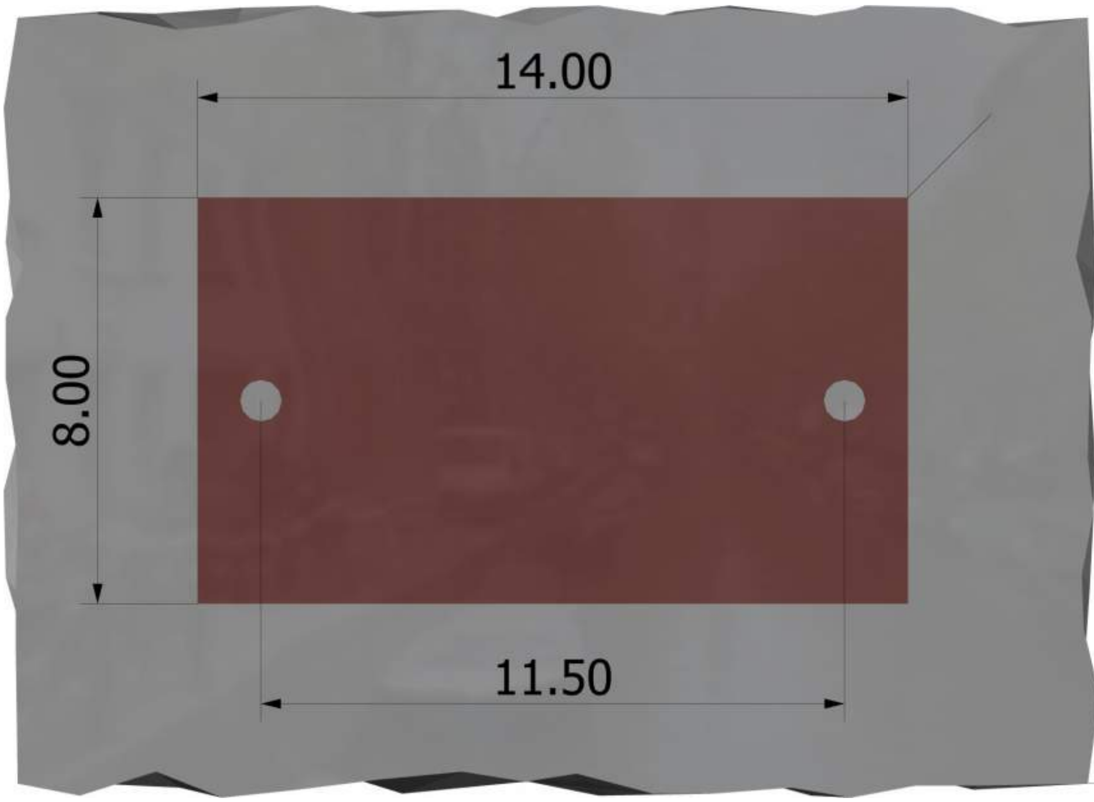
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

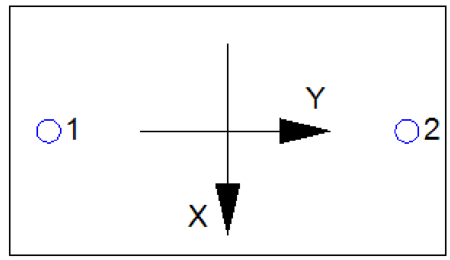


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	622.0	281.5	682.7
2	0.0	622.0	281.5	682.7
Sum	0.0	1244.0	563.0	1365.5

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**683**	**5570**	**0.12**	**Pass (Governs)**
Pryout	1365	13086	0.10	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

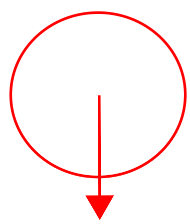
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Title:	(4) Shaft Aft Bay - Unbalanced Chain Pull
Project:	Herriman UT WTP
By:	GJE
Date:	5/24/2022

Tail Shaft

Dead Loads

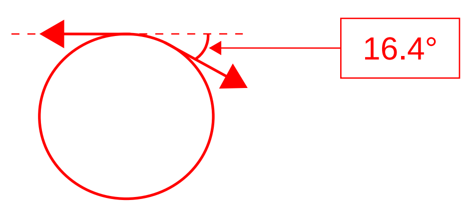
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	2025	-16.4	1.667	-572	1943	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	2025	180	1.667	0	-2025	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp

= **429.6 lbs**

Ev = $0.2*S_{DS}*Wp$

= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft

f = 3.91 plf

L = 19.17 ft

F_{slosh} = **74.9547 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	522	75	50	7
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	1438	120	681	11
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	1221	580	746	511

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Aftbay - Tail Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

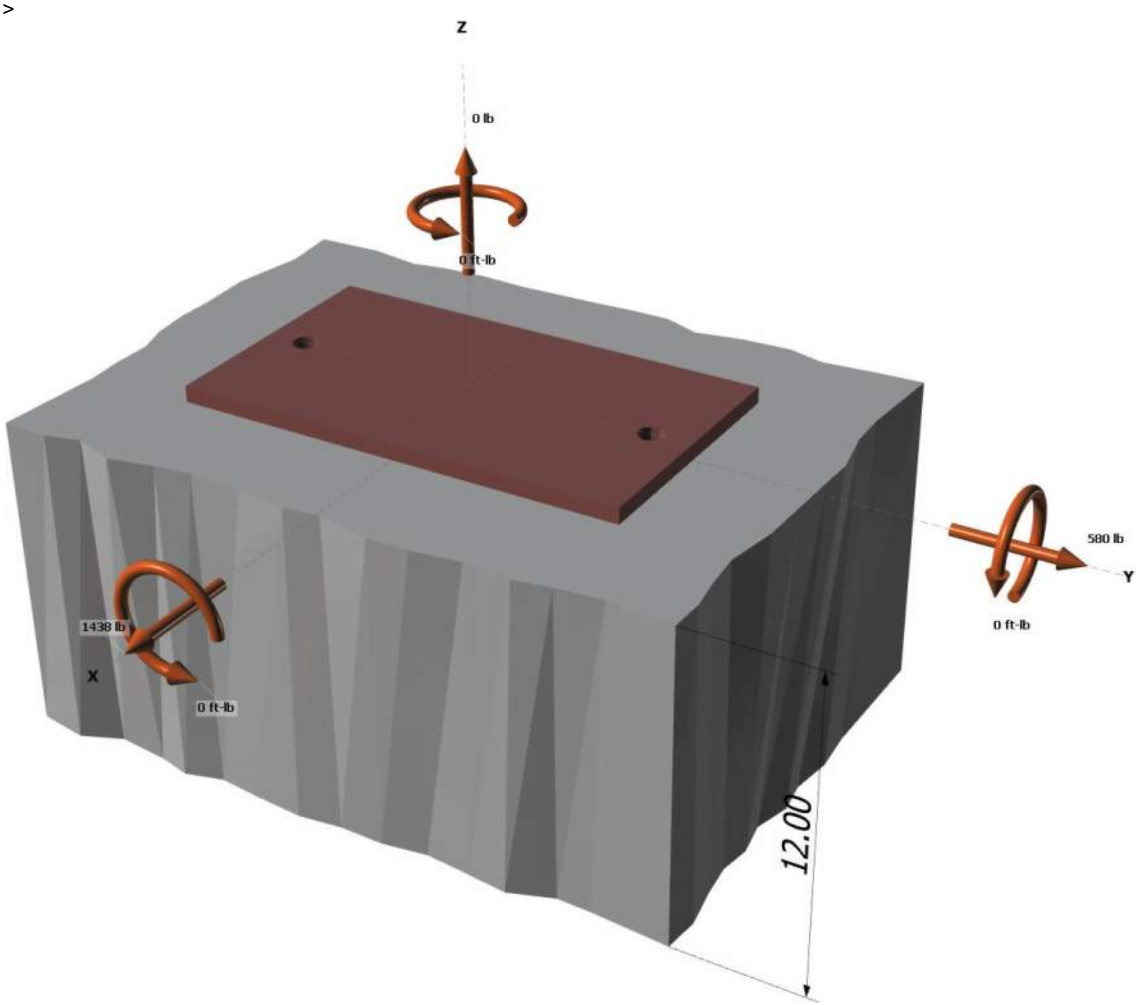
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1438
V_{uay} [lb]: 580
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

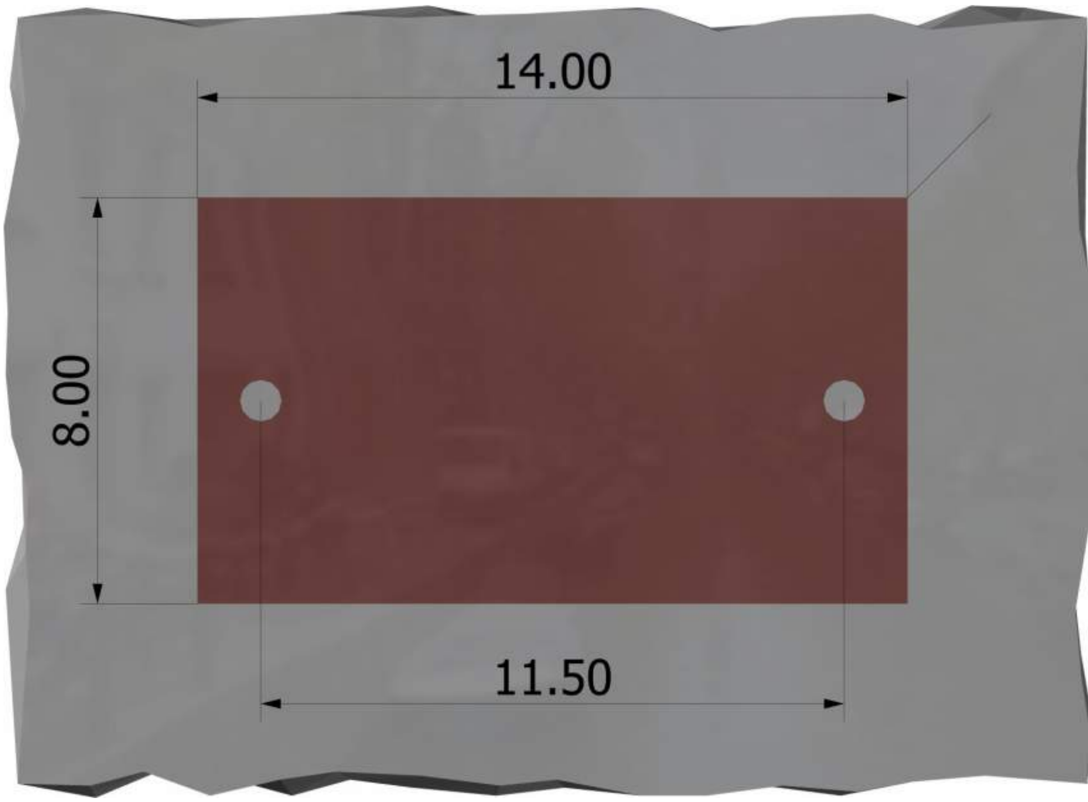
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

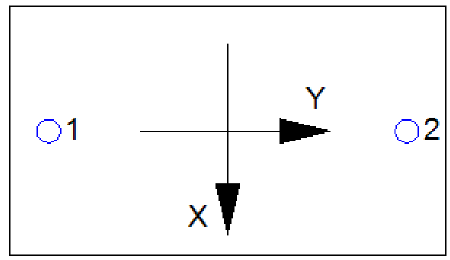
Company:	CSD	Date:	5/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	719.0	290.0	775.3
2	0.0	719.0	290.0	775.3
Sum	0.0	1438.0	580.0	1550.6

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	**775**	**5570**	**0.14**	**Pass (Governs)**
Pryout	1551	13086	0.12	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

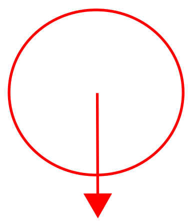
Title: (4) Shaft Fore Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022 ⚠1

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.042		9.521	1030.553 lbs
Shaft Sprocket 1			32	1.875	32 lbs
Shaft Sprocket 2			32	17.21	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	18.875	60 lbs
					0 lbs
					0 lbs
				Total:	**1307.553 lbs**

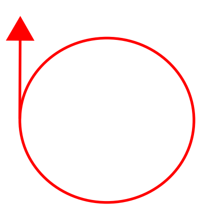


Dead loads all act vertically.

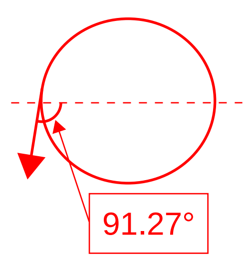
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	1749	90	0.3	1749	0	lbs ⚠1
Collector CP (1/2 per side)	1195	-91.27	1.875	-1195	-26	lbs
Collector CP (1/2 per side)	1195	-91.27	17.21	-1195	-26	lbs
Weight of chain and (3) flights	119	-25	1.875	-50	108	lbs
Weight of chain and (3) flights	119	-25	17.21	-50	108	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 30'				0	0	lbs
W=30'*1.78plf+3*18.2'*2.4plf/2				0	0	lbs
W=119lbs				0	0	lbs
				0	0	lbs

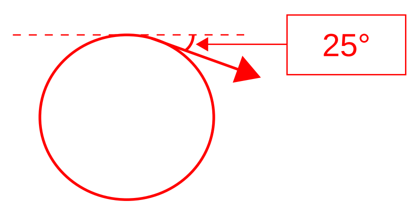
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp
= **559.6 lbs**

Ev = $0.2*S_{DS}*Wp$
= **248.4 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 4.95 plf ⚠1
L = 19.042 ft
F_{slosh} = **94.2579 lbs**

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	699	0	609	0	
Live	-479	-81	1220	-82	
Seismic	133	346	116	308	
1.4D	978	0	852	0	
1.2D+1.6L	72	-130	2683	-130	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	971	692	846	615	<-- Controls
$(0.9-0.2S_{DS})D\pm E$	496	692	432	615	<-- Controls
1.2D+1.6L+E	492	611	2067	534	

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

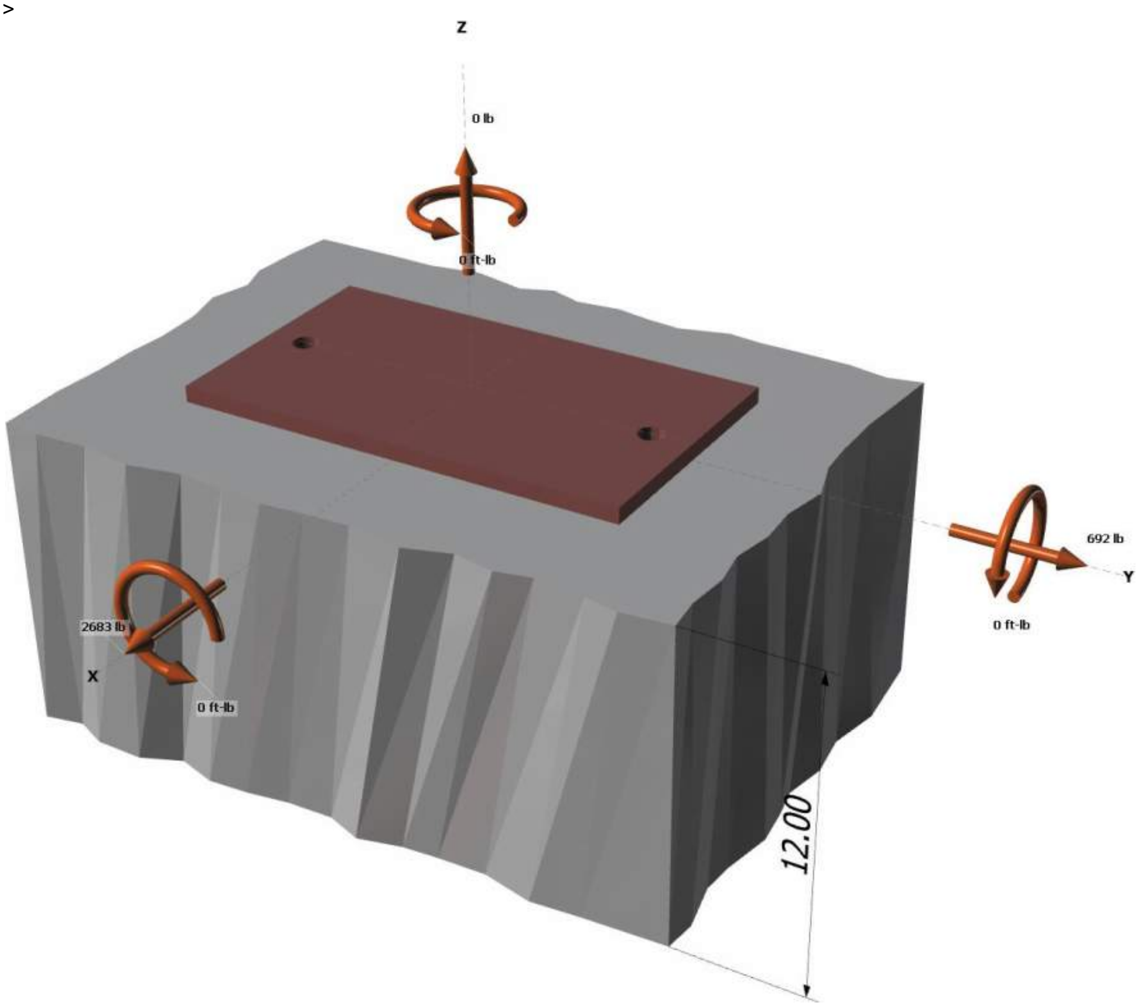
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 2683
V_{uay} [lb]: 692
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

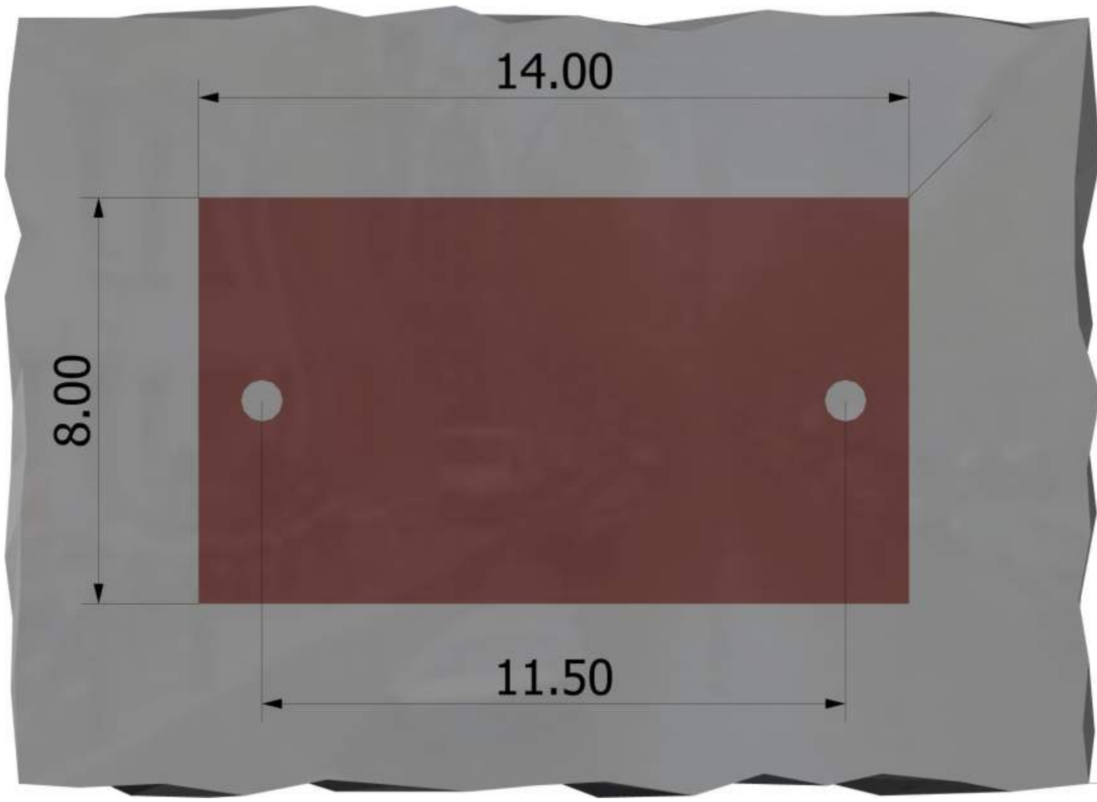
<Figure 1>



SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

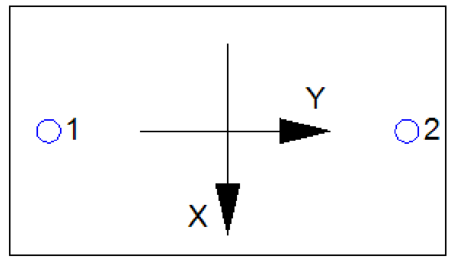


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	1341.5	346.0	1385.4
2	0.0	1341.5	346.0	1385.4
Sum	0.0	2683.0	692.0	2770.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\,;\, k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\,;\, k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**1385**	**5570**	**0.25**	**Pass (Governs)**
Pryout	2771	13086	0.21	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

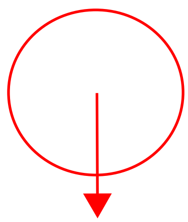
Title: (4) Shaft Fore Bay - Unbalanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
4.5" Dia Shaft	54.12	19.042		9.521	1030.553 lbs
Shaft Sprocket 1			32	1.875	32 lbs
Shaft Sprocket 2			32	17.21	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	18.875	60 lbs
					0 lbs
					0 lbs
				Total:	**1307.553 lbs**

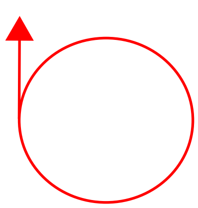


Dead loads all act vertically.

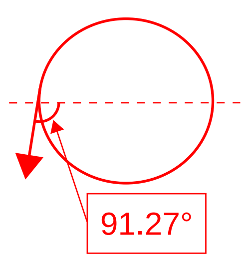
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	1749	90	0.3	1749	0	lbs
Collector CP (Single Side)	1720	-91.27	17.21	-1720	-38	lbs
				0	0	lbs
Weight of chain and (3) flights	119	-25	1.875	-50	108	lbs
Weight of chain and (3) flights	119	-25	17.21	-50	108	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 30'				0	0	lbs
W=30'*1.78plf+3*18.2'*2.4plf/2				0	0	lbs
W=119lbs				0	0	lbs
				0	0	lbs

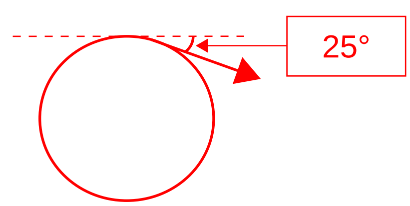
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp
= **559.6 lbs**
Ev = $0.2*S_{DS}*Wp$
= **248.4 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 4.95 plf
L = 19.042 ft
F_{slosh} = 94.2579 lbs

Total Reactions (LRFD)

Ω_0= 2

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	699	0	609	0	
Live	-1506	-104	1577	-74	
Seismic	133	346	116	308	
1.4D	978	0	852	0	
1.2D+1.6L	-1571	-166	3254	-118	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	971	692	846	615	<-- Controls
$(0.9-0.2S_{DS})D\pm E$	496	692	432	615	<-- Controls
1.2D+1.6L+E	-535	588	2423	542	

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

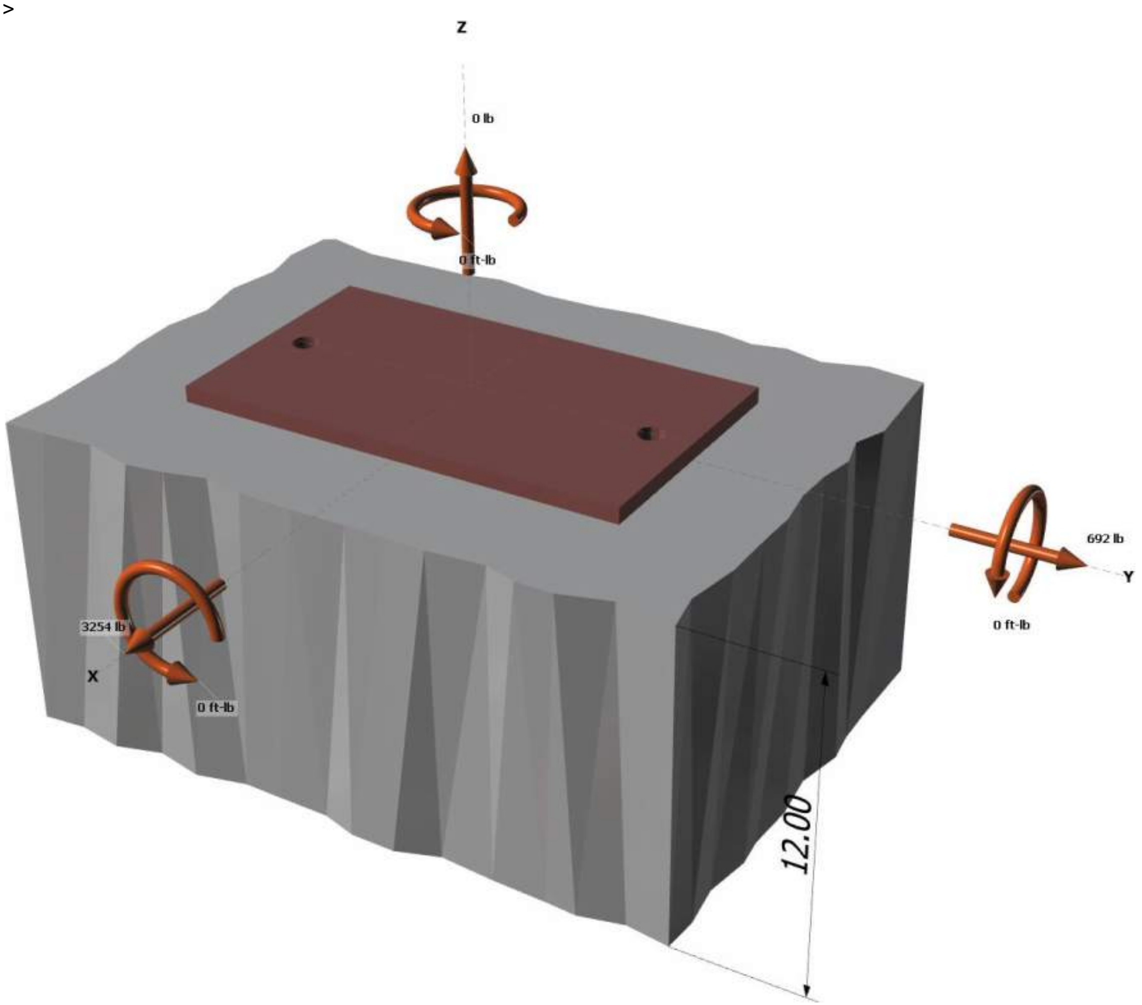
Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 3254
V_{uay} [lb]: 692
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

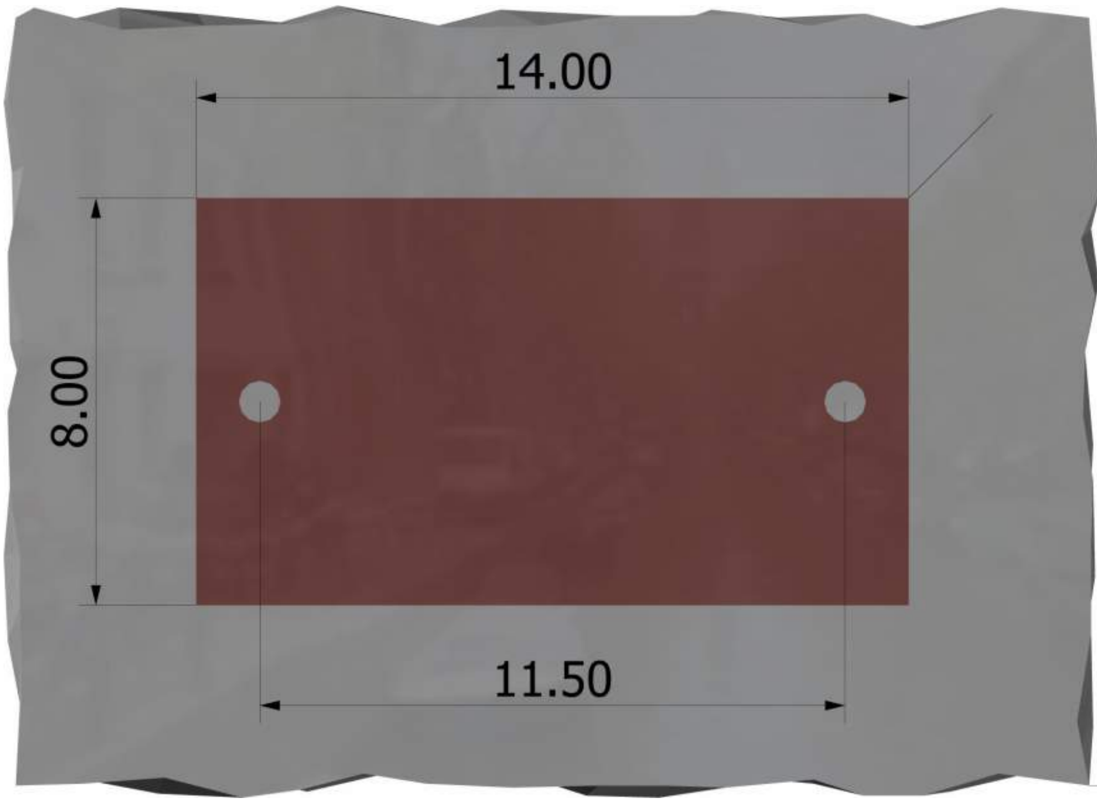
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
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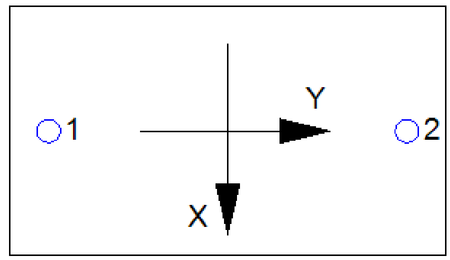
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	1627.0	346.0	1663.4
2	0.0	1627.0	346.0	1663.4
Sum	0.0	3254.0	692.0	3326.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**1663**	**5570**	**0.30**	**Pass (Governs)**
Pryout	3327	13086	0.25	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

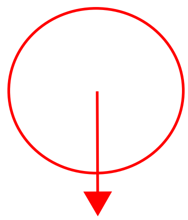
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Title: (4) Shaft Fore Bay - Balanced Chain Pull　　By: GJE
Project: Herriman UT WTP　　Date: 5/25/2022

Lower Influent Shaft (Shaft below head shaft)

Dead Loads

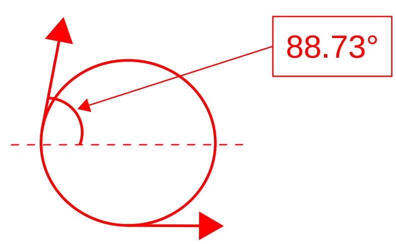
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	1195	88.73	1.667	1195	26	lbs
Vert Collector CP (1/2 per side)	1195	88.73	17.333	1195	26	lbs
Horiz Collector CP (1/2 per side)	1195	0	1.667	0	1195	lbs
Horiz Collector CP (1/2 per side)	1195	0	17.333	0	1195	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

$F_p =$ 0.428 Wp
= **429.6 lbs**

$E_v = 0.2 * S_{DS} * W_p$
= **190.7 lbs**

$S_{DS} =$ 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
$F_{slosh} =$ **74.9547 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-1205	-1232	-1184	-1211
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	-1325	-1972	-1293	-1937
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	-507	-727	-488	-707

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Influent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

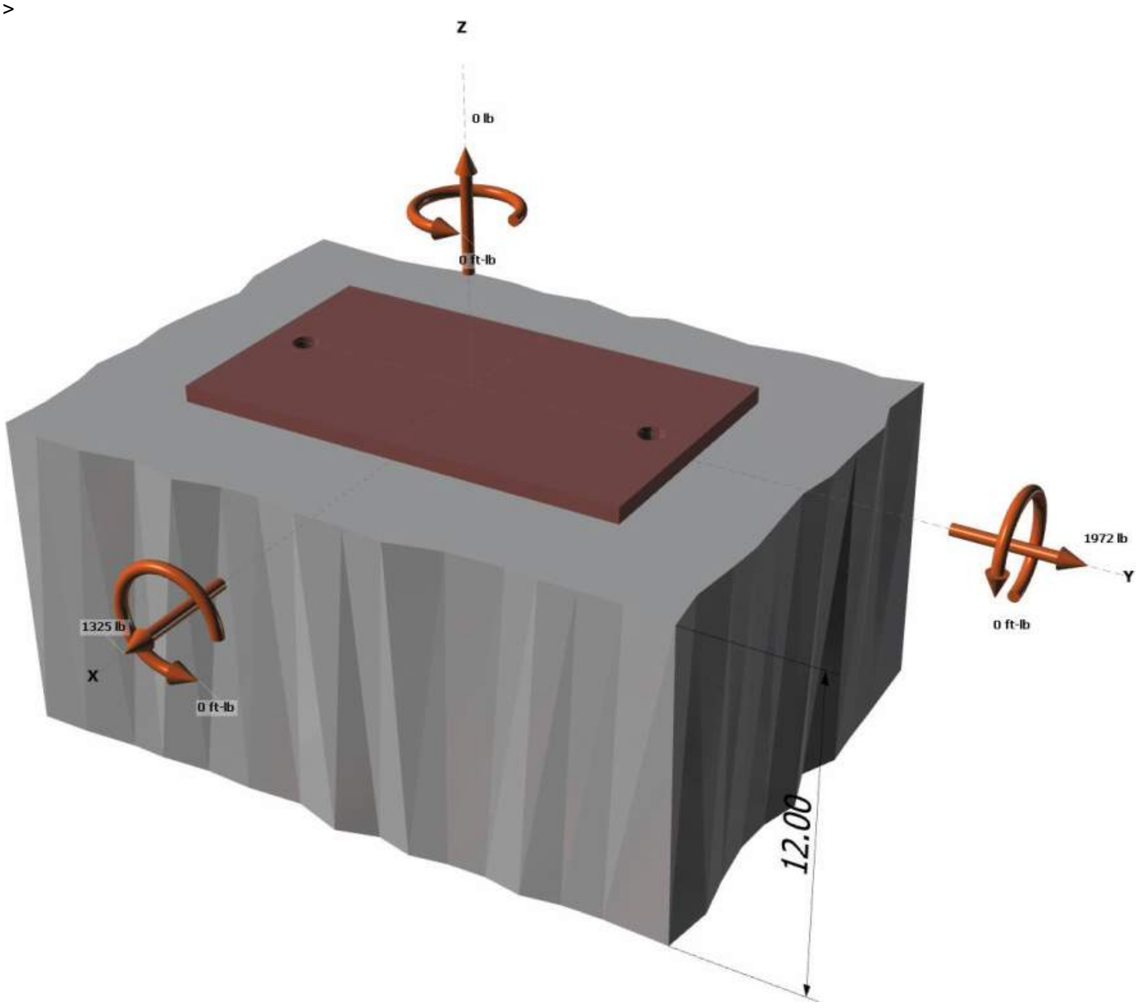
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1325
V_{uay} [lb]: 1972
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

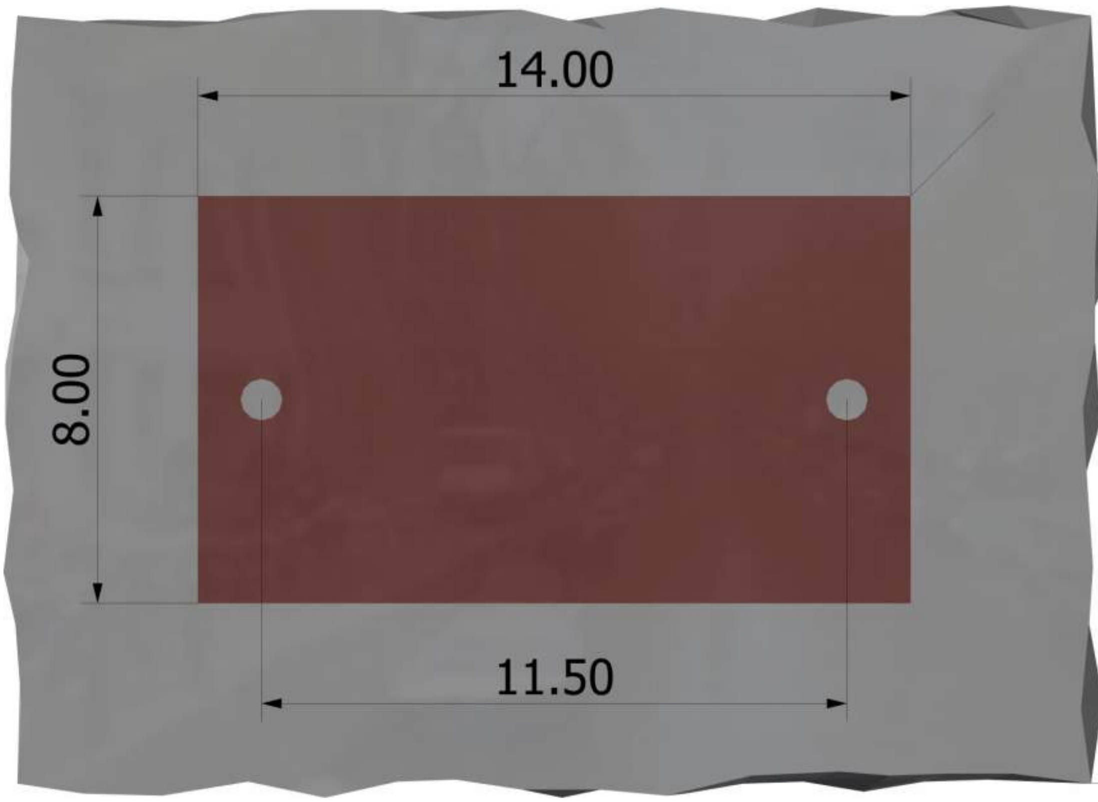
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



Anchor Designer™ Software
Version 2.9.7376.0

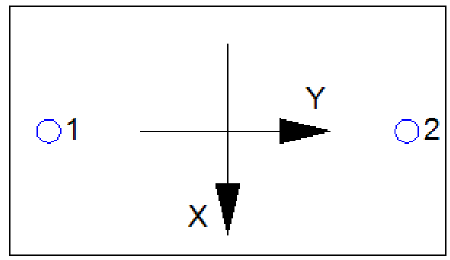
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	662.5	986.0	1187.9
2	0.0	662.5	986.0	1187.9
Sum	0.0	1325.0	1972.0	2375.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	1188	7426	0.16	Pass

Pryout	**2376**	**13086**	**0.18**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

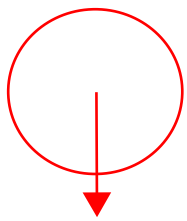
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (4) Shaft Fore Bay - Unbalanced Chain Pull By: GJE
Project: Herriman UT WTP Date: 5/25/2022 △1

Lower Influent Shaft (Shaft below head shaft)

Dead Loads

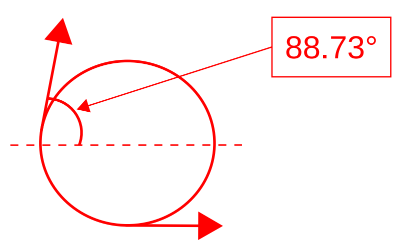
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	1720	88.73	1.667	1720	38	lbs △1
				0	0	lbs
Horiz Collector CP (Single Side)	1720	0	1.667	0	1720	lbs △1
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **429.6 lbs**

Ev = $0.2{*}S_{DS}{*}W_p$ S_{DS} = 0.95
= **190.7 lbs**

Sloshing on shaft
f = 3.91 plf △1
L = 19.17 ft
F_{slosh} = 74.9547 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-1570	-1605	-150	-153
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	-1909	-2568	362	-245
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	-871	-1100	547	351

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Influent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

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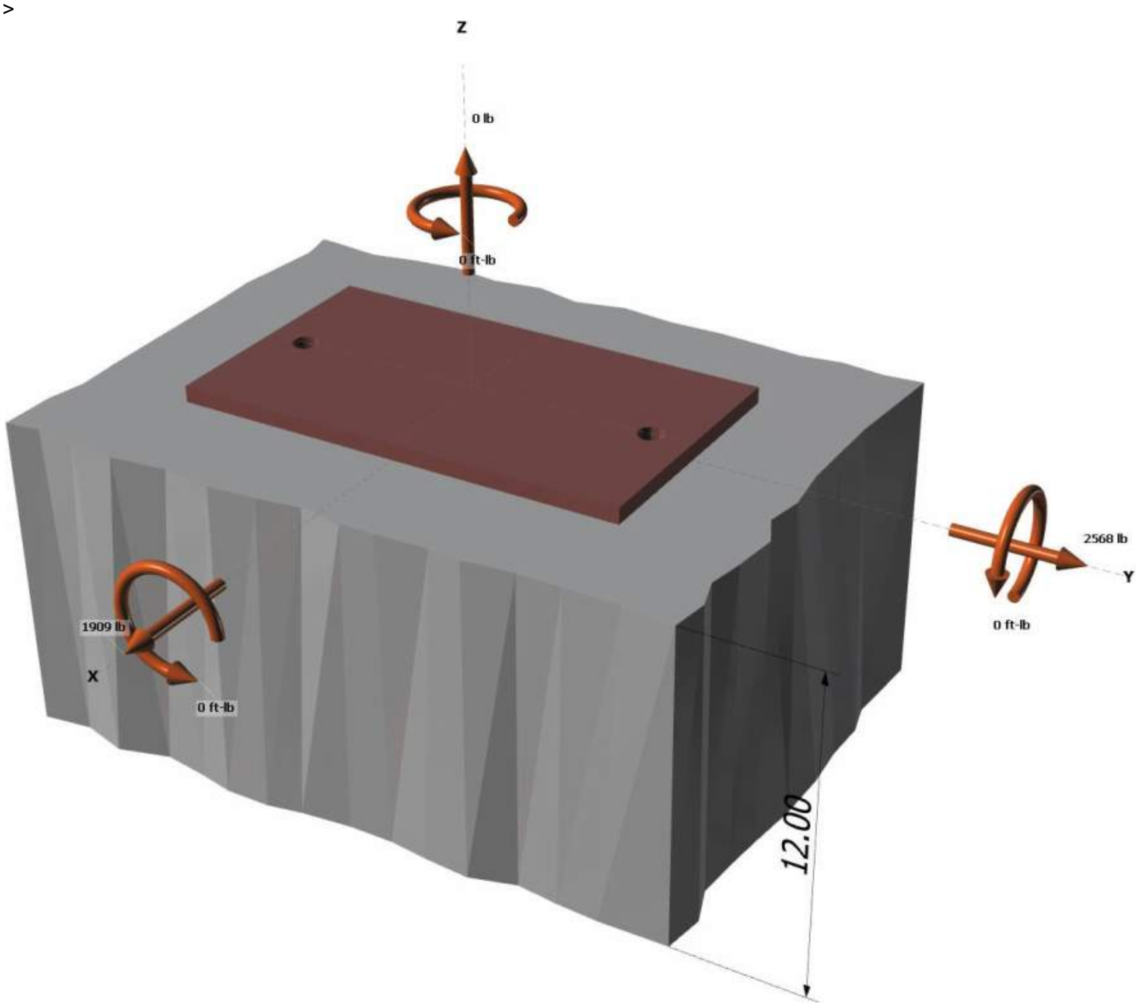
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1909
V_{uay} [lb]: 2568
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

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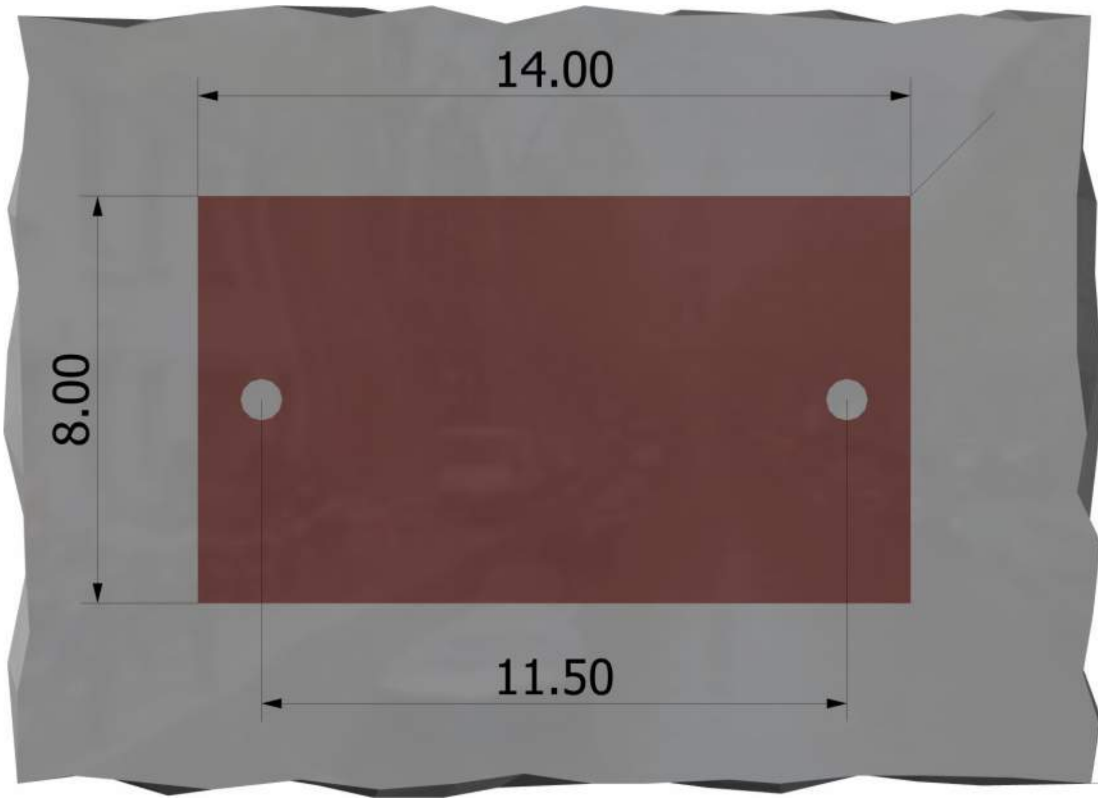
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



Anchor Designer™
Software
Version 2.9.7376.0

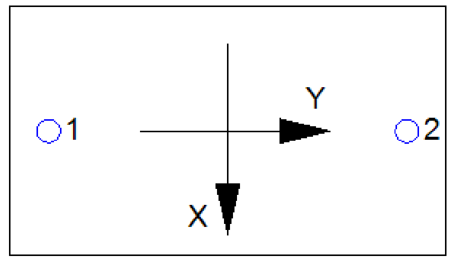
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	954.5	1284.0	1599.9
2	0.0	954.5	1284.0	1599.9
Sum	0.0	1909.0	2568.0	3199.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag} ; k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} ; k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	1600	7426	0.22	Pass

Pryout	**3200**	**13086**	**0.24**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

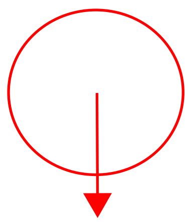
Title: (4) Shaft Fore Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022

Lower Effluent Shaft

Dead Loads

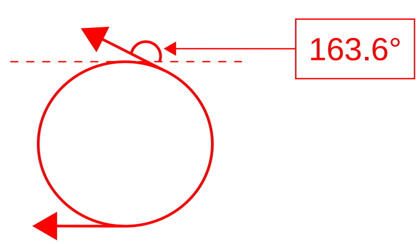
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	1195	163.6	1.667	337	-1146	lbs
Vert Collector CP (1/2 per side)	1195	163.6	17.333	337	-1146	lbs
Horiz Collector CP (1/2 per side)	1195	180	1.667	0	-1195	lbs
Horiz Collector CP (1/2 per side)	1195	180	17.333	0	-1195	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **429.6 lbs**

Ev = $0.2 * S_{DS} * Wp$
= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
F_{slosh} = **74.9547 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-340	2362	-334	2321
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	59	3779	66	3713
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	358	2867	362	2824

<-- Controls (1.2D+1.6L)

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Effluent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

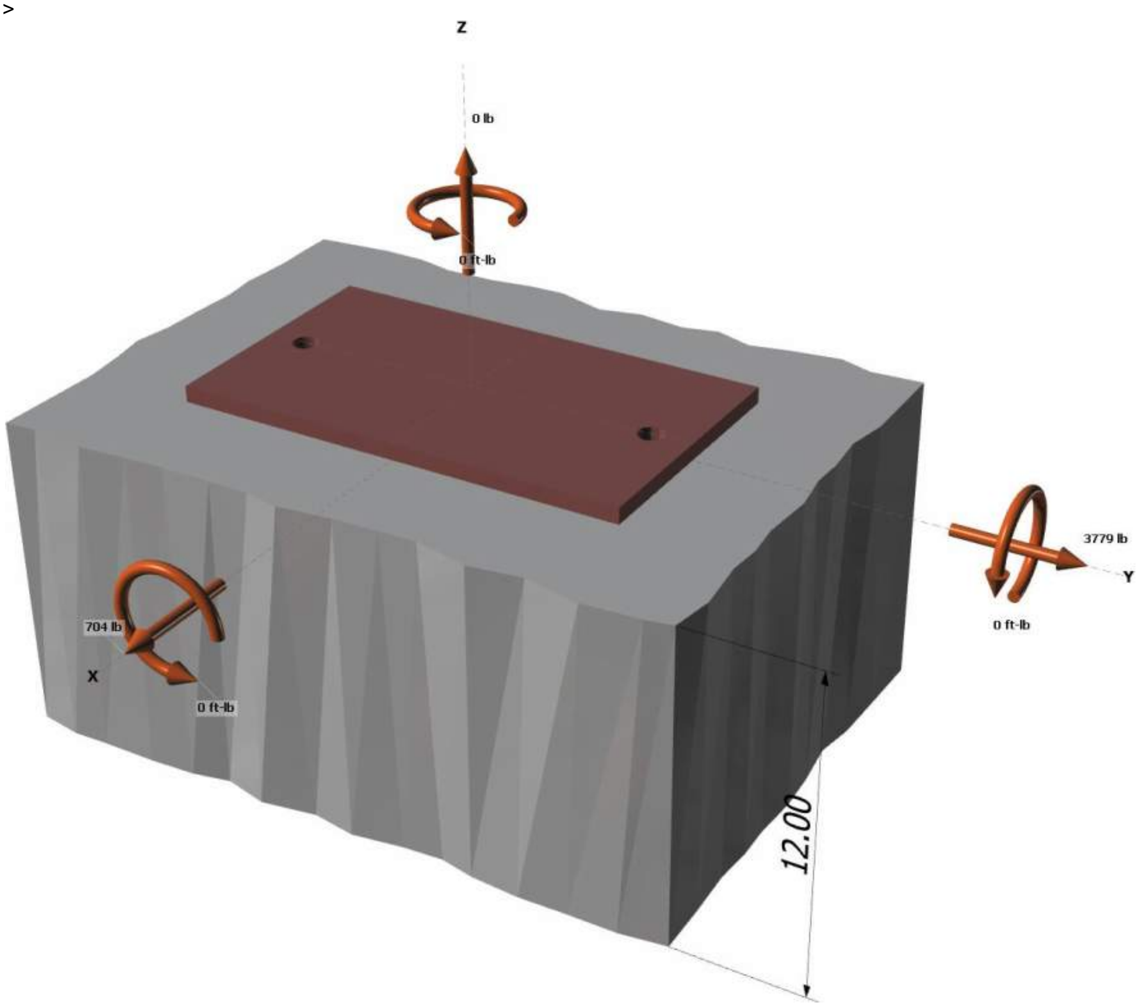
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 704
V_{uay} [lb]: 3779
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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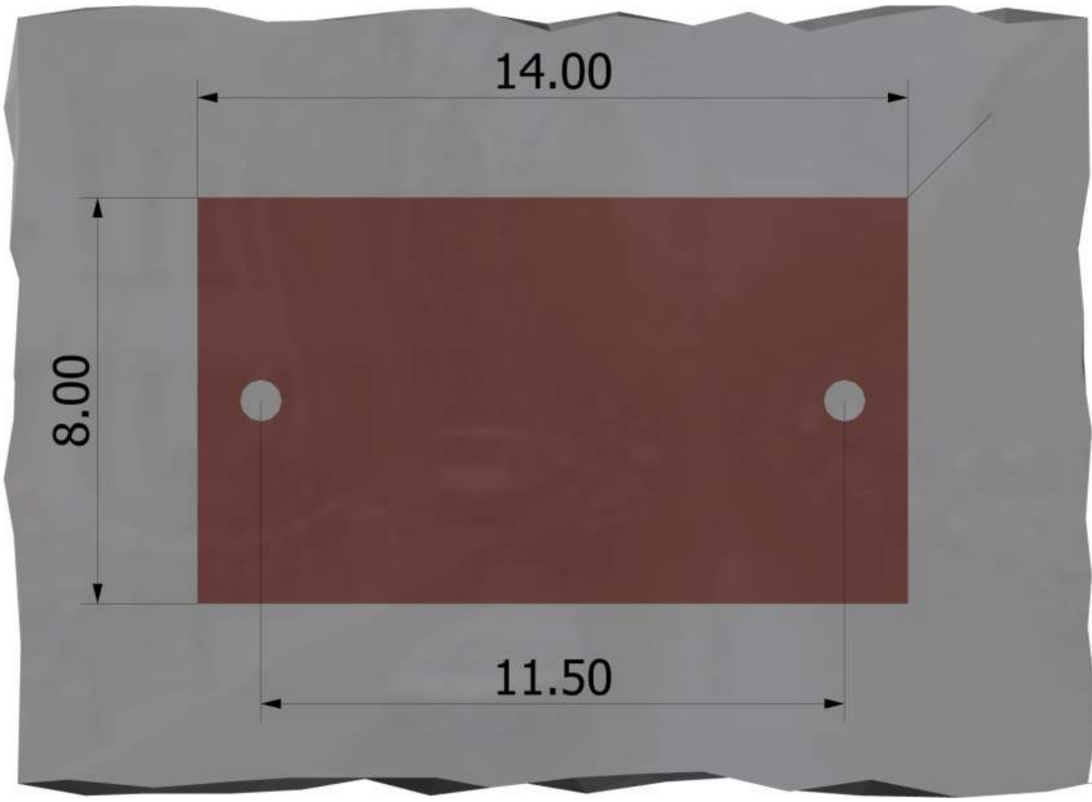
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie Anchor Designer™ Software
Version 2.9.7376.0

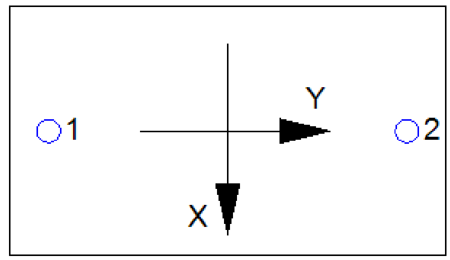
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	352.0	1889.5	1922.0
2	0.0	352.0	1889.5	1922.0
Sum	0.0	704.0	3779.0	3844.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	1922	7426	0.26	Pass

Pryout	**3844**	**13086**	**0.29**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

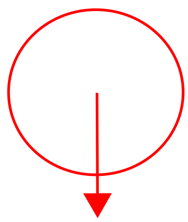
Title: (4) Shaft Fore Bay - Unbalanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022

Lower Effluent Shaft

Dead Loads

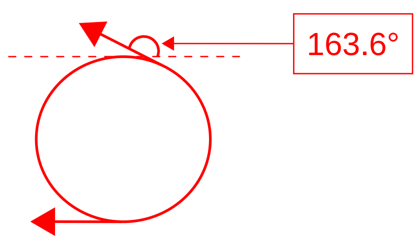
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	1720	163.6	1.667	486	-1650	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	1720	180	1.667	0	-1720	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp

= **429.6 lbs**

Ev = $0.2*S_{DS}*Wp$

= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft

f = 3.91 plf

L = 19.17 ft

F_{slosh} = 74.9547 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	-443	3077	-42	293
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	-106	4923	534	469
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	255	3582	654	797

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Effluent Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

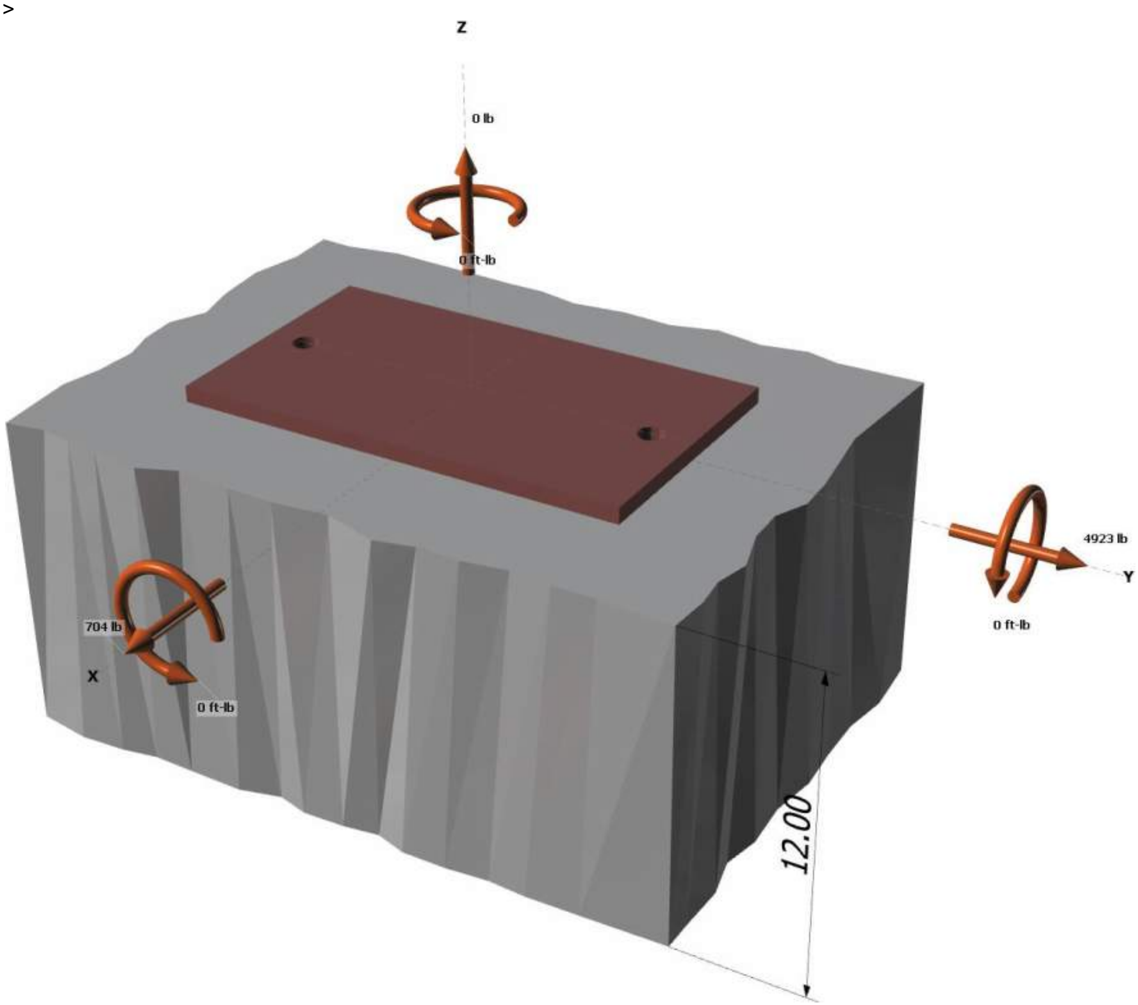
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 704
V_{uay} [lb]: 4923
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

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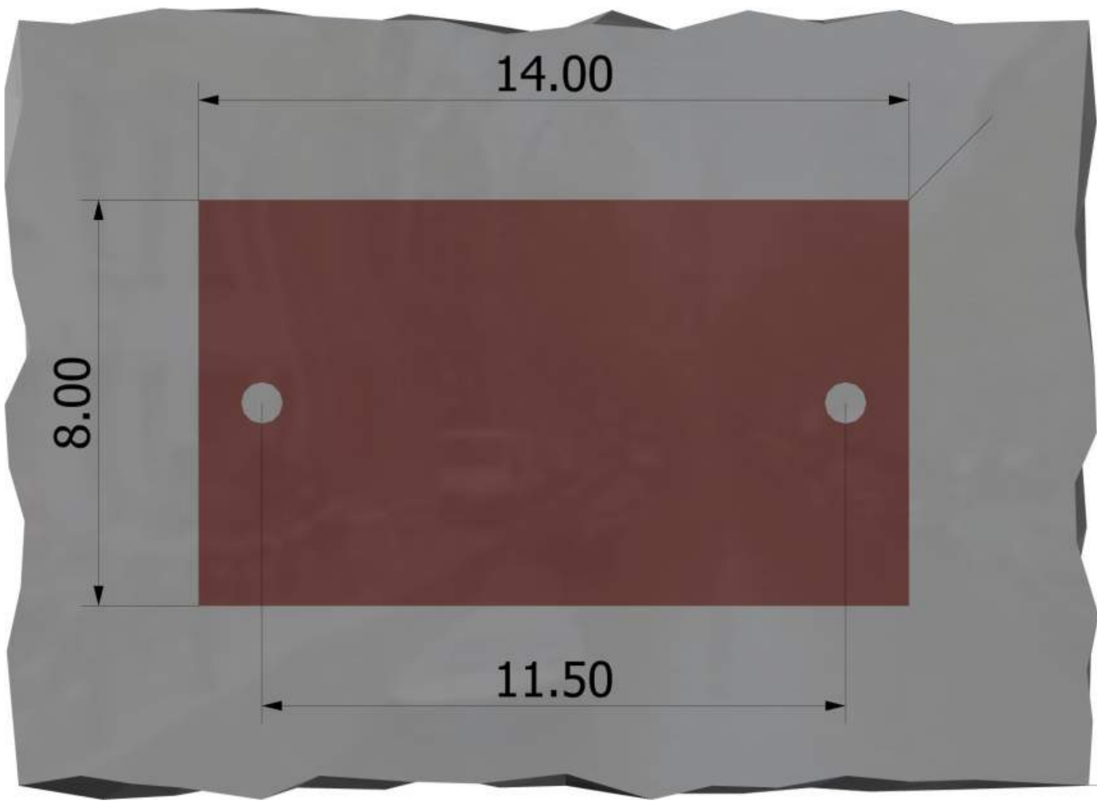
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

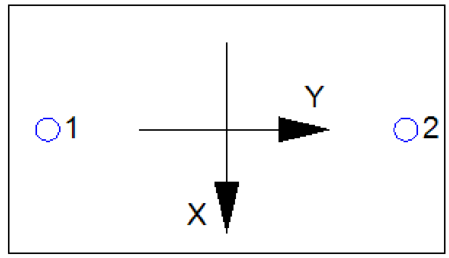
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	352.0	2461.5	2486.5
2	0.0	352.0	2461.5	2486.5
Sum	0.0	704.0	4923.0	4973.1

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	2487	7426	0.33	Pass

Pryout	**4973**	**13086**	**0.38**	**Pass (Governs)**

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

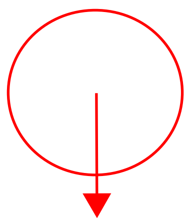
Title: (4) Shaft Fore Bay - Balanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022

Tail Shaft

Dead Loads

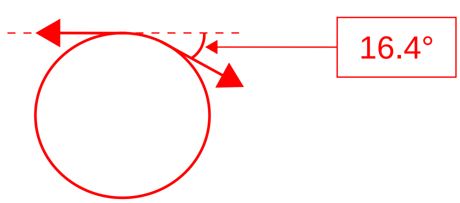
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Horiz Collector CP (1/2 per side)	1195	-16.4	1.667	-337	1146	lbs
Horiz Collector CP (1/2 per side)	1195	-16.4	17.333	-337	1146	lbs
Horiz Collector CP (1/2 per side)	1195	180	1.667	0	-1195	lbs
Horiz Collector CP (1/2 per side)	1195	180	17.333	0	-1195	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **429.6 lbs**
Ev = $0.2 \cdot S_{DS} \cdot W_p$
= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
F_{slosh} = 74.9547 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	503	0	501	0	
Live	340	49	334	48	
Seismic	96	253	95	252	
1.4D	704	0	701	0	
1.2D+1.6L	1148	78	1136	77	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504	
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504	
1.2D+1.6L+E	1039	554	1031	552	<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Tail Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

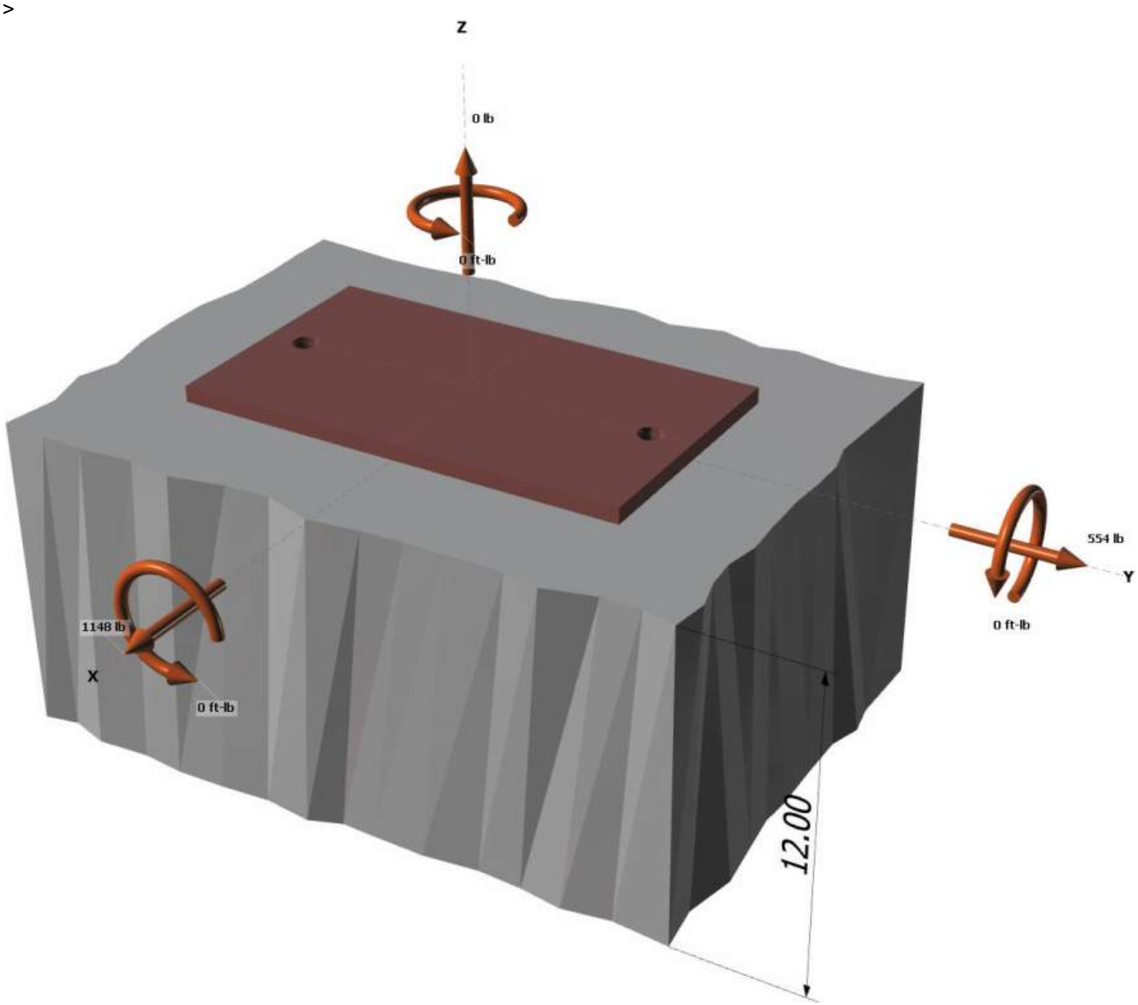
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

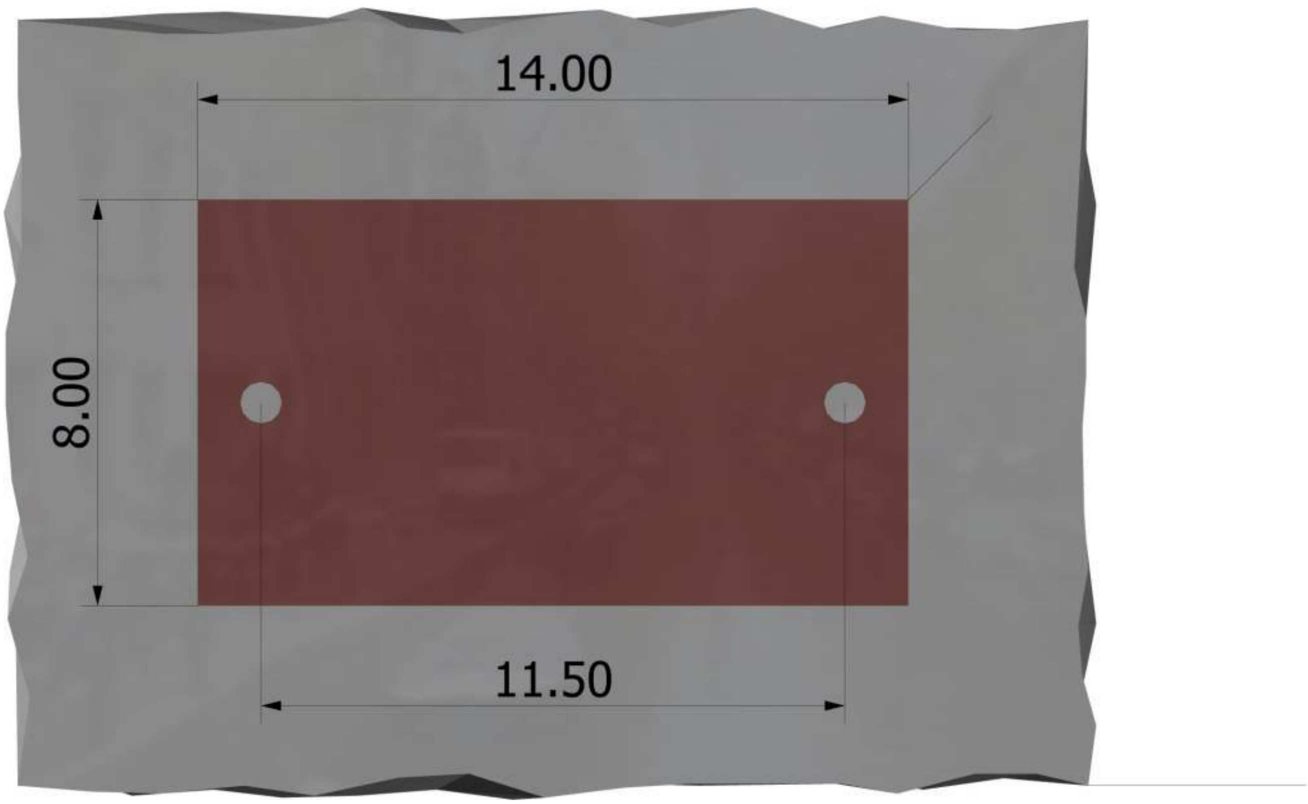
N_{ua} [lb]: 0
V_{uax} [lb]: 1148
V_{uay} [lb]: 554
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



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Software
Version 2.9.7376.0

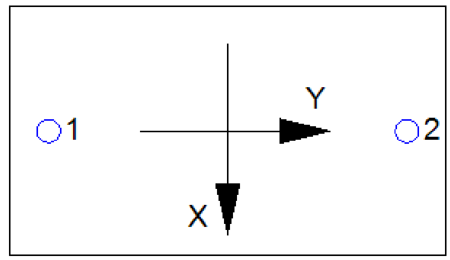
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	574.0	277.0	637.3
2	0.0	574.0	277.0	637.3
Sum	0.0	1148.0	554.0	1274.7

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\,;\,k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\,;\,k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	**637**	**5570**	**0.11**	**Pass (Governs)**
Pryout	1275	13086	0.10	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

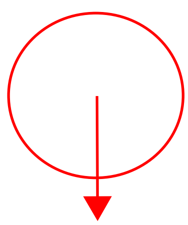
Title: (4) Shaft Fore Bay - Unbalanced Chain Pull
Project: Herriman UT WTP

By: GJE
Date: 5/25/2022

Tail Shaft

Dead Loads

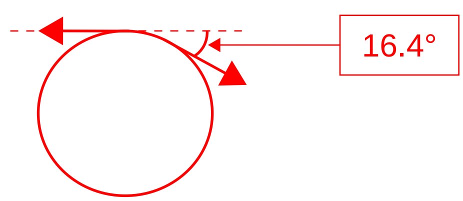
Description	plf	Length (ft)	Weight	Distance	Total
4" Dia Shaft	42.76	19.17		9.585	819.7092 lbs
Shaft Sprocket 1			32	1.667	32 lbs
Shaft Sprocket 2			32	17.333	32 lbs
Self Align Wall Bearing 1			60	1.667	60 lbs
Self Align Wall Bearing 2			60	17.333	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**1003.709 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Horiz Collector CP (Single Side)	1720	-16.4	1.667	-486	1650	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	1720	180	1.667	0	-1720	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

F_p = 0.428 Wp
= **429.6 lbs**

$E_v = 0.2*S_{DS}*W_p$
= **190.7 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 3.91 plf
L = 19.17 ft
$\mathbf{F_{slosh}}$ = **74.9547 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	503	0	501	0
Live	443	64	42	6
Seismic	96	253	95	252
1.4D	704	0	701	0
1.2D+1.6L	1313	102	669	10
$(1.2+0.2S_{DS})D\pm E$	699	505	696	504
$(0.9-0.2S_{DS})D\pm E$	357	505	356	504
1.2D+1.6L+E	1142	569	739	510

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Forebay - Tail Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

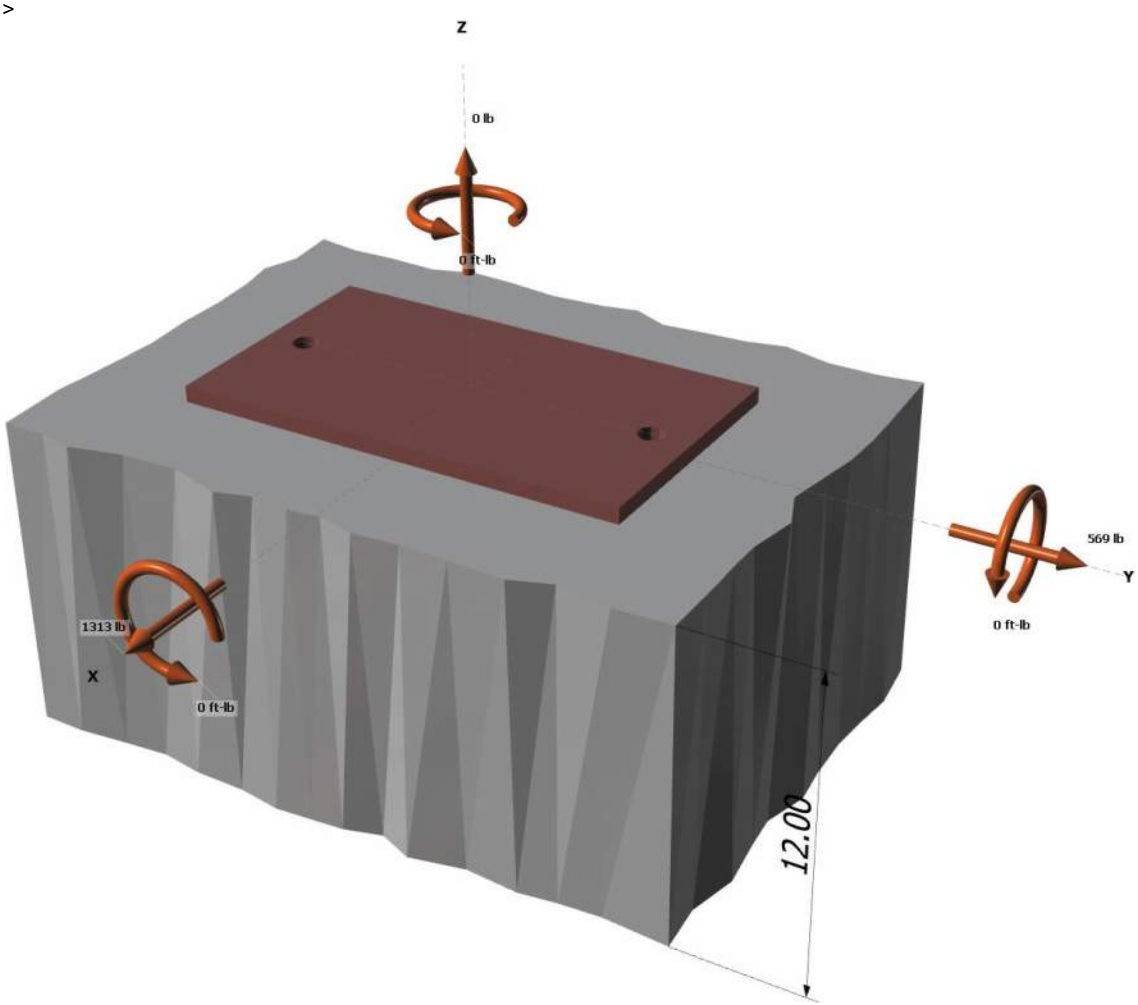
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1313
V_{uay} [lb]: 569
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

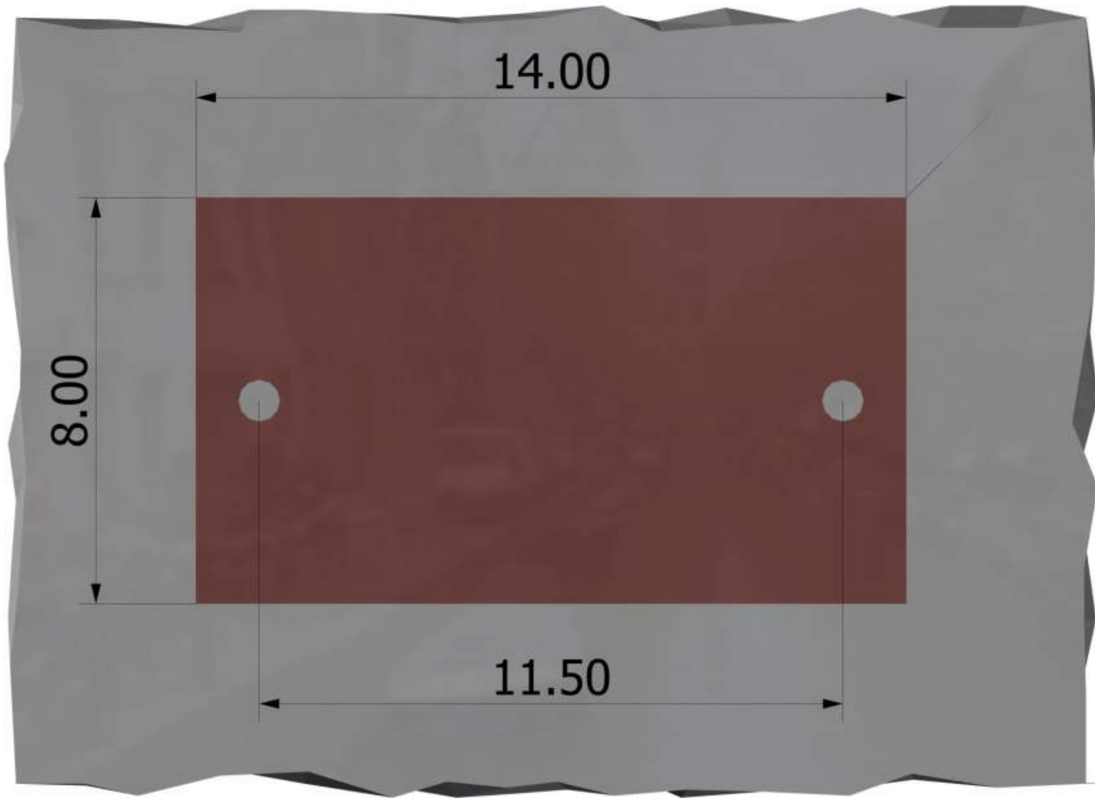
<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
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Version 2.9.7376.0

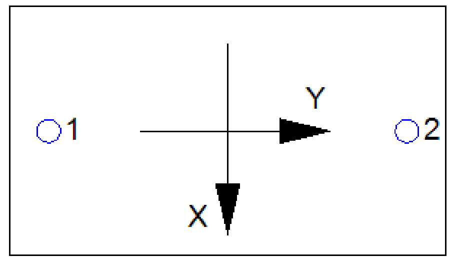
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	656.5	284.5	715.5
2	0.0	656.5	284.5	715.5
Sum	0.0	1313.0	569.0	1431.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11425	1.0	0.65	0.75	5570

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag} ; k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} ; k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	340.73	184.52	1.000	1.000	1.000	5062	9347

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
531.00	324.00	1.000	1.000	1.000	1.000	12492	20474	0.70

ϕV_{cpg} (lb)
13086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**715**	**5570**	**0.13**	**Pass (Governs)**
Pryout	1431	13086	0.11	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

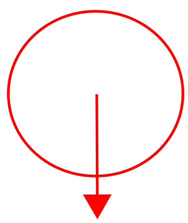
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Balanced Chain Pull | By: GJE
Project: Herriman UT WTP | Date: 2/24/2022

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	5.958		2.979	99.55818 lbs
Shaft Sprocket 1			32	1.625	32 lbs
Shaft Sprocket 2			32	4.625	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	5.792	60 lbs
					0 lbs
					0 lbs
				Total:	**376.5582 lbs**

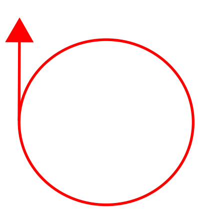


Dead loads all act vertically.

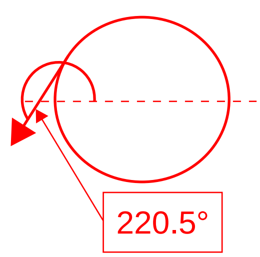
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	826	90	0.3	826	0	lbs
Collector CP (1/2 per side)	564	220.5	1.625	-366	-429	lbs
Collector CP (1/2 per side)	564	220.5	4.625	-366	-429	lbs
Weight of chain and (8) flights	142	-17.1	1.625	-42	136	lbs
Weight of chain and (8) flights	142	-17.1	4.625	-42	136	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 40'				0	0	lbs
W=40'*1.96plf+8*15.8lb/2				0	0	lbs
W=142lbs				0	0	lbs
				0	0	lbs

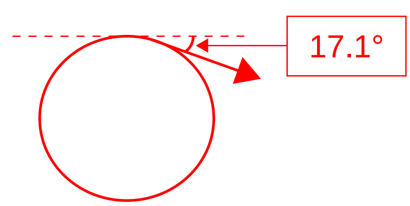
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp
= **161.2 lbs**

Ev = $0.2 * S_{DS} * Wp$
= **71.5 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 1.55 plf
L = 5.958 ft
F_{slosh} = **9.2349 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	229	0	148	0
Live	-396	279	386	308
Seismic	43	102	28	68
1.4D	320	0	207	0
1.2D+1.6L	-360	446	796	492
$(1.2+0.2S_{DS})D\pm E$	318	205	206	136
$(0.9-0.2S_{DS})D\pm E$	162	205	105	136
1.2D+1.6L+E	-79	484	592	443

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

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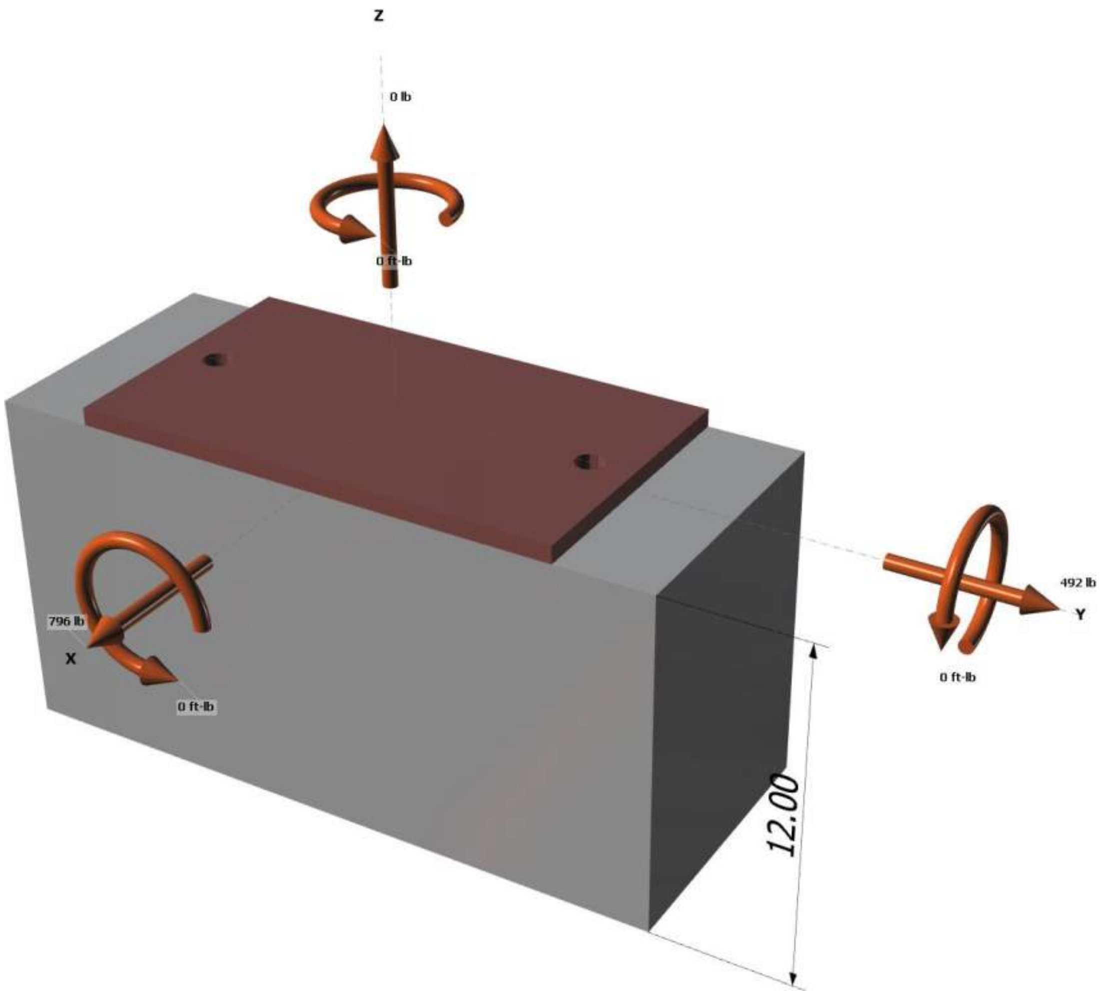
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 796
V_{uay} [lb]: 492
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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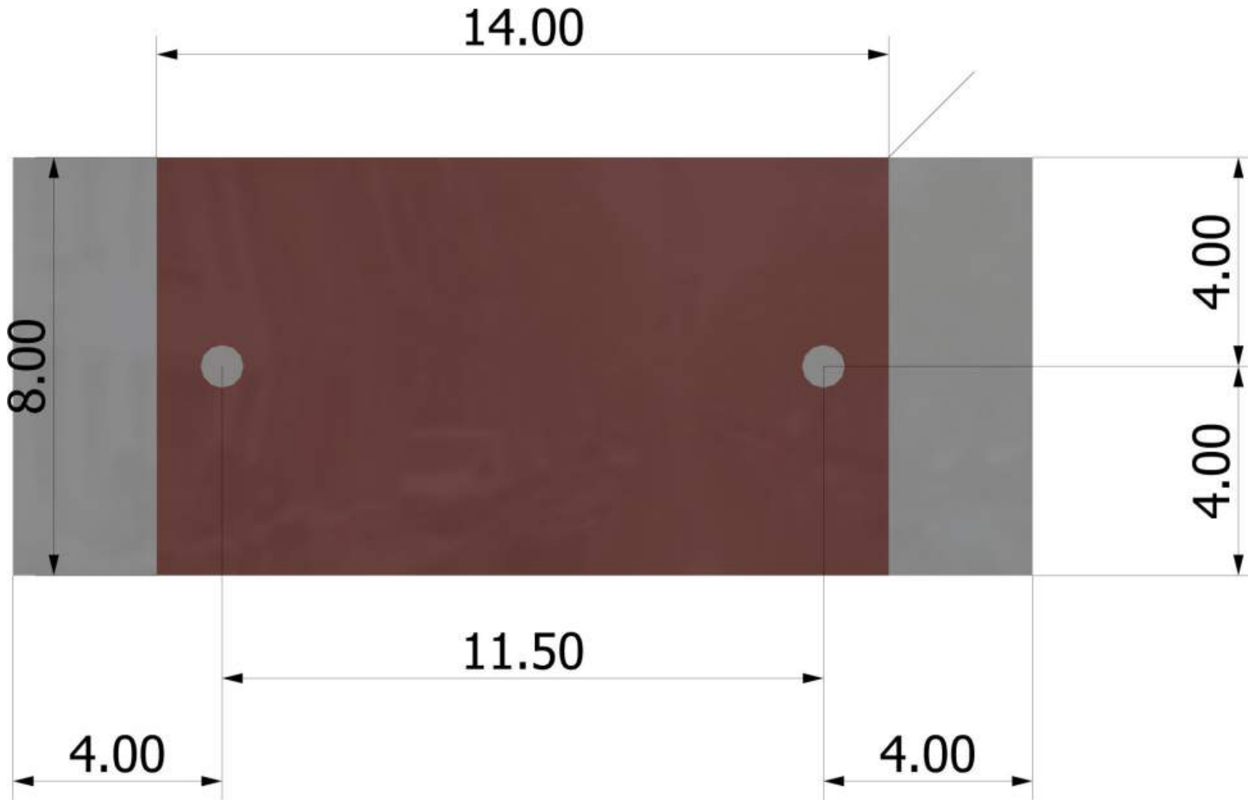
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

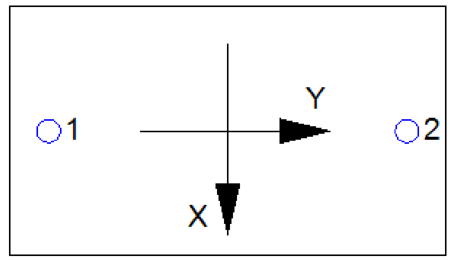


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	398.0	246.0	467.9
2	0.0	398.0	246.0	467.9
Sum	0.0	796.0	492.0	935.8

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
96.00	288.00	0.800	1.000	1.000	11154	0.70	2082

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
117.00	72.00	1.000	0.900	1.000	1.000	3944	0.70	4037

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

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E-mail:	gevers@csd-eng.com		

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
48.00	72.00	1.000	1.000	1.000	3944	0.70	3681

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ec,V}\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
117.00	72.00	1.000	1.000	1.000	1.000	3944	0.70	8972

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	156.00	184.52	0.877	1.000	1.000	5062	3752

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
155.97	132.16	1.000	0.909	1.000	1.000	6376	6838	0.70

ϕV_{cpg} (lb)
5252

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	468	7426	0.06	Pass
T Concrete breakout y+	492	2082	0.24	Pass
T Concrete breakout x+	796	4037	0.20	Pass
|| Concrete breakout y-	398	3681	0.11	Pass
|| Concrete breakout x-	492	8972	0.05	Pass
Concrete breakout, combined	**-**	**-**	**0.31**	**Pass (Governs)**
Pryout	936	5252	0.18	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

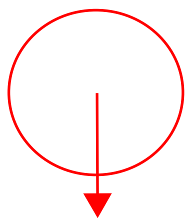
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Unbalanced Chain Pull | By: GJE
Project: Herriman UT WTP | Date: 2/24/2022

Head Shaft

Dead Loads

Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	5.958		2.979	99.55818 lbs
Shaft Sprocket 1			32	1.625	32 lbs
Shaft Sprocket 2			32	4.625	32 lbs
(1) Drive Sprocket			93	0.3	93 lbs
Self Align Wall Bearing 1			60	0.167	60 lbs
Self Align Wall Bearing 2			60	5.792	60 lbs
					0 lbs
					0 lbs
				Total:	**376.5582 lbs**

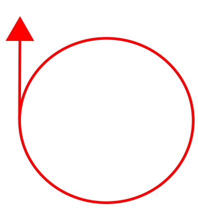


Dead loads all act vertically.

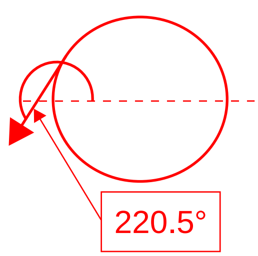
Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Drive Train CP	826	90	0.3	826	0	lbs
Collector CP (Single Side)	812	220.5	4.625	-527	-617	lbs
				0	0	lbs
Weight of chain and (8) flights	142	-17.1	1.625	-42	136	lbs
Weight of chain and (8) flights	142	-17.1	4.625	-42	136	lbs
Assumed Catenary Θ = 30°				0	0	lbs
Assumed Catenary L = 40'				0	0	lbs
W=40'*1.96plf+8*15.8lb/2				0	0	lbs
W=142lbs				0	0	lbs
				0	0	lbs

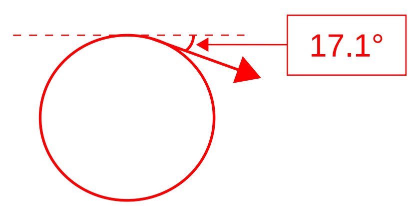
Drive Chain



Collector



Weight of Chain



Seismic Loads

Fp = 0.428 Wp

= **161.2 lbs**

Ev = $0.2*S_{DS}*Wp$

= **71.5 lbs**

S_{DS} = 0.95

Sloshing on shaft

f = 1.55 plf

L = 5.958 ft

F_{slosh} = 9.2349 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	229	0	148	0
Live	-627	9	412	337
Seismic	43	102	28	68
1.4D	320	0	207	0
1.2D+1.6L	-729	15	836	539
$(1.2+0.2S_{DS})D\pm E$	318	205	206	136
$(0.9-0.2S_{DS})D\pm E$	162	205	105	136
1.2D+1.6L+E	-309	214	617	473

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

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Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - Head Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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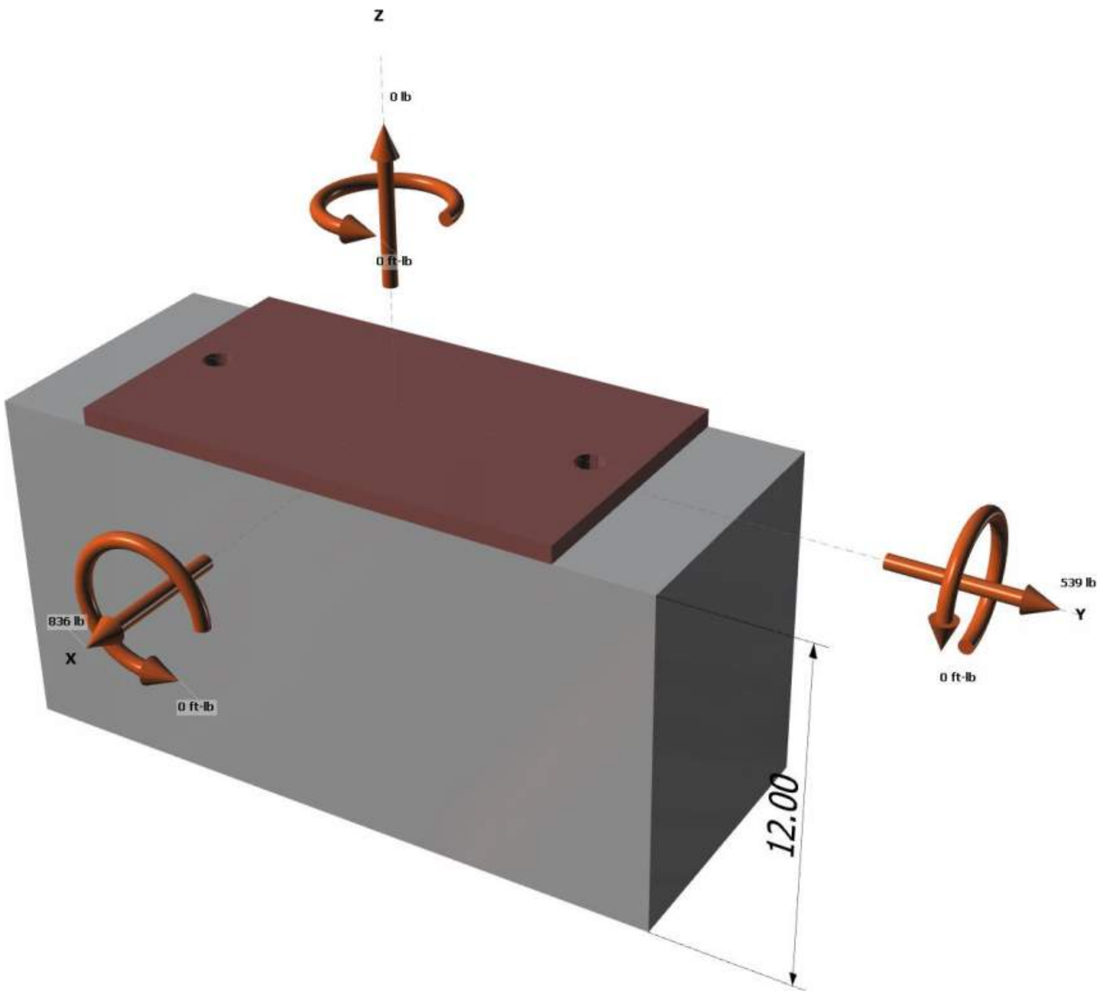
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 836
V_{uay} [lb]: 539
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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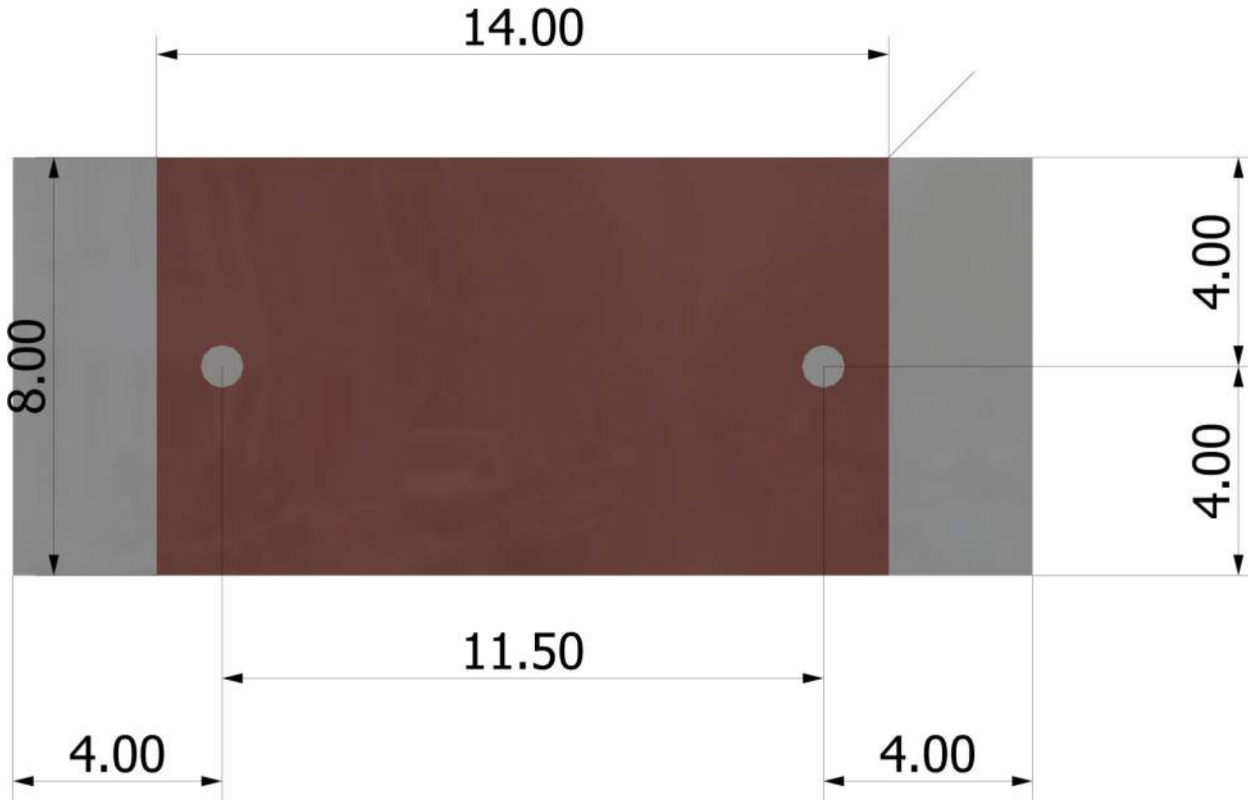
<Figure 2>



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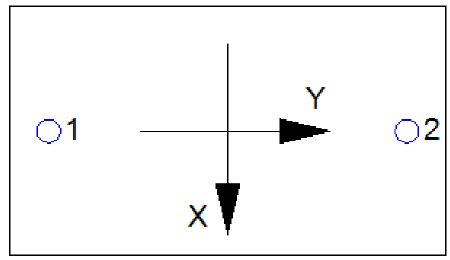
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	418.0	269.5	497.3
2	0.0	418.0	269.5	497.3
Sum	0.0	836.0	539.0	994.7

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
96.00	288.00	0.800	1.000	1.000	11154	0.70	2082

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
117.00	72.00	1.000	0.900	1.000	1.000	3944	0.70	4037

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

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E-mail:	gevers@csd-eng.com		

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
48.00	72.00	1.000	1.000	1.000	3944	0.70	3681

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
117.00	72.00	1.000	1.000	1.000	1.000	3944	0.70	8972

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	156.00	184.52	0.877	1.000	1.000	5062	3752

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
155.97	132.16	1.000	0.909	1.000	1.000	6376	6838	0.70

ϕV_{cpg} (lb)
5252

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	497	7426	0.07	Pass
T Concrete breakout y+	539	2082	0.26	Pass
T Concrete breakout x+	836	4037	0.21	Pass
|| Concrete breakout y-	418	3681	0.11	Pass
|| Concrete breakout x-	539	8972	0.06	Pass
Concrete breakout, combined	**-**	**-**	**0.33**	**Pass (Governs)**
Pryout	995	5252	0.19	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

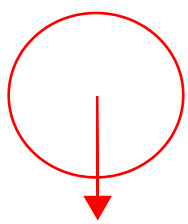
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Balanced Chain Pull   By: GJE
Project: Herriman UT WTP   Date: 2/24/2022

Hopper End Corner Shaft

Dead Loads

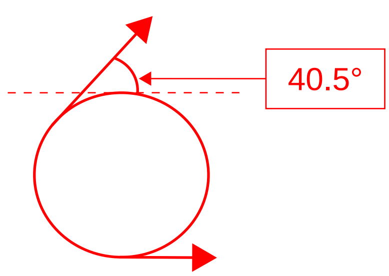
Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	6		3	100.26 lbs
Shaft Sprocket 1			32	1.333	32 lbs
Shaft Sprocket 2			32	4.667	32 lbs
Self Align Wall Bearing 1			60	1.333	60 lbs
Self Align Wall Bearing 2			60	4.667	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**284.26 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	564	40.5	1.333	366	429	lbs
Vert Collector CP (1/2 per side)	564	40.5	4.667	366	429	lbs
Horiz Collector CP (1/2 per side)	564	0	1.333	0	564	lbs
Horiz Collector CP (1/2 per side)	564	0	4.667	0	564	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **121.7 lbs**

Ev = $0.2 \cdot S_{DS} \cdot Wp$ S_{DS} = 0.95
= **54.0 lbs**

Sloshing on shaft
f = 1.55 plf
L = 6 ft
F_{slosh} = 9.3 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	142	0	142	0
Live	-366	-993	-366	-993
Seismic	27	65	27	65
1.4D	199	0	199	0
1.2D+1.6L	-416	-1589	-416	-1589
$(1.2+0.2S_{DS})D\pm E$	198	131	198	131
$(0.9-0.2S_{DS})D\pm E$	101	131	101	131
1.2D+1.6L+E	-169	-862	-169	-862

<-- Controls (1.2D+1.6L)

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - Hopper End Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

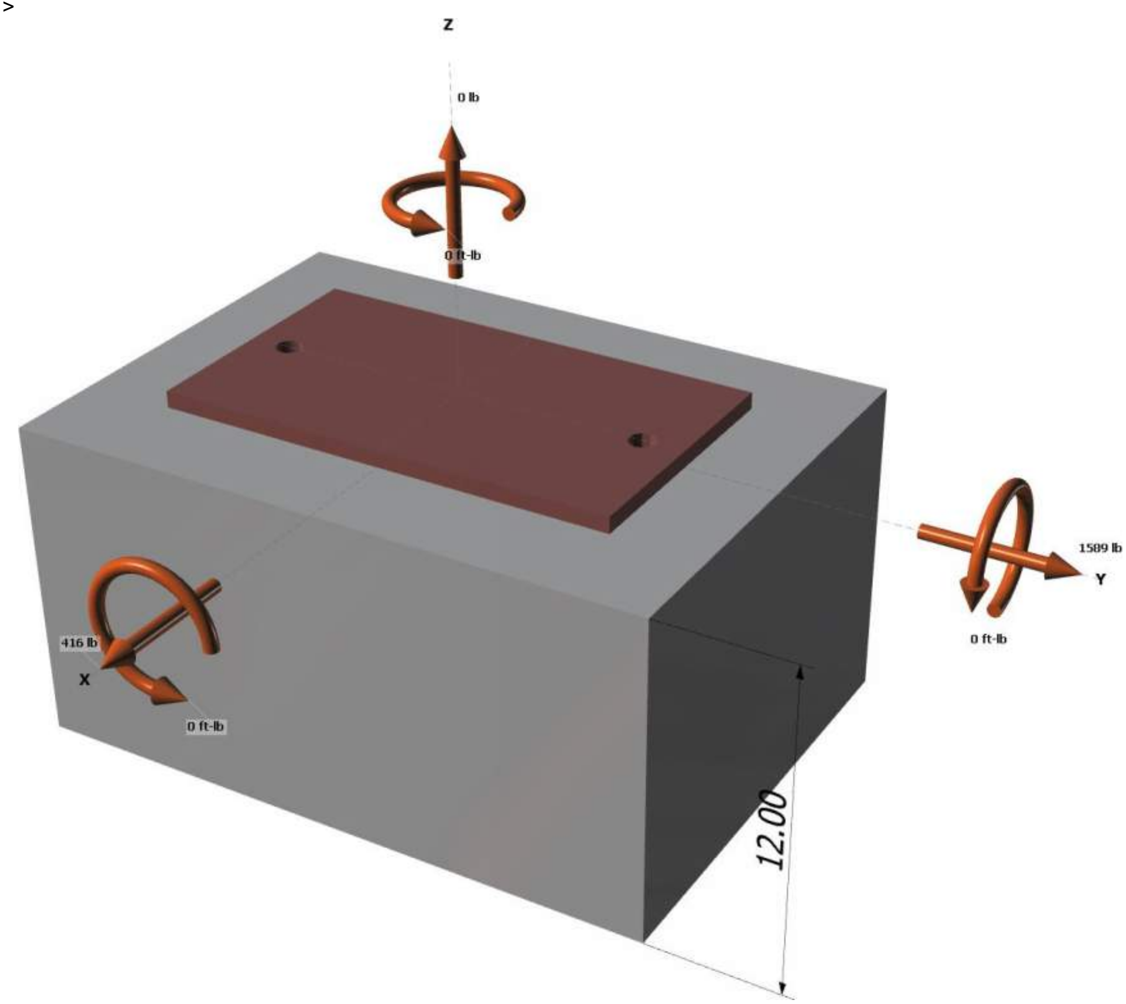
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 416
V_{uay} [lb]: 1589
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>

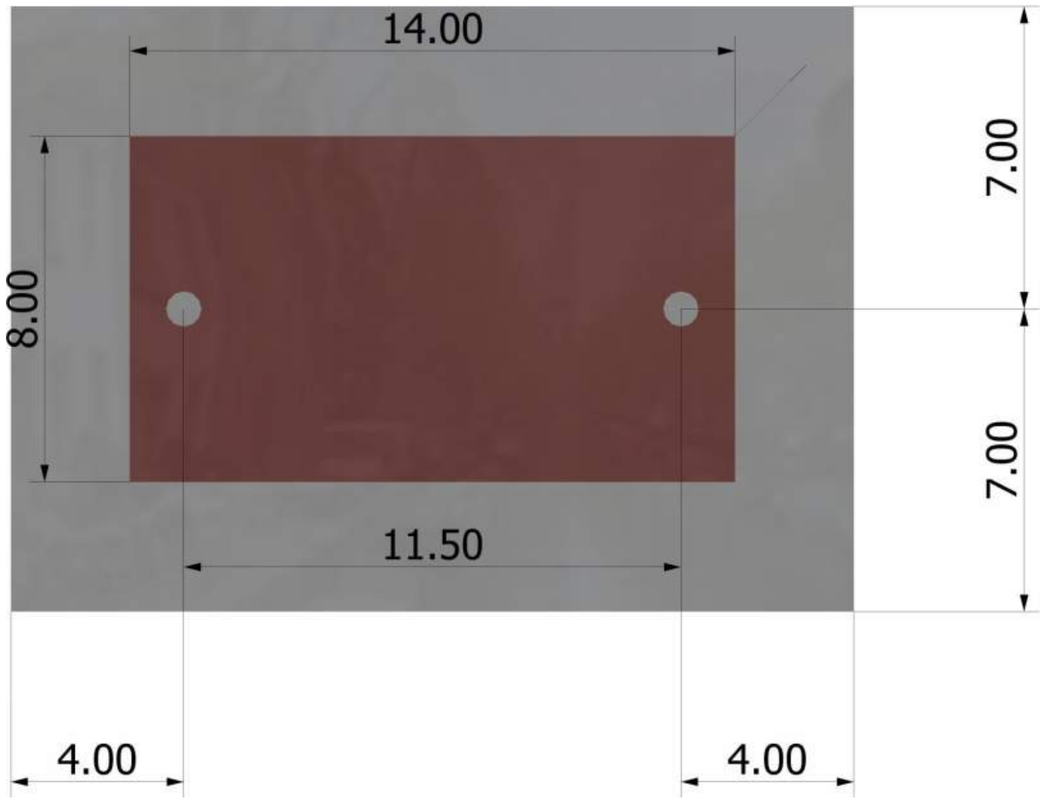


SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

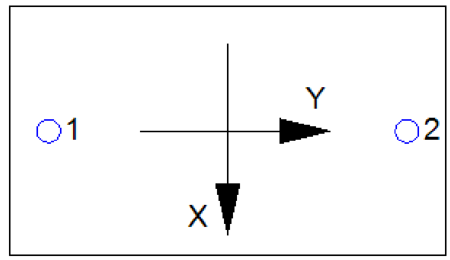


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	208.0	794.5	821.3
2	0.0	208.0	794.5	821.3
Sum	0.0	416.0	1589.0	1642.6

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
168.00	288.00	0.875	1.000	1.000	11154	0.70	3985

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	7.00	9130

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
204.75	220.50	1.000	0.814	1.000	1.000	9130	0.70	4832

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
72.00	72.00	1.000	1.000	1.000	3944	0.70	5521

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	7.00	9130

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ec,V}\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
204.75	220.50	1.000	1.000	1.000	1.000	9130	0.70	11868

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	264.88	184.52	0.877	1.000	1.000	5062	6370

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
273.00	196.00	1.000	0.871	1.000	1.000	8569	10401	0.70

ϕV_{cpg} (lb)
8918

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	821	7426	0.11	Pass
T Concrete breakout y+	1589	3985	0.40	Pass
T Concrete breakout x+	416	4832	0.09	Pass
|| Concrete breakout y-	208	5521	0.04	Pass
|| Concrete breakout x-	1589	11868	0.13	Pass
Concrete breakout, combined	**-**	**-**	**0.41**	**Pass (Governs)**
Pryout	1643	8918	0.18	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

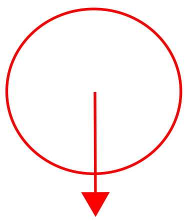
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Unbalanced Chain Pull
Project: Herriman UT WTP
By: GJE
Date: 2/24/2022

Hopper End Corner Shaft

Dead Loads

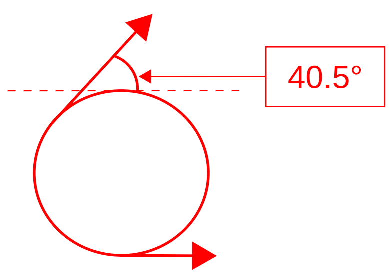
Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	6		3	100.26 lbs
Shaft Sprocket 1			32	1.333	32 lbs
Shaft Sprocket 2			32	4.667	32 lbs
Self Align Wall Bearing 1			60	1.333	60 lbs
Self Align Wall Bearing 2			60	4.667	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**284.26 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	812	40.5	1.333	527	617	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	812	0	1.333	0	812	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **121.7 lbs**
Ev = $0.2 \cdot S_{DS} \cdot Wp$
= **54.0 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 1.55 plf
L = 6 ft
$\mathbf{F_{slosh}}$ = **9.3 lbs**

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End	
	Y	X	Y	X
Dead	142	0	142	0
Live	-410	-1112	-117	-318
Seismic	27	65	27	65
1.4D	199	0	199	0
1.2D+1.6L	-486	-1779	-17	-508
$(1.2+0.2S_{DS})D\pm E$	198	131	198	131
$(0.9-0.2S_{DS})D\pm E$	101	131	101	131
1.2D+1.6L+E	-213	-981	80	-187

<-- Controls

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

SIMPSON Strong-Tie Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - Hopper End Shaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

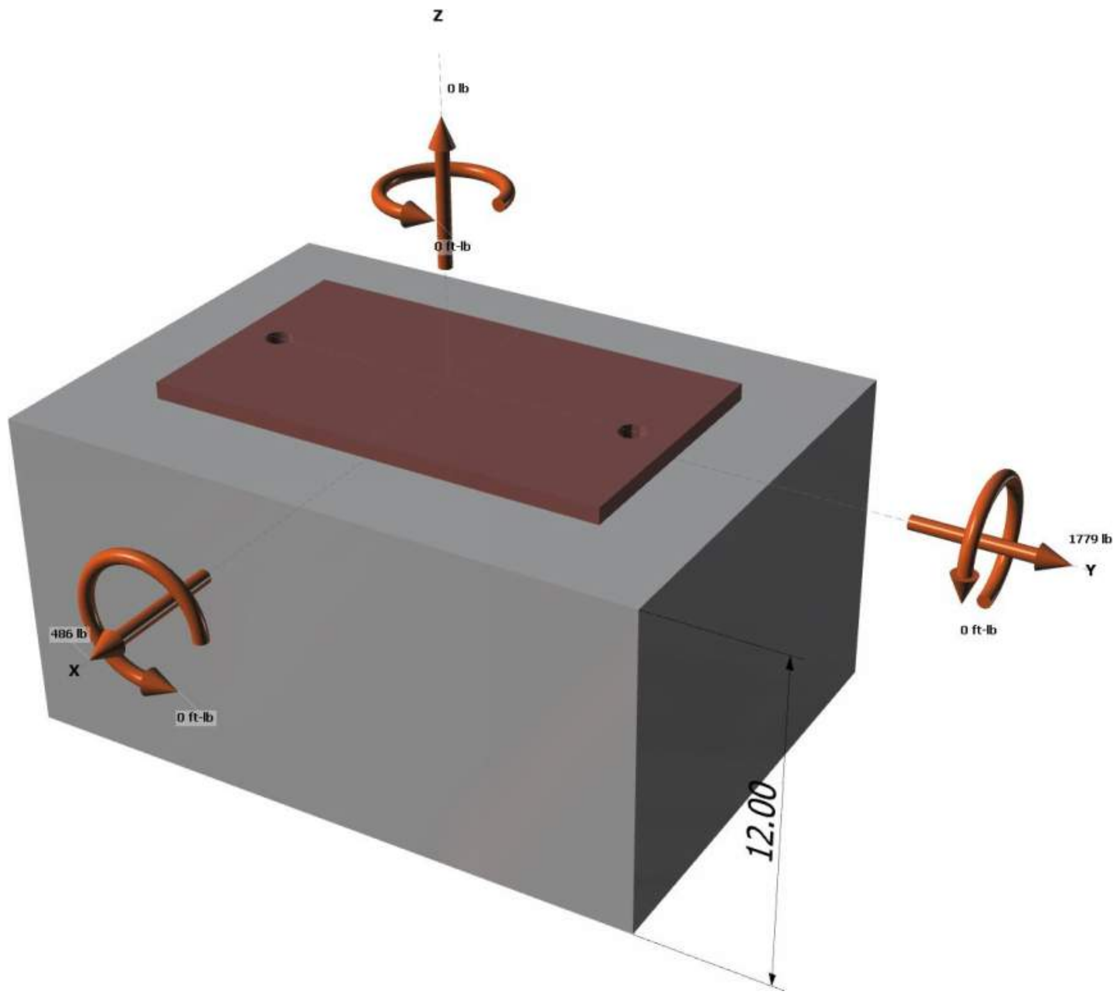
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 486
V_{uay} [lb]: 1779
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>

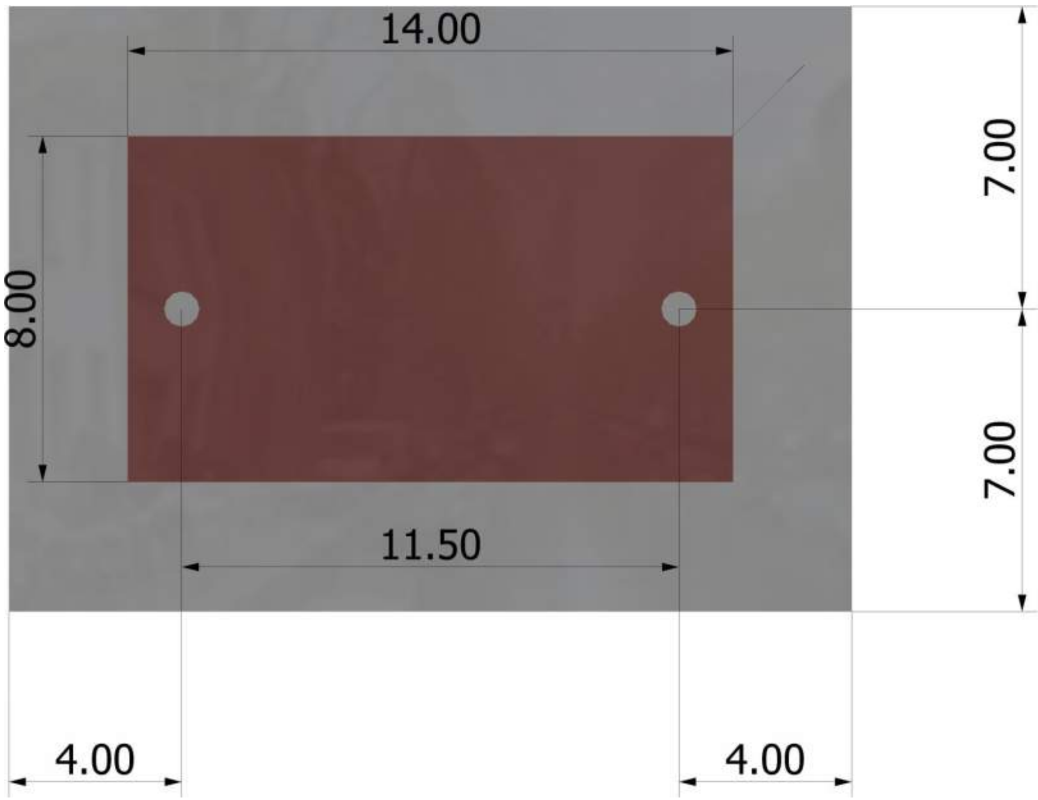


SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

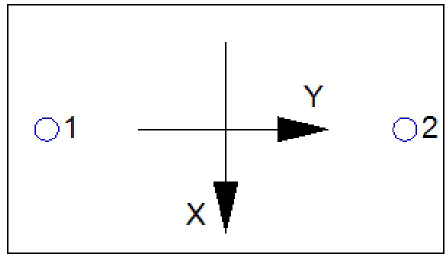


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	243.0	889.5	922.1
2	0.0	243.0	889.5	922.1
Sum	0.0	486.0	1779.0	1844.2

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
168.00	288.00	0.875	1.000	1.000	11154	0.70	3985

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	7.00	9130

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
204.75	220.50	1.000	0.814	1.000	1.000	9130	0.70	4832

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\, \Psi_{ed,V}\, \Psi_{c,V}\, \Psi_{h,V} V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
72.00	72.00	1.000	1.000	1.000	3944	0.70	5521

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	7.00	9130

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\, \Psi_{ec,V}\, \Psi_{ed,V}\, \Psi_{c,V}\, \Psi_{h,V} V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
204.75	220.50	1.000	1.000	1.000	1.000	9130	0.70	11868

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\, \Psi_{ec,Na}\, \Psi_{ed,Na}\, \Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\, \Psi_{ec,N}\, \Psi_{ed,N}\, \Psi_{c,N}\, \Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	264.88	184.52	0.877	1.000	1.000	5062	6370

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
273.00	196.00	1.000	0.871	1.000	1.000	8569	10401	0.70

ϕV_{cpg} (lb)
8918

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	922	7426	0.12	Pass
T Concrete breakout y+	1779	3985	0.45	Pass
T Concrete breakout x+	486	4832	0.10	Pass
|| Concrete breakout y-	243	5521	0.04	Pass
|| Concrete breakout x-	1779	11868	0.15	Pass
Concrete breakout, combined	**-**	**-**	**0.46**	**Pass (Governs)**
Pryout	1844	8918	0.21	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

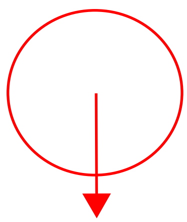
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Balanced Chain Pull
By: GJE
Project: Herriman UT WTP
Date: 2/24/2022

Non-Hopper End Corner Shaft

Dead Loads

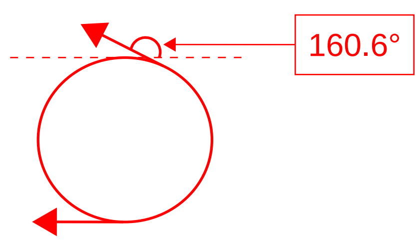
Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	6		3	100.26 lbs
Shaft Sprocket 1			32	1.333	32 lbs
Shaft Sprocket 2			32	4.667	32 lbs
Self Align Wall Bearing 1			60	1.333	60 lbs
Self Align Wall Bearing 2			60	4.667	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**284.26 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (1/2 per side)	564	160.6	1.333	187	-532	lbs
Vert Collector CP (1/2 per side)	564	160.6	4.667	187	-532	lbs
Horiz Collector CP (1/2 per side)	564	180	1.333	0	-564	lbs
Horiz Collector CP (1/2 per side)	564	180	4.667	0	-564	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **121.7 lbs**

Ev = 0.2*S_{DS}*Wp
= **54.0 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 1.55 plf
L = 6 ft
F_{slosh} = 9.3 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	142	0	142	0	
Live	-187	1096	-187	1096	
Seismic	27	65	27	65	
1.4D	199	0	199	0	<-- Controls
1.2D+1.6L	-129	1754	-129	1754	<-- Controls
$(1.2+0.2S_{DS})D\pm E$	198	131	198	131	
$(0.9-0.2S_{DS})D\pm E$	101	131	101	131	
1.2D+1.6L+E	10	1227	10	1227	

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Balanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - NonHopperEndShaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

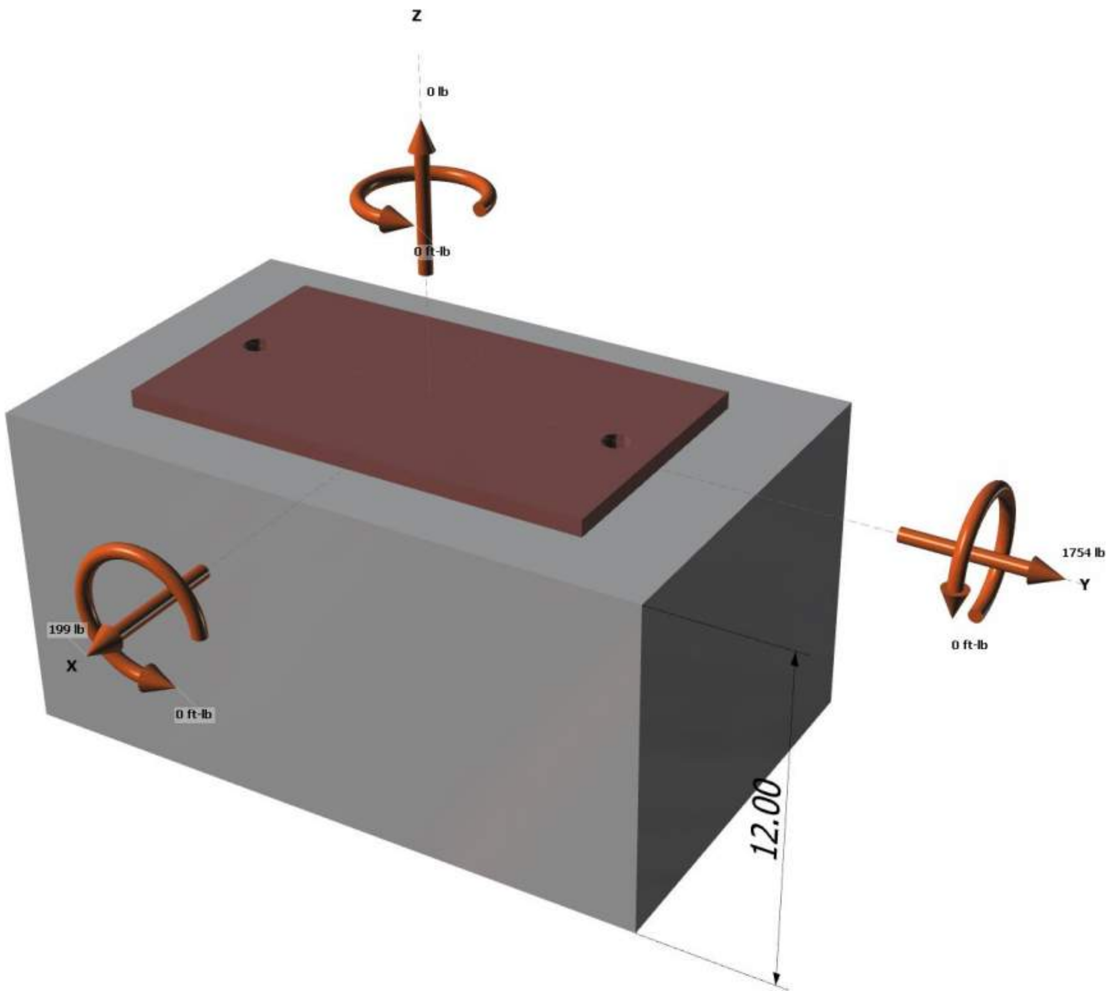
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 199
V_{uay} [lb]: 1754
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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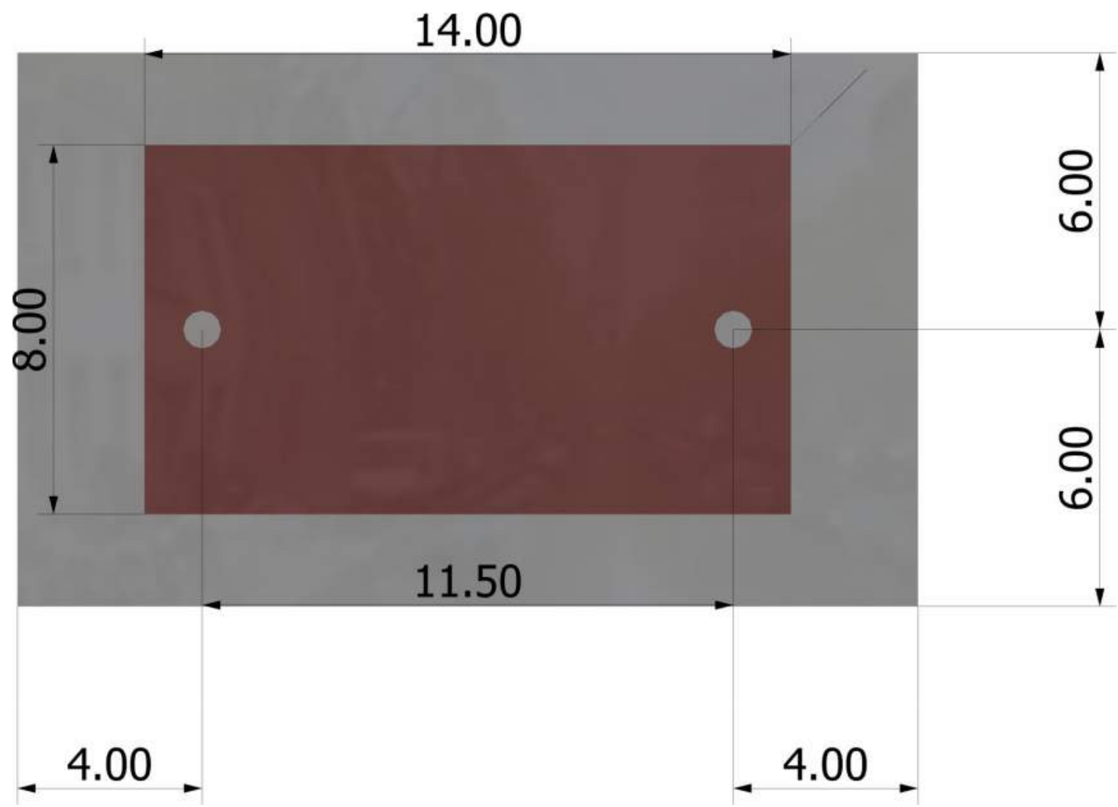
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
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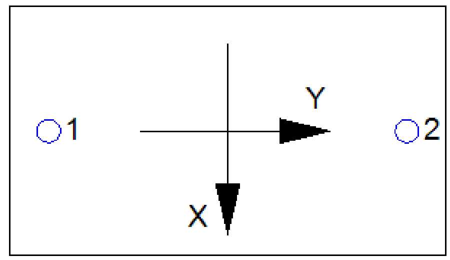
Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	99.5	877.0	882.6
2	0.0	99.5	877.0	882.6
Sum	0.0	199.0	1754.0	1765.3

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi (A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
144.00	288.00	0.850	1.000	1.000	11154	0.70	3318

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	6.00	7245

$\phi V_{cbgx} = \phi (A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
175.50	162.00	1.000	0.833	1.000	1.000	7245	0.70	4578

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

$\phi V_{cbx} = \phi\ (2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
72.00	72.00	1.000	1.000	1.000	3944	0.70	5521

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	6.00	7245

$\phi V_{cbgy} = \phi\ (2)(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
175.50	162.00	1.000	1.000	1.000	1.000	7245	0.70	10988

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi\min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi\min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	234.00	184.52	0.877	1.000	1.000	5062	5628

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
234.00	144.00	1.000	0.900	1.000	1.000	6800	9945	0.70

ϕV_{cpg} (lb)
7879

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	883	7426	0.12	Pass
T Concrete breakout y+	1754	3318	0.53	Pass
T Concrete breakout x+	199	4578	0.04	Pass
|| Concrete breakout y-	99	5521	0.02	Pass
|| Concrete breakout x-	1754	10988	0.16	Pass
Concrete breakout, combined	**-**	**-**	**0.53**	**Pass (Governs)**
Pryout	1765	7879	0.22	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

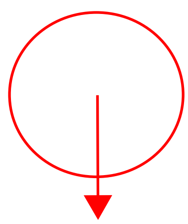
- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

Title: (3) Shaft Cross Collector - Unbalanced Chain Pull   By: GJE
Project: Herriman UT WTP   Date: 2/24/2022

Non-Hopper End Corner Shaft

Dead Loads

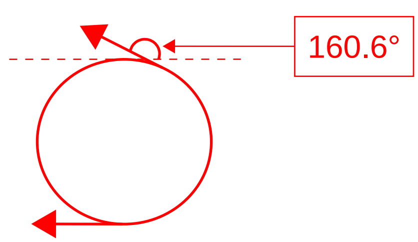
Description	plf	Length (ft)	Weight	Distance	Total
2.5" Dia Shaft	16.71	6		3	100.26 lbs
Shaft Sprocket 1			32	1.333	32 lbs
Shaft Sprocket 2			32	4.667	32 lbs
Self Align Wall Bearing 1			60	1.333	60 lbs
Self Align Wall Bearing 2			60	4.667	60 lbs
					0 lbs
					0 lbs
					0 lbs
				Total:	**284.26 lbs**



Dead loads all act vertically.

Live Loads (Chain Pulls)

Description	Total	Θ from Horiz	Distance	Y	X	
Vert Collector CP (Single Side)	812	160.6	1.333	270	-766	lbs
				0	0	lbs
Horiz Collector CP (Single Side)	812	180	1.333	0	-812	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs
				0	0	lbs



Seismic Loads

Fp = 0.428 Wp
= **121.7 lbs**

Ev = $0.2*S_{DS}*Wp$
= **54.0 lbs**

S_{DS} = 0.95

Sloshing on shaft
f = 1.55 plf
L = 6 ft
F_{slosh} = 9.3 lbs

Total Reactions (LRFD)

Load/Combo	Drive End		Idle End		
	Y	X	Y	X	
Dead	142	0	142	0	
Live	-210	1227	-60	351	
Seismic	27	65	27	65	
1.4D	199	0	199	0	<-- Controls
1.2D+1.6L	-165	1964	75	561	<-- Controls
$(1.2+0.2S_{DS})D \pm E$	198	131	198	131	
$(0.9-0.2S_{DS})D \pm E$	101	131	101	131	
1.2D+1.6L+E	-12	1358	138	482	

Ω_0= 2

Check 3/4" Diameter 316 SS threaded through rods in Simpson Strong-Tie SET-XP epoxy. Assume f'c = 3000 psi. Use an envelope of forces. Assume a spacing of 11.5". See following pages for design.

Note: For E loads along the shaft, use collars to transfer the load into the bearing housing.

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: Unbalanced - Envelope

Project description:
Location: Herriman, UT
Fastening description: Cross Collector - NonHopperEndShaft

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.75
c_{ac} (inch): 9.22
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 8.00 x 14.00 x 0.50

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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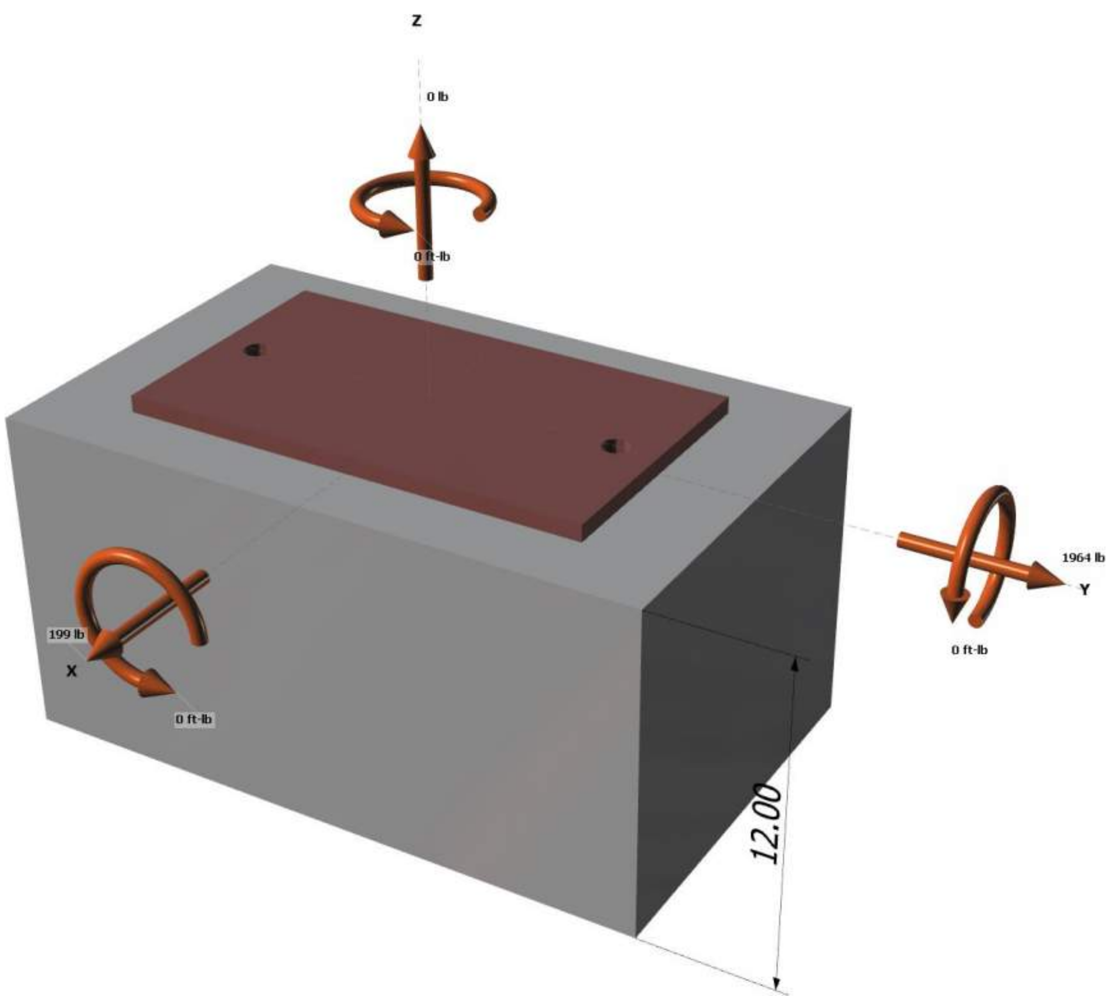
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 199
V_{uay} [lb]: 1964
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
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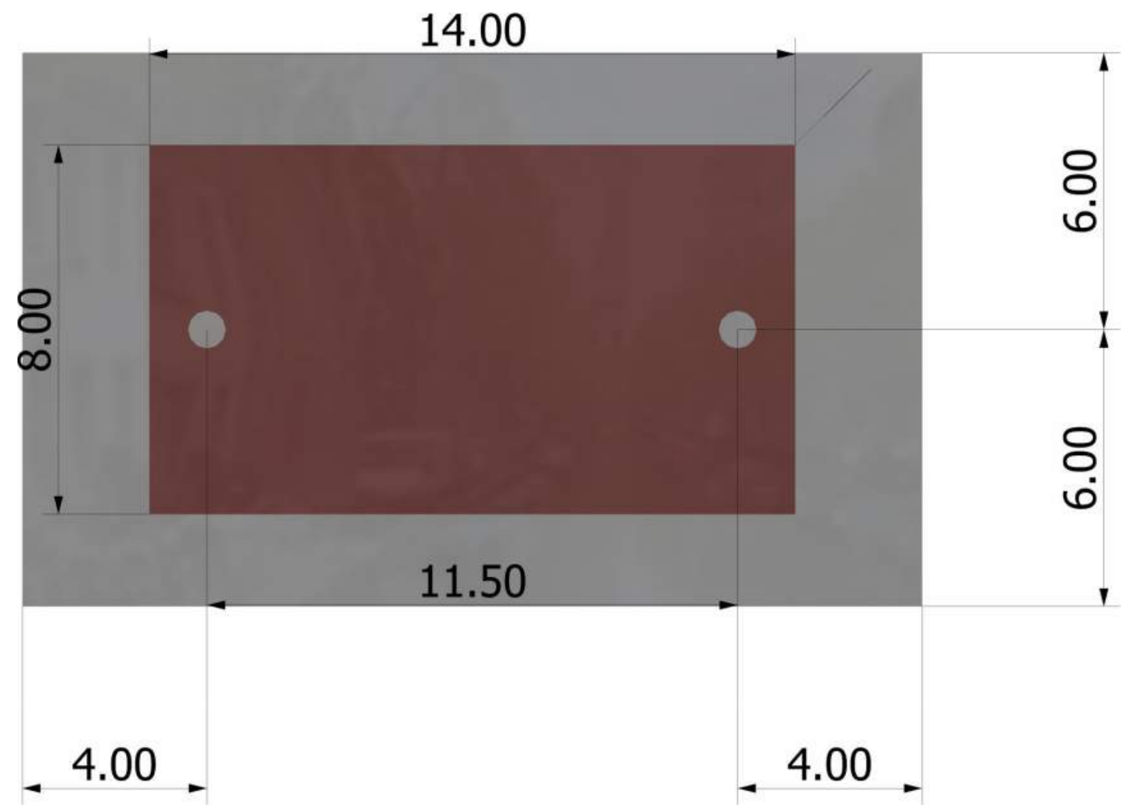
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



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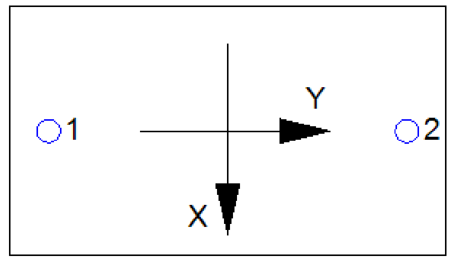
3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	99.5	982.0	987.0
2	0.0	99.5	982.0	987.0
Sum	0.0	199.0	1964.0	1974.1

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11425	1.0	0.65	7426

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	8.00	11154

$\phi V_{cby} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cby} (lb)
144.00	288.00	0.850	1.000	1.000	11154	0.70	3318

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	6.00	7245

$\phi V_{cbgx} = \phi\,(A_{Vc}/A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
175.50	162.00	1.000	0.833	1.000	1.000	7245	0.70	4578

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e/d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	4.00	3944

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E-mail:	gevers@csd-eng.com		

$\phi V_{cbx} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1a)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbx} (lb)
72.00	72.00	1.000	1.000	1.000	3944	0.70	5521

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	6.00	7245

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\ \Psi_{ec,V}\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V} V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
175.50	162.00	1.000	1.000	1.000	1.000	7245	0.70	10988

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	234.00	184.52	0.877	1.000	1.000	5062	5628

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
234.00	144.00	1.000	0.900	1.000	1.000	6800	9945	0.70

ϕV_{cpg} (lb)
7879

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	987	7426	0.13	Pass
T Concrete breakout y+	1964	3318	0.59	Pass
T Concrete breakout x+	199	4578	0.04	Pass
|| Concrete breakout y-	99	5521	0.02	Pass
|| Concrete breakout x-	1964	10988	0.18	Pass
Concrete breakout, combined	**-**	**-**	**0.59**	**Pass (Governs)**
Pryout	1974	7879	0.25	Pass

SET-XP w/ 3/4"Ø A193 Gr. B8/B8M (304/316SS) with hef = 6.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

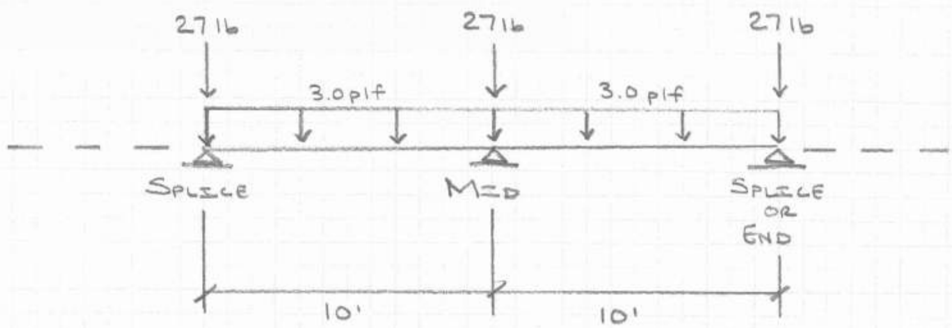
RETURN TRACK ANCHORS

LOWER EFFLUENT SHAFT AND OUTER WALLS

LOADS

D WEIGHT OF SUPPORT – 27 lb
WEIGHT OF RETURN TRACK – 3.0 plf

SUPPORTS 10' ON CENTER, SPLICE 20' ON CENTER



MID: $1.25wL = 1.25(3.0\ plf)(10') = 37.5\ lb$

END: $0.375wL = 0.375(3.0\ plf)(10') = 11.25\ lb$

SPLICE: $2(11.25\ lb) = 22.5\ lb$

L WEIGHT OF 1/2 FLIGHT ASSEMBLY – $49\ lb/2 = 24.5\ lb$
WEIGHT OF 10' OF COLLECTOR CHAIN – $1.6\ plf\ (10') = 16\ lb$

E $F_p = 0.428(64.5\ lb) = 27.6\ lb$
SLOSHING ON TRACK – 3.98 plf ⚠1

MID: $1.25(3.98\ plf)(10') = 49.8\ lb$

END: $0.375(3.98\ plf)(10') = 14.9\ lb$

SPLICE: $2(14.9\ lb) = 29.8\ lb$

LOAD COMBINATIONS – LRFD

1.4D

$1.4(37.5\,lb + 27\,lb) = 91\,lb \downarrow$

$1.4[37.5\,lb(15") + 27\,lb(7.5")] = 1071\,lb\cdot in = 90\,lb\cdot ft$

1.2D + 1.6L

$1.2(37.5\,lb + 27\,lb) + 1.6(24.5\,lb + 16\,lb) = 143\,lb \downarrow$

$1.2[37.5\,lb(15") + 27\,lb(7.5")] + 1.6[(24.5\,lb + 16\,lb)(15")] = 1890\,lb\cdot in = 158\,lb\cdot ft$

$(1.2 + 0.2S_{DS})D + \Omega_0 E + L$ △1

$[1.2 + 0.2(0.95)](37.5\,lb + 27\,lb) + (24.5\,lb + 16\,lb) = 131\,lb \downarrow$

$2(27.6\,lb + 49.8\,lb) = 155\,lb$

$[1.2 + 0.2(0.95)][37.5\,lb(15") + 27\,lb(7.5")] + (24.5\,lb + 16\,lb)(15") = 1671\,lb\cdot in = 140\,lb\cdot ft$

$2[0.428(37.5\,lb)(15") + 0.428(27\,lb)(7.5") + 49.8\,lb(15")] = 2145\,lb\cdot in = 179\,lb\cdot ft$

$(0.9 - 0.2S_{DS})D + \Omega_0 E + L$ △1

$[0.9 - 0.2(0.95)](37.5\,lb + 27\,lb) + (24.5\,lb + 16\,lb) = 87\,lb \downarrow$

$2(27.6\,lb + 49.8\,lb) = 155\,lb$

$[0.9 - 0.2(0.95)][37.5\,lb(15") + 27\,lb(7.5")] + (24.5\,lb + 16\,lb)(15") = 1151\,lb\cdot in = 96\,lb\cdot ft$

$2[0.428(37.5\,lb)(15") + 0.428(27\,lb)(7.5") + 49.8\,lb(15")] = 2145\,lb\cdot in = 179\,lb\cdot ft$

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP.

SPACING 2 3/4" → INCREASE TO 3"

ANCHORS ARE OK AT 5" EMBEDMENT

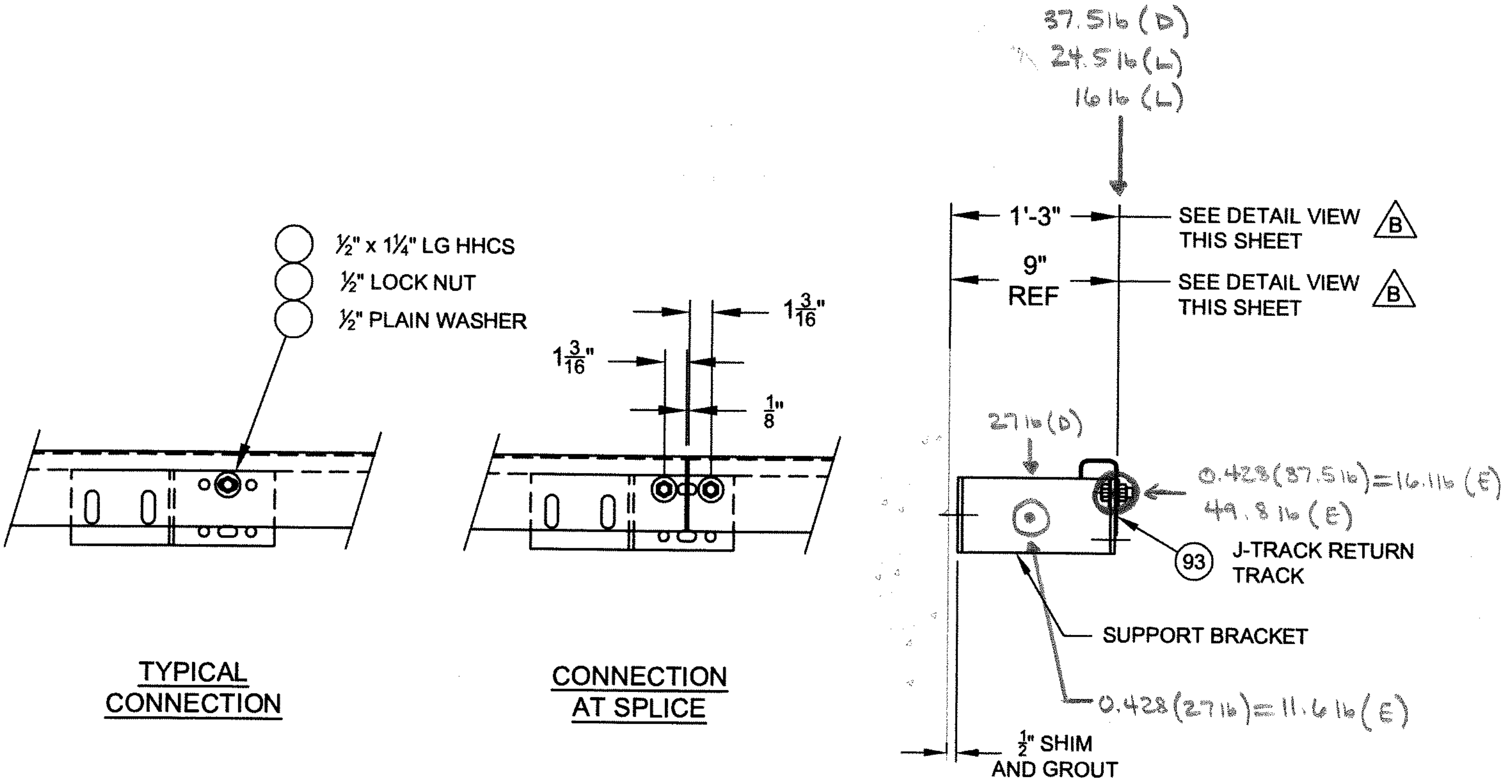
STRUCTURAL ENGINEERS
EXPERTISE • INNOVATION • EXCELLENCE

PROJECT Herriman, UT WTP

JOB NO. J211052 BY GJE

DATE 5/24/22 PAGE 163

Applied Loads



TYPICAL CONNECTION
4-SHAFT FOREBAY AT LOWER EFFLUENT
SHAFT & OUTER WALLS

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6 L

Project description:
Location: Herriman, UT
Fastening description: Lower Effluent and Outer Wall Track

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.65
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 4.00 x 5.00 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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Version 2.9.7376.0

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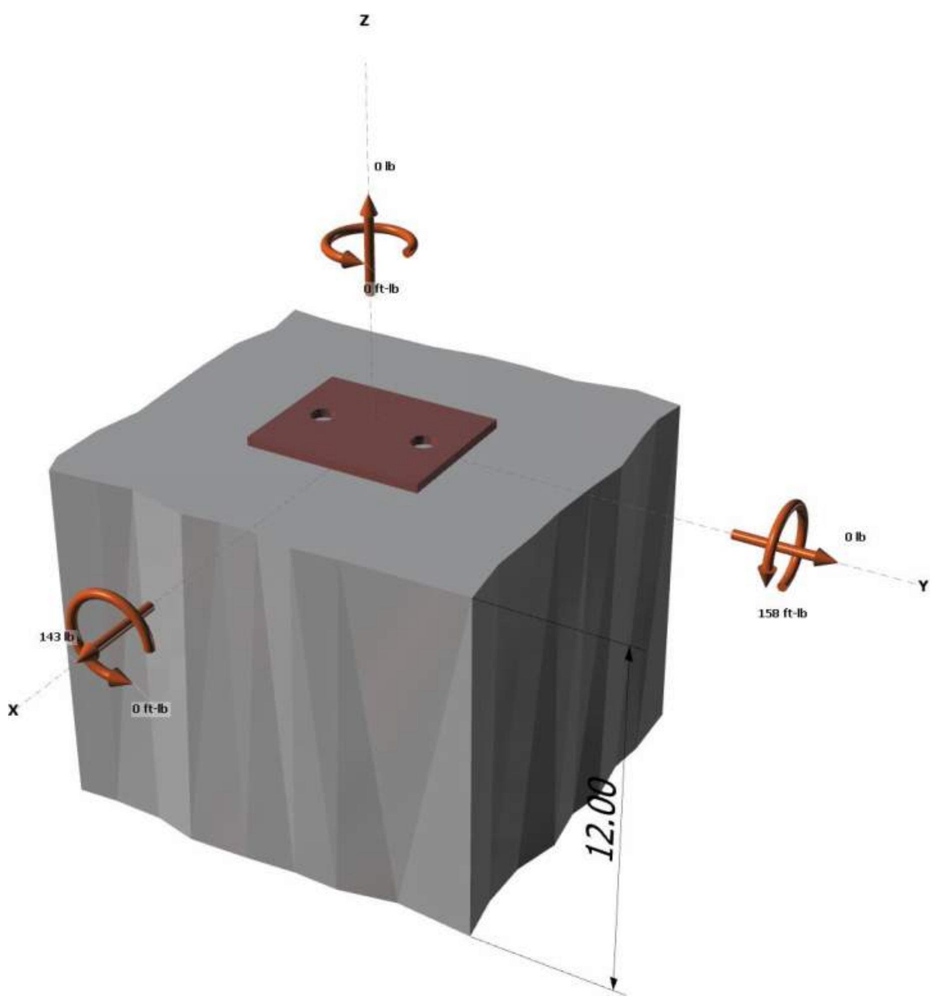
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 143
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 158
M_{uz} [ft-lb]: 0

<Figure 1>



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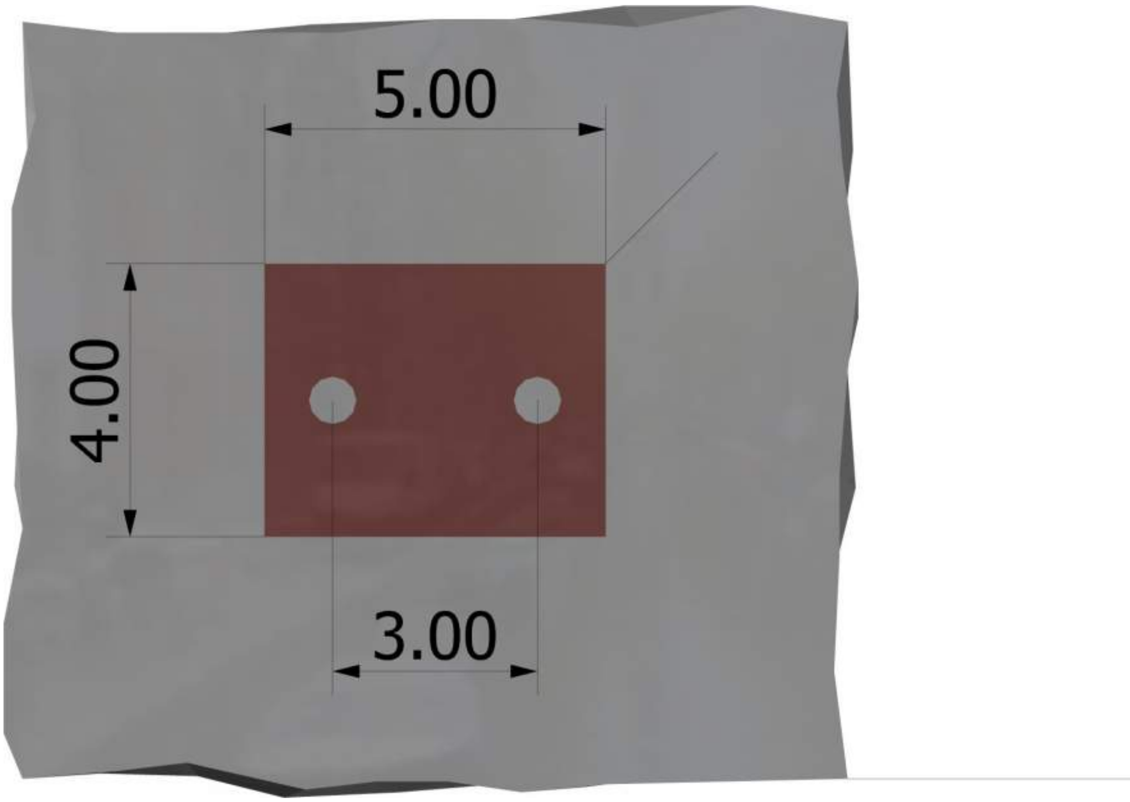

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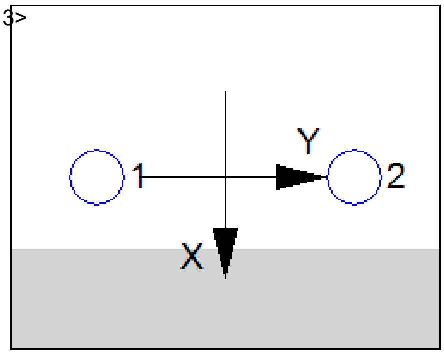
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	588.0	71.5	0.0	71.5
2	588.0	71.5	0.0	71.5
Sum	1176.0	143.0	0.0	143.0

Maximum concrete compression strain (‰): 0.09
Maximum concrete compression stress (psi): 400
Resultant tension force (lb): 1176
Resultant compression force (lb): 1176
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\, (A_{Nc} / A_{Nco})\, \Psi_{ec,N}\, \Psi_{ed,N}\, \Psi_{c,N}\, \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
270.00	225.00	-	1.000	1.000	1.00	1.000	9503	0.65	7413

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	0.93	405

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	405	0.63	5.000	3972

$\phi N_{ag} = \phi\, (A_{Na} / A_{Na0})\, \Psi_{ec,Na}\, \Psi_{ed,Na}\, \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
175.53	140.03	5.92	-	1.000	1.000	1.000	3972	0.45	2240

SIMPSON Strong-Tie®

Anchor Designer™
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Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
7730	1.0	0.65	5025

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	175.53	140.03	1.000	1.000	1.000	3972	4979

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
270.00	225.00	1.000	1.000	1.000	1.000	9503	11404	0.70

ϕV_{cpg} (lb)
6970

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	588	9660	0.06	Pass
Concrete breakout	1176	7413	0.16	Pass
Adhesive	**1176**	**2240**	**0.52**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	72	5025	0.01	Pass
Pryout	**143**	**6970**	**0.02**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.52	0.00	52.5%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	2/24/2022
Engineer:	GJE	Page:	1/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee, WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + E + L

Project description:
Location: Herriman, UT
Fastening description: Lower Effluent and Outer Wall Track

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.65
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Water-saturated concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 4.00 x 5.00 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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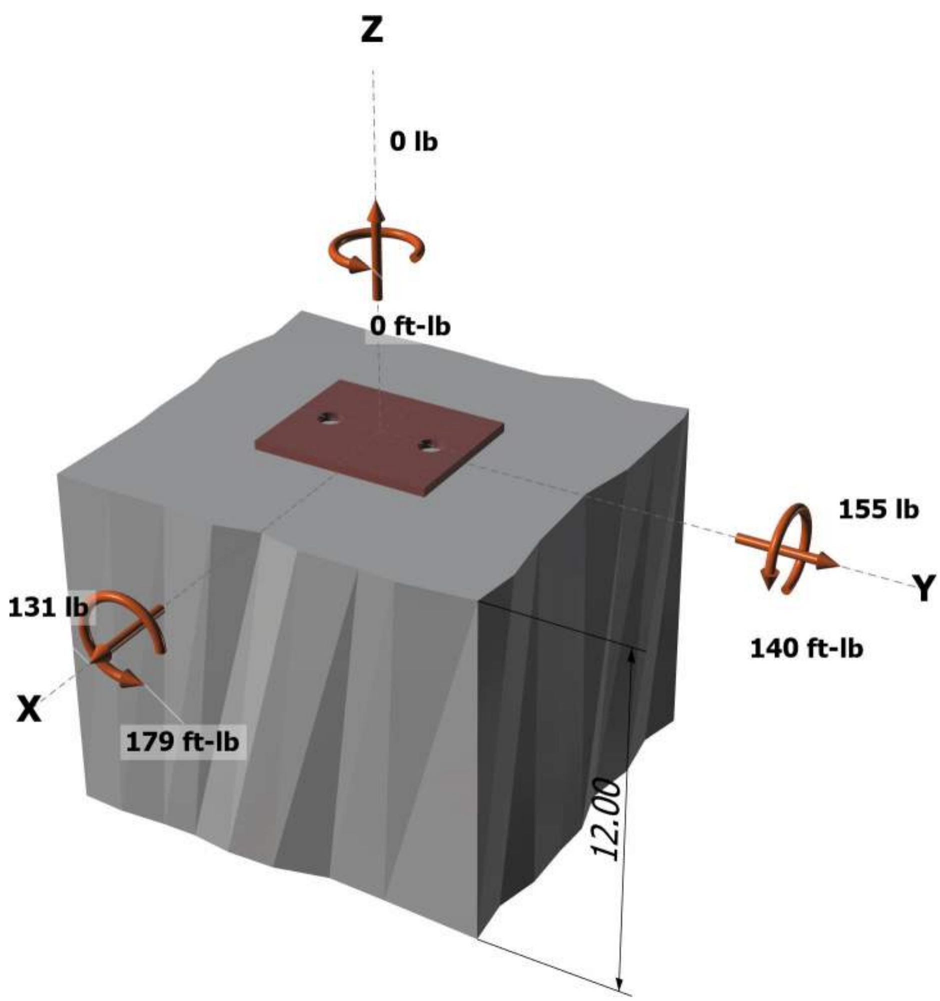
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 131
V_{uay} [lb]: 155
M_{ux} [ft-lb]: 179
M_{uy} [ft-lb]: 140
M_{uz} [ft-lb]: 0

<Figure 1>



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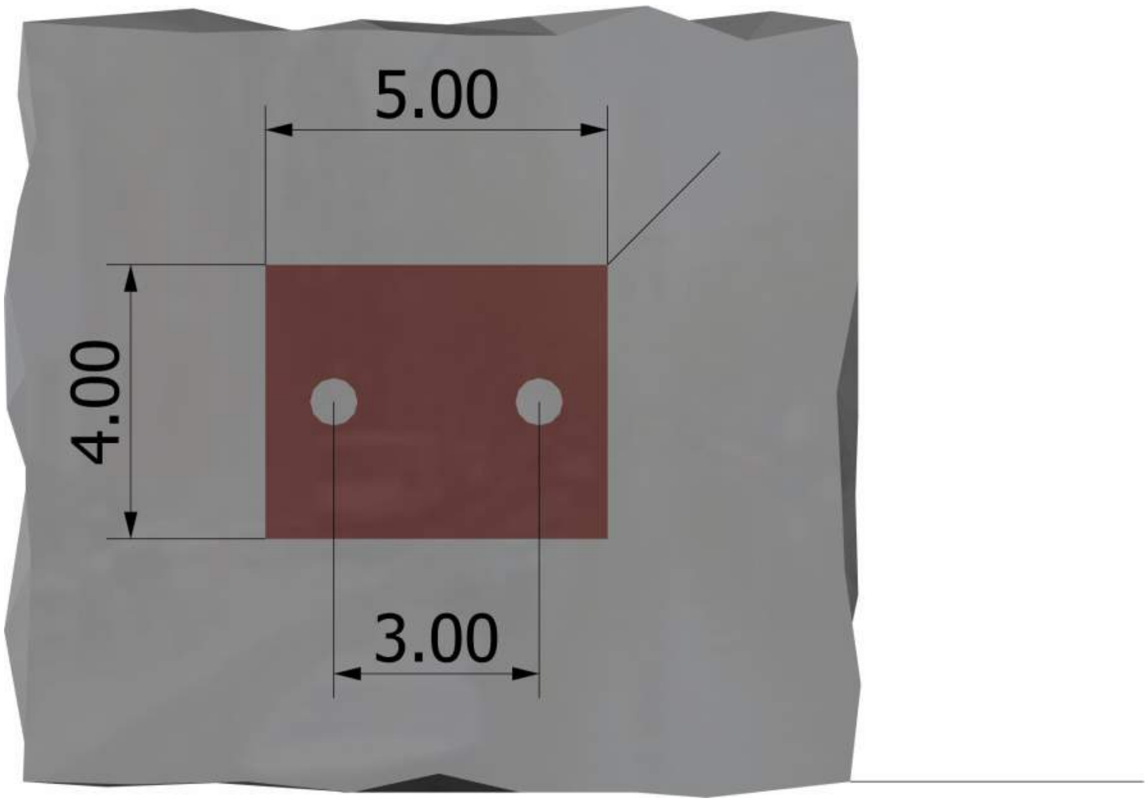
<Figure 2>

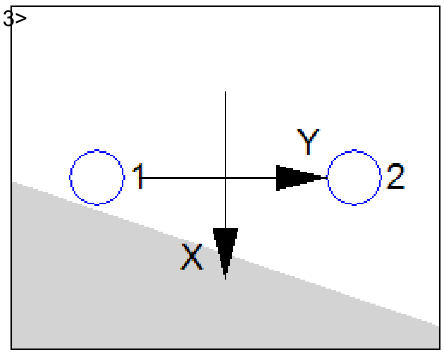


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	236.4	65.5	77.5	101.5
2	878.7	65.5	77.5	101.5
Sum	1115.1	131.0	155.0	202.9

Maximum concrete compression strain (‰): 0.14
Maximum concrete compression stress (psi): 590
Resultant tension force (lb): 1115
Resultant compression force (lb): 1115
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.86
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
270.00	225.00	-	0.897	1.000	1.00	1.000	9503	0.65	4985

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	$\tau_{k,cr}$ (psi)
435	1.00	0.93	1.00	405

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	405	0.63	5.000	3972

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
175.53	140.03	5.92	-	0.873	1.000	1.000	3972	0.45	1466

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E-mail:	gevers@csd-eng.com		

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7730	1.0	0.65	0.75	3768

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag} ; k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba} ; k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	175.53	140.03	1.000	1.000	1.000	3972	4979

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
270.00	225.00	1.000	1.000	1.000	1.000	9503	11404	0.70

ϕV_{cpg} (lb)
6970

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	879	9660	0.09	Pass
Concrete breakout	1115	4985	0.22	Pass
Adhesive	**1115**	**1466**	**0.76**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	101	3768	0.03	Pass
Pryout	**203**	**6970**	**0.03**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.76	0.00	76.1%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

AFTBAY DUAL OUTPUT DRIVE

LOADS

D

WEIGHT OF DRIVE BASE − 42 lb
WEIGHT OF DRIVE − 459 lb + 40 lb = 499 lb △
WEIGHT OF SPROCKET ASSEMBLY − 69 lb

610 lb ↓

L

DRIVE CP − 2059 lb ↓ △
DRIVE CHAIN − 20 ft (3.9 plf) = 78 lb ↓

W

$q_z G C_f = 24.46\text{ psf}(0.85)(1.6) = 33.3\text{ psf}$

$33.3\text{ psf}(1.25\text{ ft})(3.2\text{ ft}) = 134\text{ lb}$ @ 0.7 ft ↗

M = 94 lb·ft EITHER DIRECTION

E

$F_p = 0.428(610\text{ lb}) = 261\text{ lb}$ ↗ @ 0.7 ft △
$E_v = 0.2(0.95)(610\text{ lb}) = 116\text{ lb}$ ↕

NO HYDRODYNAMIC FORCES

LOAD COMBINATIONS – LRFD △

1.4 D

1.4(610 lb) = 854 lb ↓

1.2D+1.6L

1.2(610 lb)+1.6(2059 lb+78 lb) = 4151 lb ↓

M = 1.6(2059 lb+78 lb)(8") = 27354 lb·in = 2280 lb·ft

1.2D+W+L

1.2(610 lb)+(2059 lb+78 lb) = 2869 lb ↓

134 lb ↗

M = (2059 lb+78 lb)(8")+94 lb·ft(12"/1') = 18224 lb·in = 1519 lb·ft

$(1.2+0.2S_{DS})D+\Omega_0E+L$

[1.2+0.2(0.95)](610 lb)+(2059 lb+78 lb) = 2985 lb

2(261 lb) = 522 lb ↙

M = (2059 lb+78 lb)(8")+2(261 lb)(0.7 ft)(12"/1') = 21481 lb·in = 1790 lb·ft

$(0.9-0.2S_{DS})D+\Omega_0E+L$

[0.9-0.2(0.95)](610 lb)+(2059 lb+78 lb) = 2571 lb ↓

2(261 lb) = 522 lb ↗

M = (2059 lb+78 lb)(8")+2(261 lb)(0.7 ft)(12"/1') = 21481 lb·in = 1790 lb·ft

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP

SPACING 19" & 4.5", 3.25" EDGE DISTANCE

ANCHORS ARE OK AT 5" EMBEDMENT

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

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Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 0.9D + E + L

Project description:
Location: Herriman, UT
Fastening description: Aftbay Dual Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 9.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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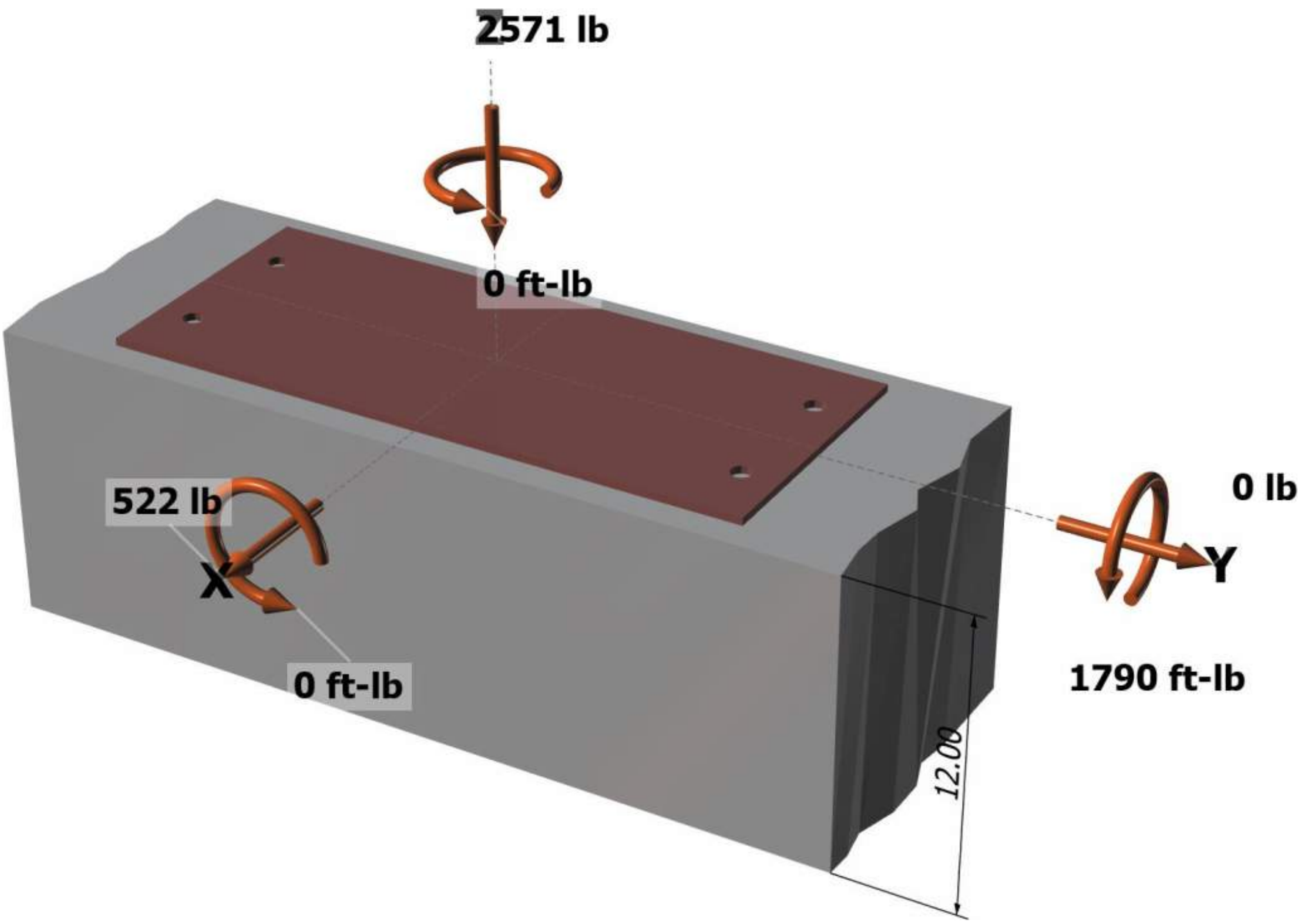
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -2571
V_{uax} [lb]: 522
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1790
M_{uz} [ft-lb]: 0

<Figure 1>



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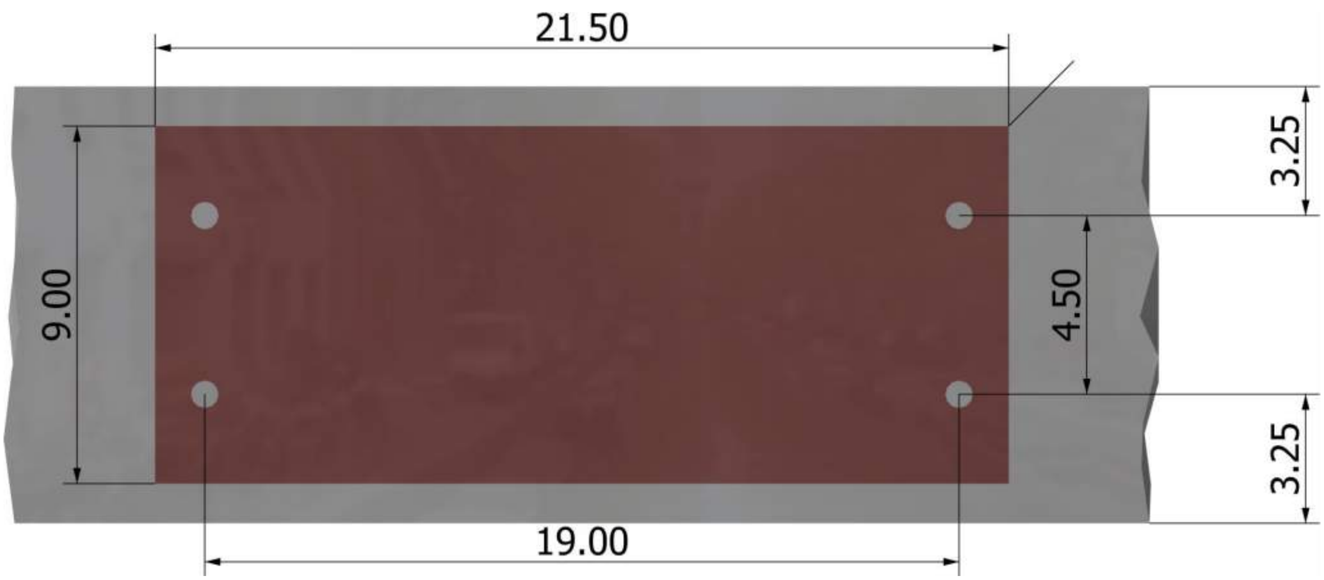
<Figure 2>



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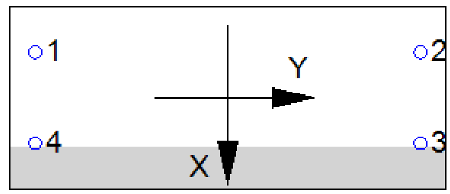
3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	957.1	130.5	0.0	130.5
2	957.1	130.5	0.0	130.5
3	34.3	130.5	0.0	130.5
4	34.3	130.5	0.0	130.5
Sum	1982.8	522.0	0.0	522.0

Maximum concrete compression strain (‰): 0.05
Maximum concrete compression stress (psi): 203
Resultant tension force (lb): 1983
Resultant compression force (lb): 4555
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 2.09
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
330.00	225.00	3.25	0.782	0.830	1.00	1.000	9503	0.65	5878

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
269.95	150.57	6.14	3.25	0.746	0.859	1.000	4271	0.55	2697

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8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
7730	0.8	0.65	4020

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
5.00	0.625	1.00	3000	3.25	2692

$\phi V_{cbgx} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
95.06	47.53	1.000	1.000	1.000	1.000	2692	0.70	3769

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\,;\,k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na}N_{ba}\,;\,k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	269.95	150.57	0.859	1.000	1.000	4271	6577

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
330.00	225.00	1.000	0.830	1.000	1.000	9503	11569	0.70

ϕV_{cpg} (lb)
9207

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	957	9660	0.10	Pass
Concrete breakout	1983	5878	0.34	Pass
Adhesive	**1983**	**2697**	**0.74**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	131	4020	0.03	Pass
T Concrete breakout x+	**261**	**3769**	**0.07**	**Pass (Governs)**
Pryout	522	9207	0.06	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.74	0.00	73.5%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6L

Project description:
Location: Herriman, UT
Fastening description: Aftbay Dual Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 9.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

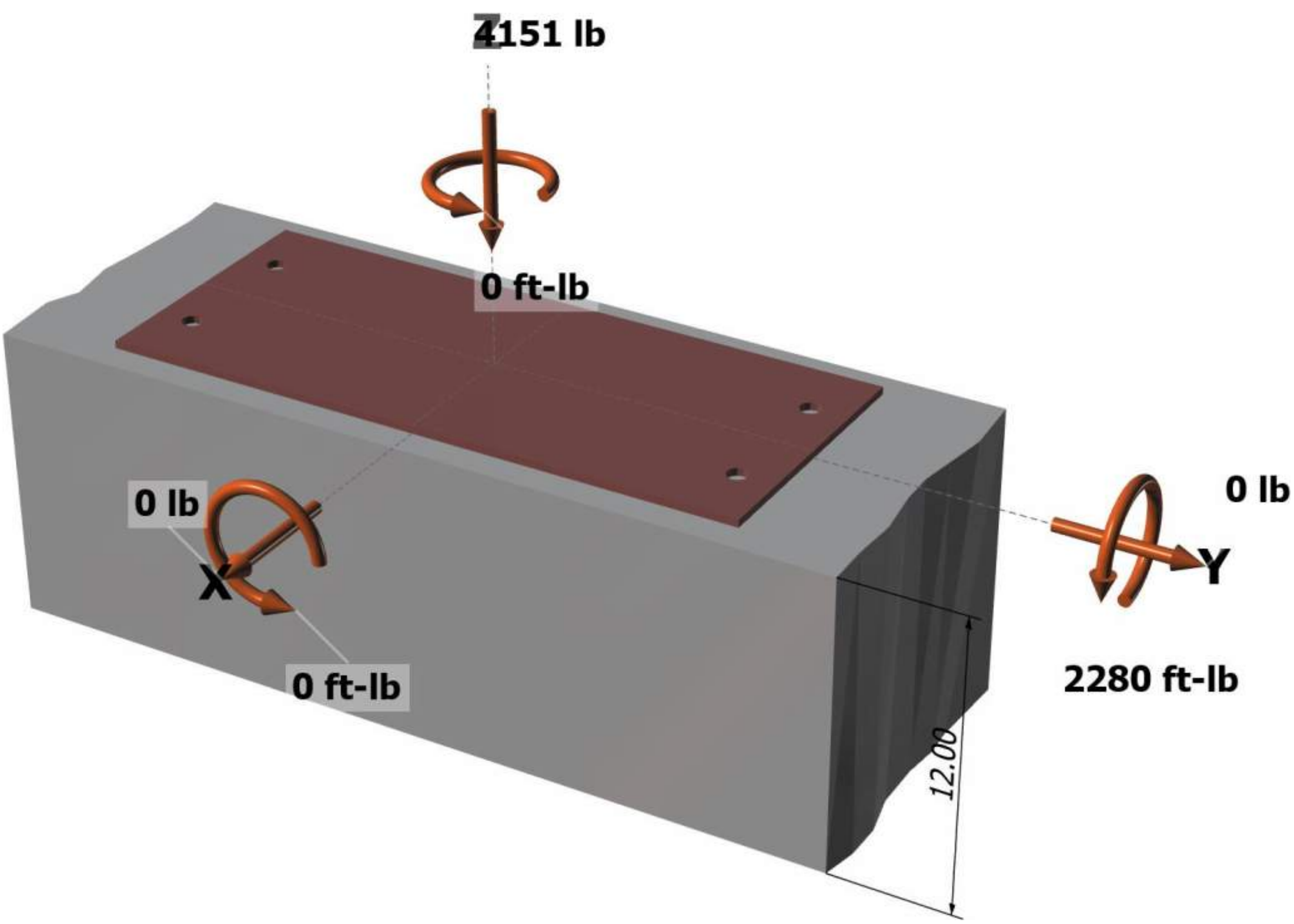
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -4151
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 2280
M_{uz} [ft-lb]: 0

<Figure 1>



SIMPSON Strong-Tie Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
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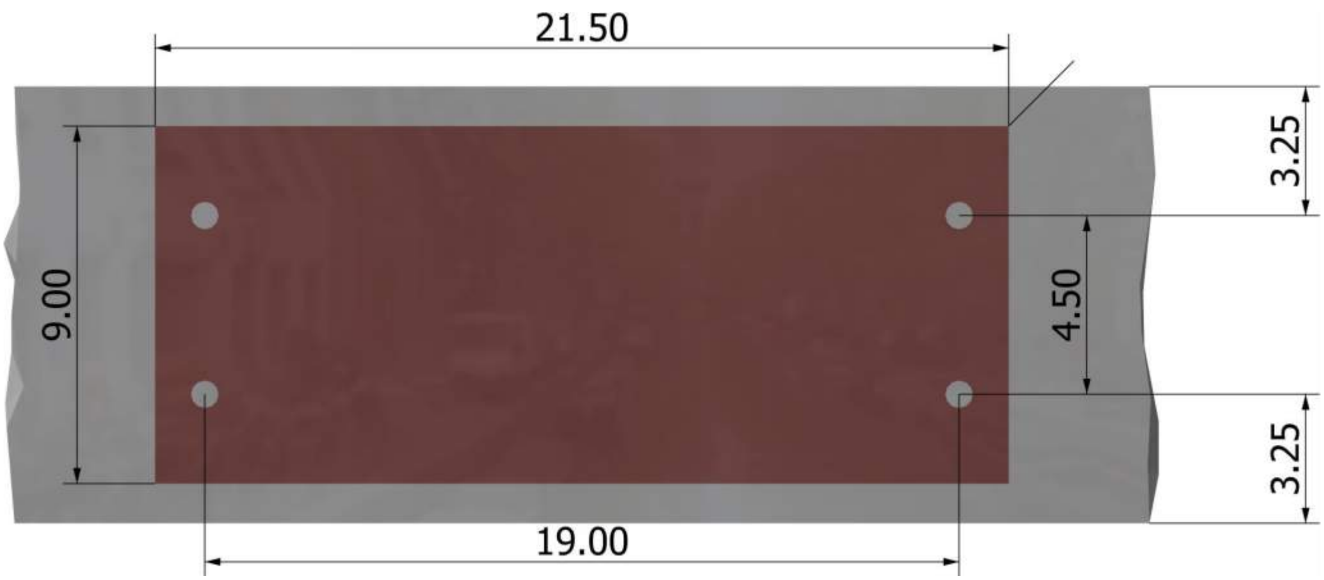
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
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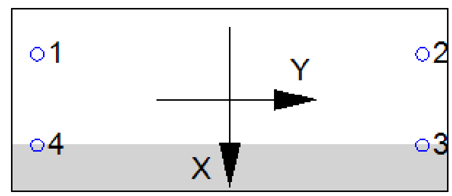
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	993.7	0.0	0.0	0.0
2	993.7	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	1987.4	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.06
Maximum concrete compression stress (psi): 247
Resultant tension force (lb): 1987
Resultant compression force (lb): 6139
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\ (A_{Nc} / A_{Nco})\, \Psi_{ec,N}\, \Psi_{ed,N}\, \Psi_{c,N}\, \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
322.50	225.00	3.25	1.000	0.830	1.00	1.000	9503	0.65	7349

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\ (A_{Na} / A_{Na0})\, \Psi_{ec,Na}\, \Psi_{ed,Na}\, \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
230.33	150.57	6.14	3.25	1.000	0.859	1.000	4271	0.55	3086

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	994	9660	0.10	Pass
Concrete breakout	1987	7349	0.27	Pass
Adhesive	**1987**	**3086**	**0.64**	**Pass (Governs)**

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

AFTBAY SINGLE OUTPUT DRIVE

LOADS

D

WEIGHT OF DRIVE BASE – 26 lb
WEIGHT OF DRIVE – 154 lb + 40 lb = 194 lb △1
WEIGHT OF SPROCKET ASSEMBLY – 69 lb

L

DRIVE CP – 2059 lb ↓ △1
DRIVE CHAIN – 20 ft (3.9 plf) = 78 lb ↓

W

$q_z G C_F = 24.46\ psf (0.85)(1.6) = 33.3\ psf$

$33.3\ psf (1.25\ ft)(3.0\ ft) = 125\ lb\ @\ 0.7\ ft$ ⤢

M = 88 lb·ft EITHER DIRECTION

E

$F_P = 0.428 (289\ lb) = 124\ lb\ @\ 0.7\ ft$ ⤢ △1
$E_V = 0.2(0.95)(289\ lb) = 55\ lb$ ↕

NO HYDRODYNAMIC FORCES

LOAD COMBINATIONS – LRFD

1.4D
$1.4(289\ lb) = 405\ lb \downarrow$

1.2D + 1.6L
$1.2(289 lb) + 1.6(2059\ lb + 78\ lb) = 3766\ lb \downarrow$
$M = 1.6(2059\ lb + 78 lb)(7") = 23934\ lb \cdot in = 1995\ lb \cdot ft$

1.2D + W + L
$1.2(289\ lb) + (2059\ lb + 78\ lb) = 2484\ lb \downarrow$
$125\ lb \nearrow$
$M = (2059\ lb + 78\ lb)(7") + 88\ lb \cdot ft\left(\frac{12"}{1'}\right) = 16015\ lb \cdot in = 1335\ lb \cdot ft$

$(1.2 + 0.2S_{DS})D + \Omega_0 E + L$
$[1.2 + 0.2(0.95)](289\ lb) + (2095\ lb + 78\ lb) = 2574\ lb \downarrow$
$2(124\ lb) = 248\ lb \nearrow$
$M = (2059\ lb + 78\ lb)(7") + 2(124\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 17042\ lb \cdot in = 1420\ lb \cdot ft$

$(0.9 - 0.2S_{DS})D + \Omega_0 E + L$
$[0.9 - 0.2(0.95)](289\ lb) + (2059\ lb + 78\ lb) = 2342\ lb \downarrow$
$2(124\ lb) = 248\ lb \nearrow$
$M = (2059\ lb + 78\ lb)(7") + 2(124\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 17042\ lb \cdot in = 1420\ lb \cdot ft$

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP

SPACING 19" & 4.5", 2.25" EDGE DISTANCE

ANCHORS ARE OK AT 5" EMBEDMENT

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 0.9D + E + L

Project description:
Location: Herriman, UT
Fastening description: Aftbay Single Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 8.00 x 21.50 x 0.25

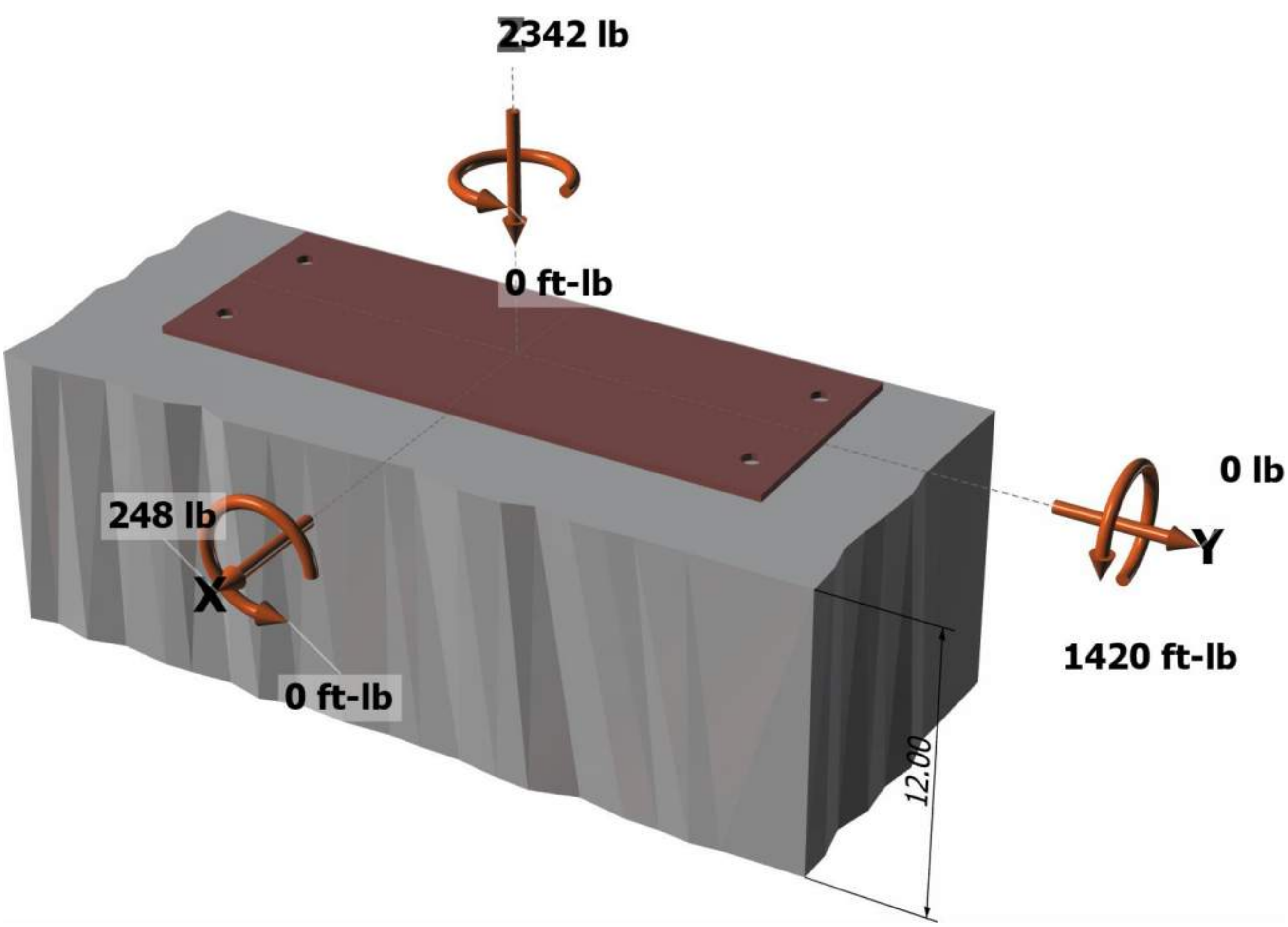
Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -2342
V_{uax} [lb]: 248
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1420
M_{uz} [ft-lb]: 0

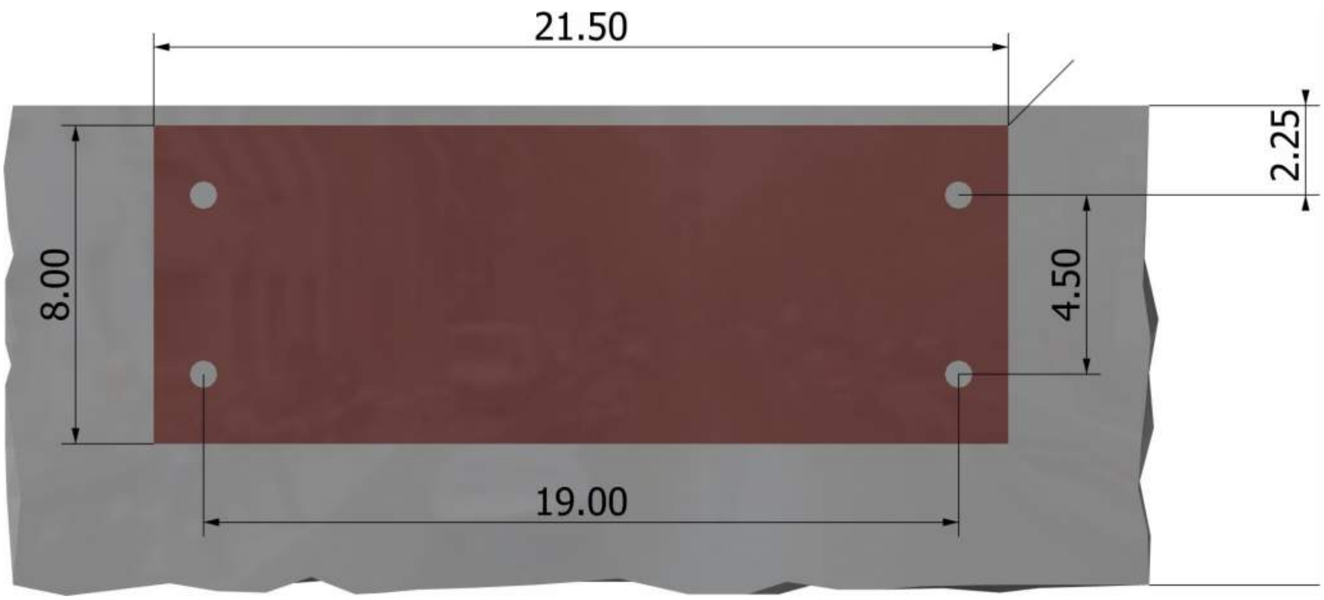
<Figure 1>



SIMPSON Strong-Tie Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	3/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



Anchor Designer™
Software
Version 2.9.7376.0

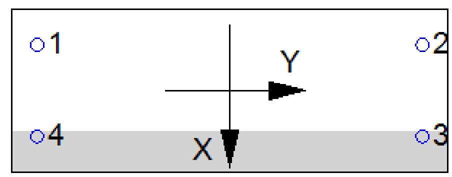
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	4/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	826.9	62.0	0.0	62.0
2	826.9	62.0	0.0	62.0
3	0.0	62.0	0.0	62.0
4	0.0	62.0	0.0	62.0
Sum	1653.8	248.0	0.0	248.0

Maximum concrete compression strain (‰): 0.04
Maximum concrete compression stress (psi): 186
Resultant tension force (lb): 1654
Resultant compression force (lb): 3997
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
292.50	225.00	2.25	1.000	0.790	1.00	1.000	9503	0.65	4758

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	$\tau_{k,cr}$ (psi)
435	1.00	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na}/A_{Na0})\,\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
205.79	150.57	6.14	2.25	1.000	0.810	1.000	4271	0.55	1950

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7730	0.8	0.65	0.75	3015

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	316.22	150.57	0.810	1.000	1.000	4271	7265

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
427.50	225.00	1.000	0.790	1.000	1.000	9503	14264	0.70

ϕV_{cpg} (lb)
10171

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	827	9660	0.09	Pass
Concrete breakout	1654	4758	0.35	Pass
Adhesive	**1654**	**1950**	**0.85**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	62	3015	0.02	Pass
Pryout	**248**	**10171**	**0.02**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.85	0.00	84.8%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6L

Project description:
Location: Herriman, UT
Fastening description: Aftbay Single Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 8.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™
Software
Version 2.9.7376.0

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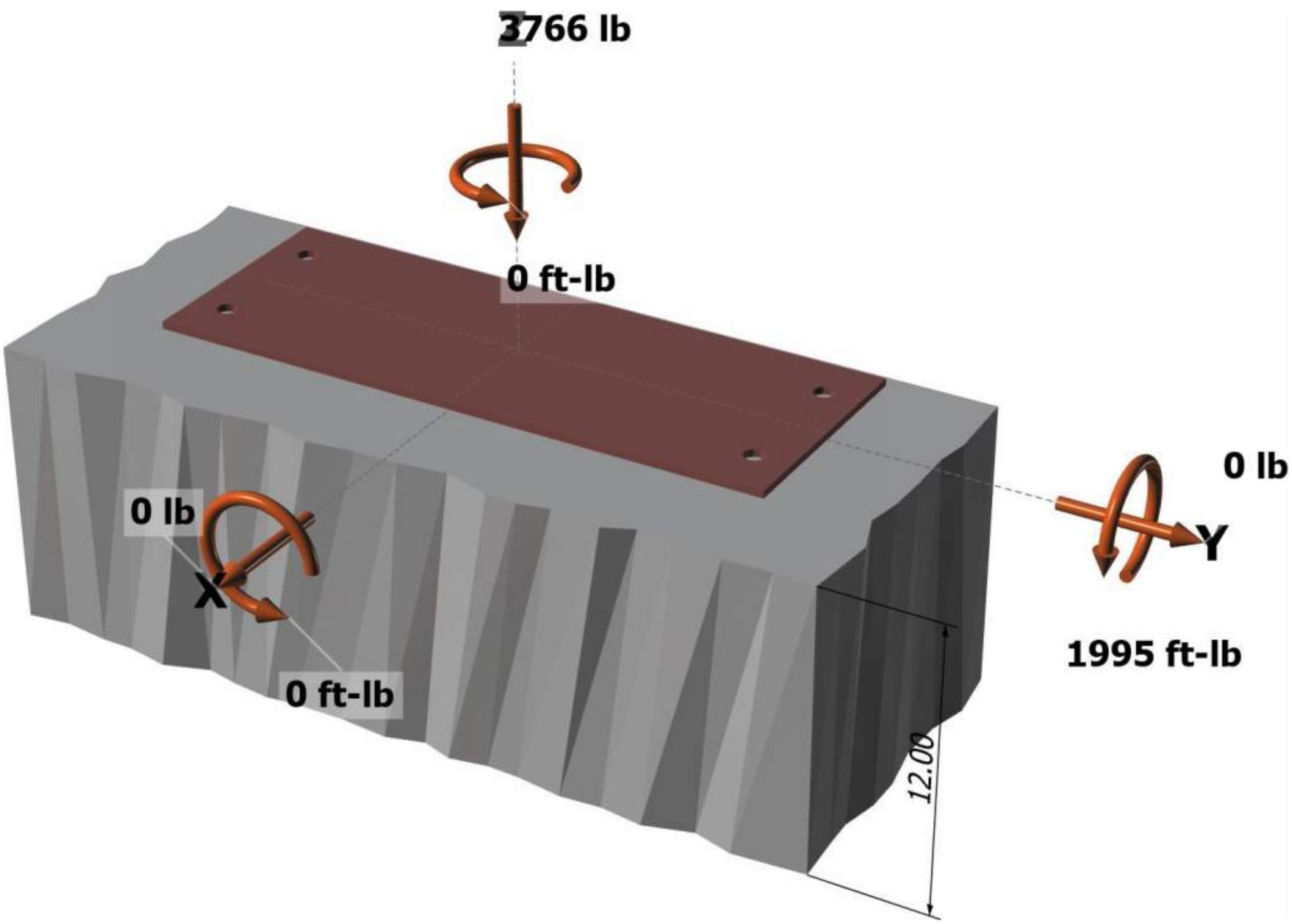
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -3766
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1995
M_{uz} [ft-lb]: 0

<Figure 1>



Anchor Designer™
Software
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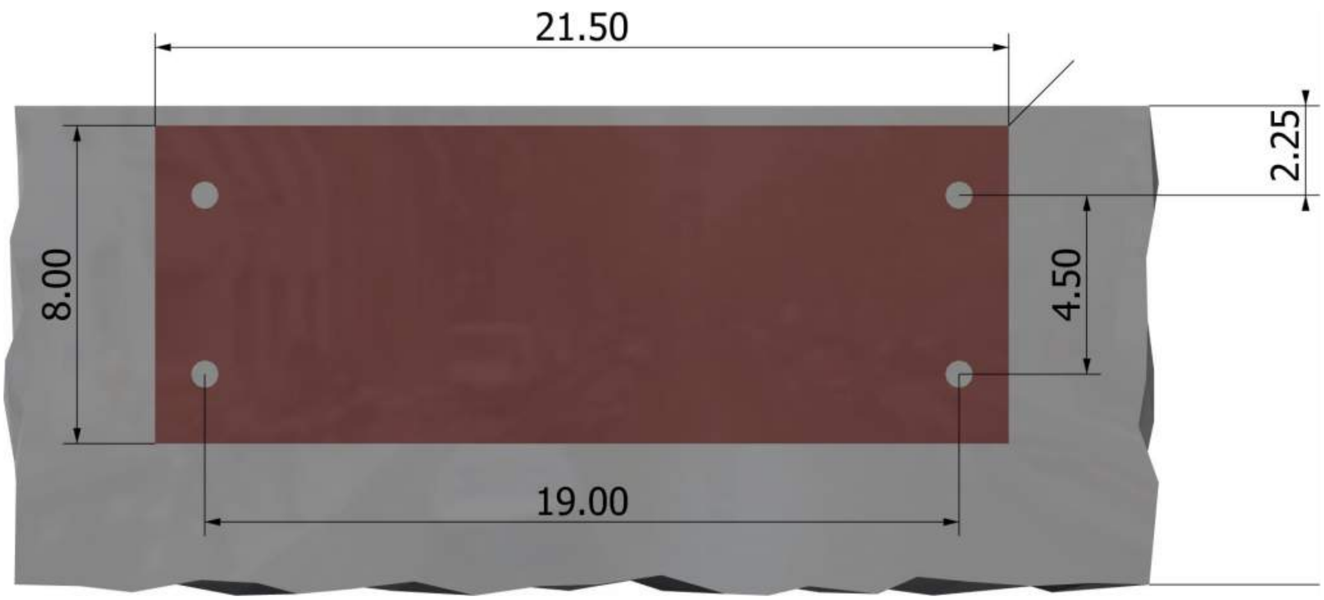
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

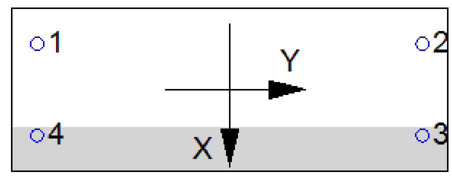
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1041.3	0.0	0.0	0.0
2	1041.3	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	2082.7	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.06
Maximum concrete compression stress (psi): 256
Resultant tension force (lb): 2083
Resultant compression force (lb): 5850
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
292.50	225.00	2.25	1.000	0.790	1.00	1.000	9503	0.65	6344

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
205.79	150.57	6.14	2.25	1.000	0.810	1.000	4271	0.55	2600

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1041	9660	0.11	Pass
Concrete breakout	2083	6344	0.33	Pass
Adhesive	**2083**	**2600**	**0.80**	**Pass (Governs)**

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

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STRUCTURAL ENGINEERS
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PROJECT HERRIMAN, UT WTP

JOB NO. J211052 BY GJE

△ 5/25/22

DATE 1/6/22 PAGE 201

FOREBAY DUAL OUTPUT DRIVE

LOADS

D

WEIGHT OF DRIVE BASE – 42 lb

WEIGHT OF DRIVE – 287 lb + 40 lb = 327 lb △

WEIGHT OF SPROCKET ASSEMBLY – 69 lb

438 lb ↓

L

DRIVE CP – 1749 lb ↓ △

DRIVE CHAIN – 20 ft (1.4 lb) = 28 lb ↓

W

$q_z G C_f$ = 24.46 psf (0.85)(1.6) = 33.3 psf

33.3 psf (1.25 ft)(3.2 ft) = 134 lb @ 0.7 ft ↙↗

M = 94 lb·ft EITHER DIRECTION

E △

F_p = 0.428(438 lb) = 188 lb ↙↗

E_v = 0.2(0.95)(438 lb) = 83 lb ↕

NO HYDRODYNAMIC FORCES

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JOB NO. J211052 BY GJG

△ 5/25/22

DATE 1/10/22 PAGE 202

LOAD COMBINATIONS – LRFD △

1.4D

$1.4(438\ lb) = 613\ lb \downarrow$

1.2D+1.6L

$1.2(438\ lb)+1.6(1749\ lb+28\ lb) = 3369\ lb \downarrow$

$M = 1.6(1749\ lb+28\ lb)(8") = 22746\ lb\cdot in = 1896\ lb\cdot ft$

1.2D+W+L

$1.2(438\ lb)+(1749\ lb+28\ lb) = 2303\ lb$

$134\ lb \nearrow$

$M = (1749\ lb+28\ lb)(8")+94\ lb\cdot ft\left(\frac{12"}{1'}\right) = 15344\ lb\cdot in = 1279\ lb\cdot ft$

$(1.2+0.2S_{DS})D+\Omega_o E+L$

$[1.2+0.2(0.95)](438\ lb)+(1749\ lb+28\ lb) = 2386\ lb \downarrow$

$2(188\ lb) = 376\ lb \nearrow$

$M = (1749\ lb+28\ lb)(8")+2(188\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 17375\ lb\cdot in = 1448\ lb\cdot ft$

$(0.9-0.2S_{DS})D+\Omega_o E+L$

$[0.9-0.2(0.95)](438\ lb)+(1749\ lb+28\ lb) = 2088\ lb \downarrow$

$2(188\ lb) = 376\ lb \nearrow$

$M = (1749\ lb+28\ lb)(8")+2(188\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 17375\ lb\cdot in = 1448\ lb\cdot ft$

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP

SPACING 19" & 4.5", 3.25" EDGE DISTANCE

ANCHORS ARE OK AT 5" EMBEDMENT

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 0.9D + E + L

Project description:
Location: Herriman, UT
Fastening description: Forebay Dual Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 9.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie®

Anchor Designer™
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Version 2.9.7376.0

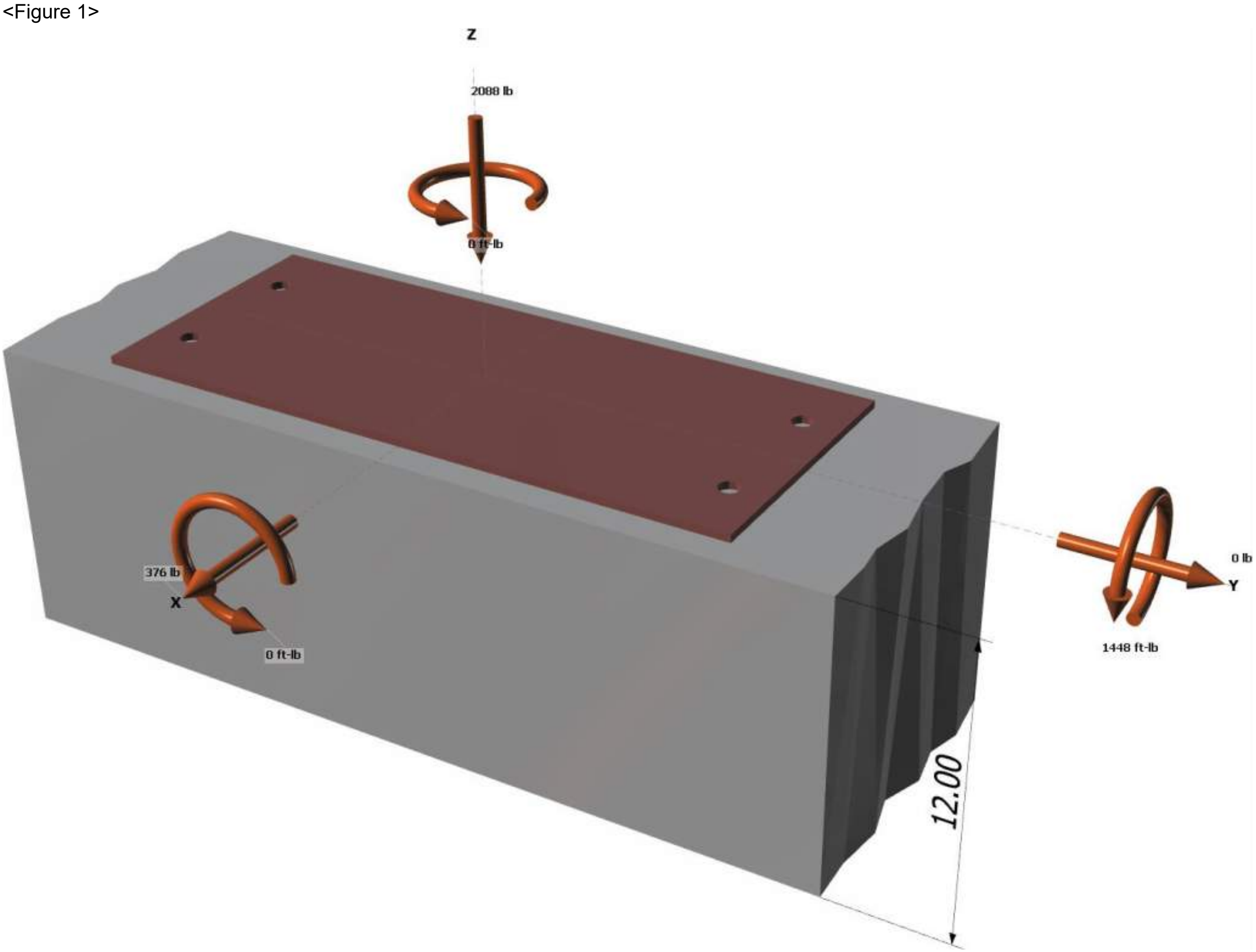
Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	2/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -2088
V_{uax} [lb]: 376
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1448
M_{uz} [ft-lb]: 0

<Figure 1>



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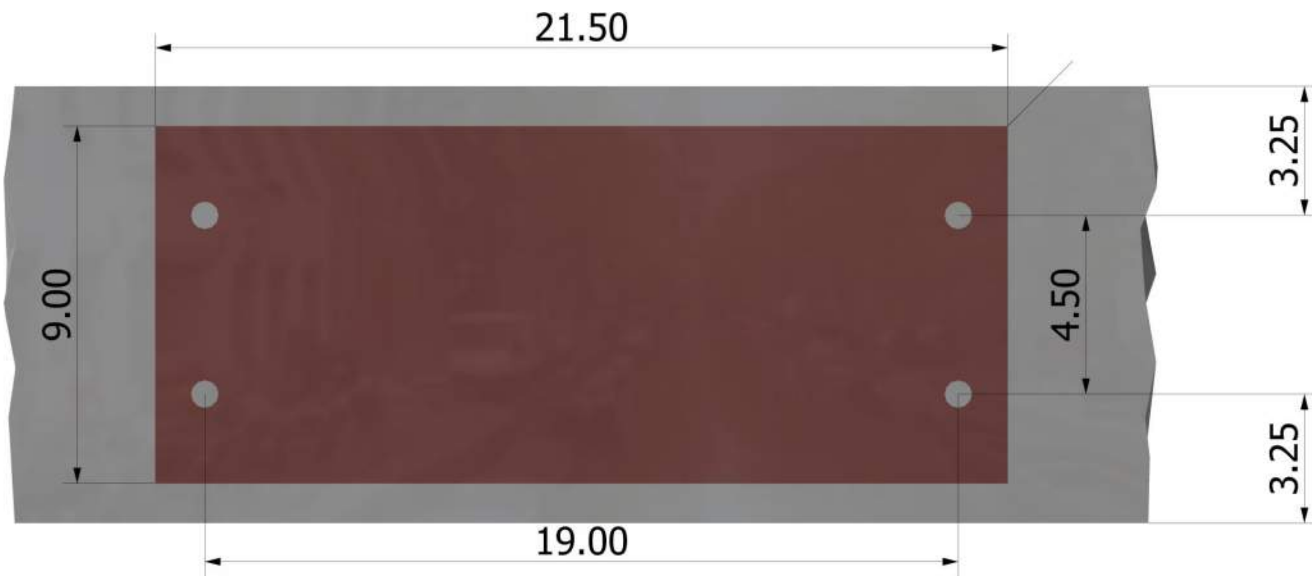
E-mail:	gevers@csd-eng.com		

<Figure 2>



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Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	4/6
Project:	Herriman, UT WTP		
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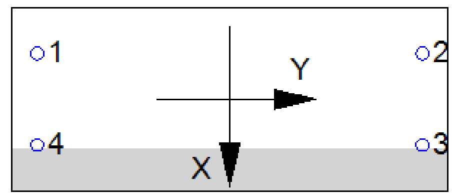
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	771.3	94.0	0.0	94.0
2	771.3	94.0	0.0	94.0
3	27.1	94.0	0.0	94.0
4	27.1	94.0	0.0	94.0
Sum	1596.7	376.0	0.0	376.0

Maximum concrete compression strain (‰): 0.04
Maximum concrete compression stress (psi): 164
Resultant tension force (lb): 1597
Resultant compression force (lb): 3685
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 2.10
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
330.00	225.00	3.25	0.781	0.830	1.00	1.000	9503	0.65	4407

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	$\tau_{k,cr}$ (psi)
435	1.00	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na}/A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
269.95	150.57	6.14	3.25	0.745	0.859	1.000	4271	0.55	2022

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7730	0.8	0.65	0.75	3015

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
5.00	0.625	1.00	3000	3.25	2692

$\phi V_{cbgx} = \phi\ (A_{Vc} / A_{Vco})\ \Psi_{ec,V}\ \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in²)	A_{Vco} (in²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
95.06	47.53	1.000	1.000	1.000	1.000	2692	0.70	3769

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi\min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi\min|k_{cp}(A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in²)	A_{Na0} (in²)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	269.95	150.57	0.859	1.000	1.000	4271	6577

A_{Nc} (in²)	A_{Nco} (in²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
330.00	225.00	1.000	0.830	1.000	1.000	9503	11569	0.70

ϕV_{cpg} (lb)
9207

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	771	9660	0.08	Pass
Concrete breakout	1597	4407	0.36	Pass
Adhesive	**1597**	**2022**	**0.79**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	94	3015	0.03	Pass
T Concrete breakout x+	**188**	**3769**	**0.05**	**Pass (Governs)**
Pryout	376	9207	0.04	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.79	0.00	79.0%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Anchor Designer™
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Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6L

Project description:
Location: Herriman, UT
Fastening description: Forebay Dual Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 9.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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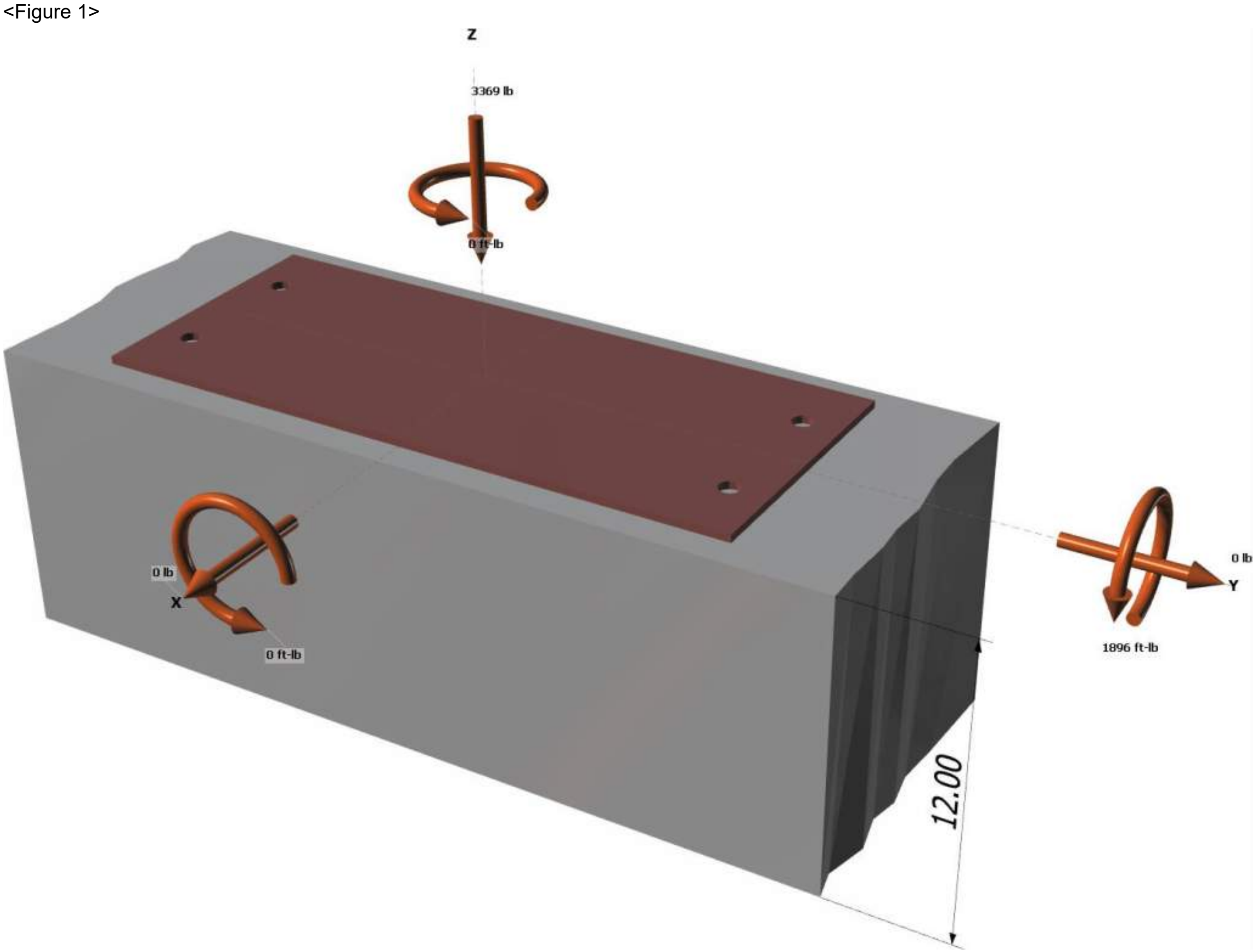
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -3369
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1896
M_{uz} [ft-lb]: 0

<Figure 1>



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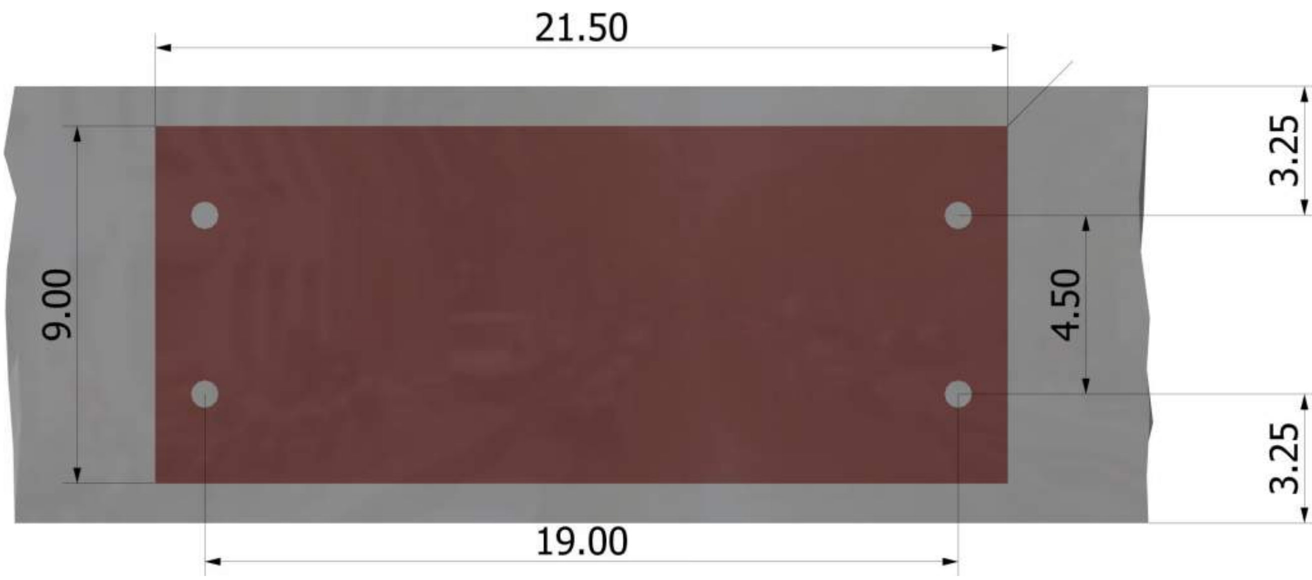
<Figure 2>



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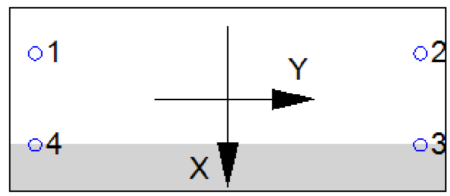
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	848.2	0.0	0.0	0.0
2	848.2	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	1696.4	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.05
Maximum concrete compression stress (psi): 206
Resultant tension force (lb): 1696
Resultant compression force (lb): 5064
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
322.50	225.00	3.25	1.000	0.830	1.00	1.000	9503	0.65	7349

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
230.33	150.57	6.14	3.25	1.000	0.859	1.000	4271	0.55	3086

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	5/25/2022
Engineer:	GJE	Page:	5/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	848	9660	0.09	Pass
Concrete breakout	1696	7349	0.23	Pass
Adhesive	**1696**	**3086**	**0.55**	**Pass (Governs)**

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

FOREBAY SINGLE OUTPUT DRIVE

LOADS

D
WEIGHT OF DRIVE BASE – 26 lb
WEIGHT OF DRIVE – 154 lb + 40 lb = 194 lb △1
WEIGHT OF SPROCKET ASSEMBLY – 69 lb
289 lb ↓

L
DRIVE CP – 1749 lb ↓
DRIVE CHAIN – 20 ft (1.4 plf) = 28 lb ↓

W
$q_z GC_f$ = 24.46 psf (0.85)(1.6) = 33.3 psf
33.3 psf (1.25 ft)(3.0 ft) = 125 lb @ 0.7 ft ↕
M = 88 lb·ft EITHER DIRECTION

E
F_p = 0.428 (289 lb) = 124 lb @ 0.7 ft ↕
E_V = 0.2 (0.95)(289 lb) = 55 lb ↕
NO HYDRODYNAMIC FORCES

LOAD COMBINATIONS – LRFD △

1.4D

1.4(289 lb) = 405 lb ↓

1.2D + 1.6L

1.2(289 lb) + 1.6(1749 lb + 28 lb) = 3190 lb ↓

M = 1.6(1749 lb + 28 lb)(7.25") = 20614 lb·in = 1718 lb·ft

1.2D + W + L

1.2(289 lb) + (1749 lb + 28 lb) = 2124 lb ↓

125 lb ↙

$M = (1749\ lb + 28\ lb)(7.25") + 88\ lb\cdot ft\left(\frac{12"}{1'}\right) = 13940\ lb\cdot in = 1162\ lb\cdot ft$

$(1.2 + 0.2S_{DS})D + \Omega_0 E + L$

[1.2 + 0.2(0.95)](289 lb) + (1749 lb + 28 lb) = 2179 lb ↓

2(124 lb) = 248 lb ↙

$M = (1749\ lb + 28\ lb)(7.25") + 2(124\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 14967\ lb\cdot in = 1248\ lb\cdot ft$

$(0.9 - 0.2S_{DS})D + \Omega_0 E + L$

[0.9 – 0.2(0.95)](289 lb) + (1749 lb + 28 lb) = 1982 lb ↓

2(124 lb) = 248 lb ↙

$M = (1749\ lb + 28\ lb)(7.25") + 2(124\ lb)(0.7\ ft)\left(\frac{12"}{1'}\right) = 14967\ lb\cdot in = 1248\ lb\cdot ft$

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP

SPACING 19" & 4.5", 2.5" EDGE DISTANCE

ANCHORS ARE OK AT 5" EMBEDMENT

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 0.9D + E + L

Project description:
Location: Herriman, UT
Fastening description: Forebay Single Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 8.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

Anchor Designer™ Software
Version 2.9.7376.0

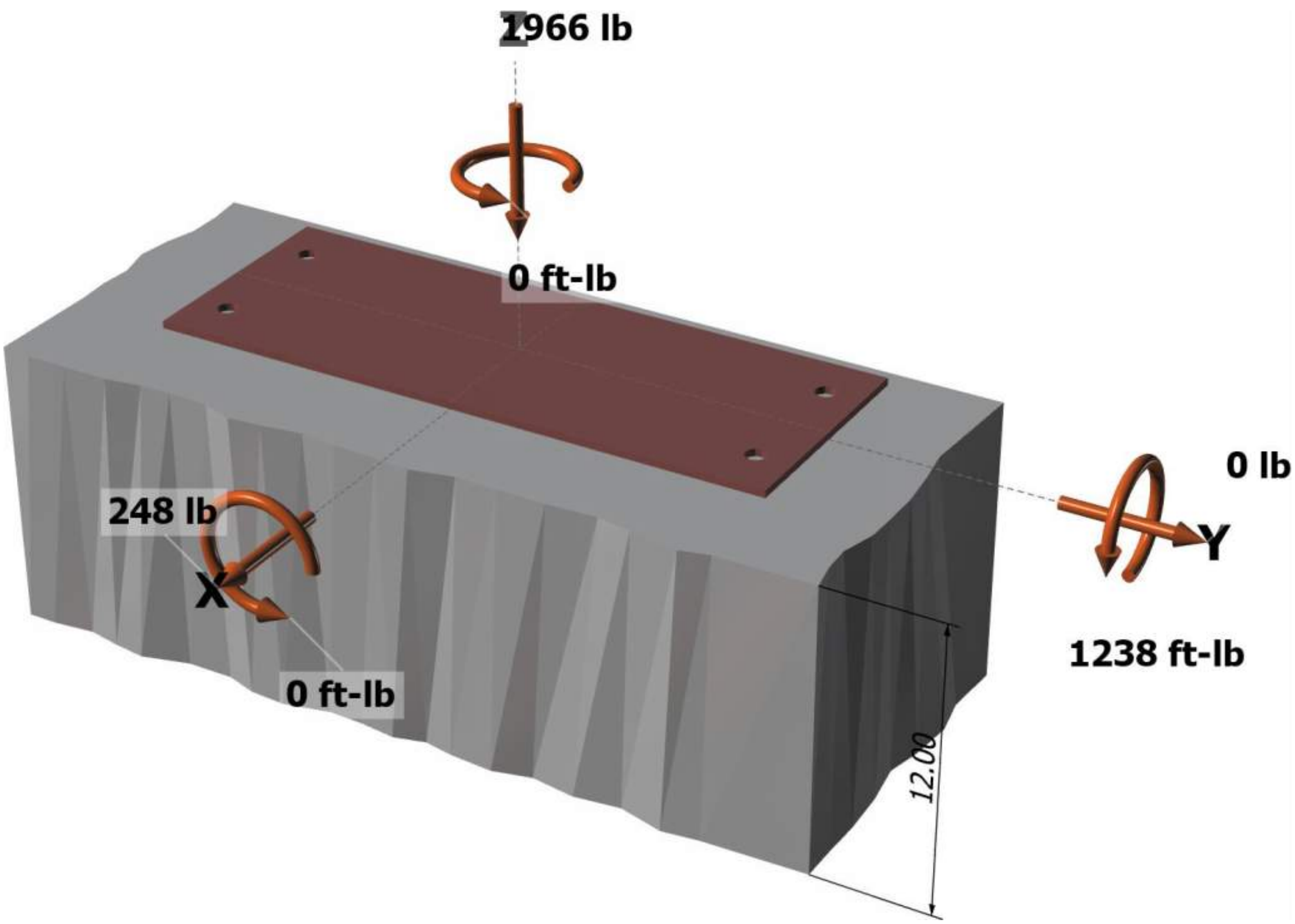
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -1966
V_{uax} [lb]: 248
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1238
M_{uz} [ft-lb]: 0

<Figure 1>



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Version 2.9.7376.0

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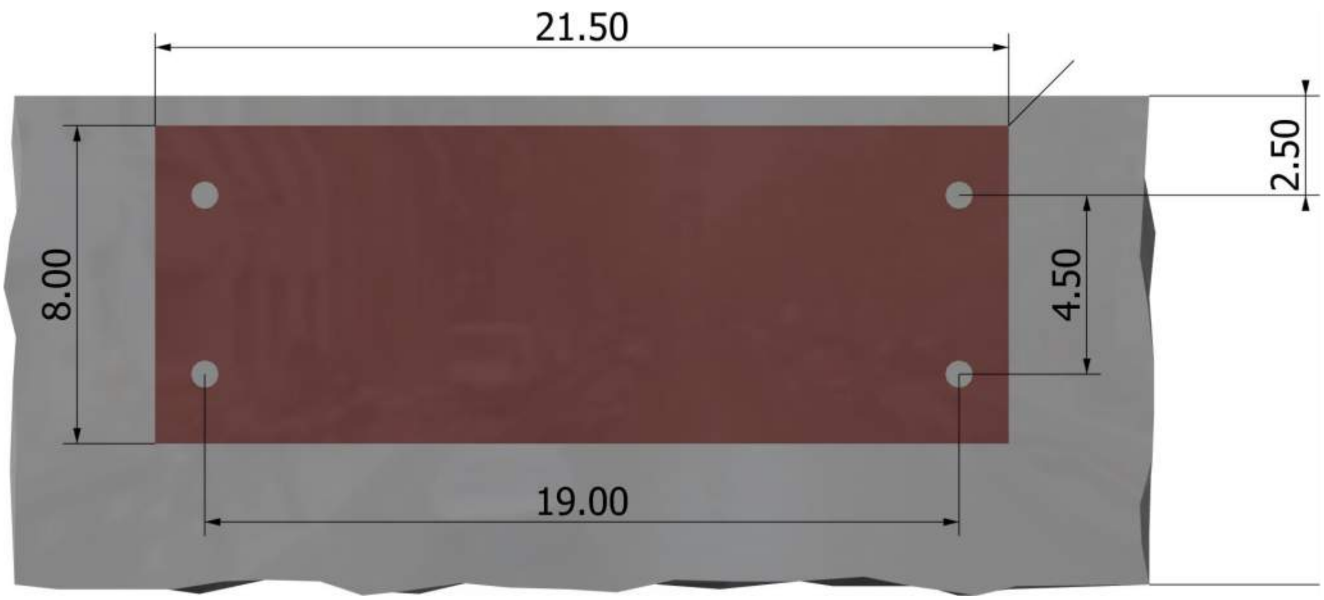
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



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Engineer:	GJE	Page:	4/6
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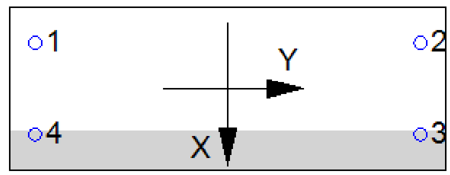
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	740.8	62.0	0.0	62.0
2	740.8	62.0	0.0	62.0
3	0.0	62.0	0.0	62.0
4	0.0	62.0	0.0	62.0
Sum	1481.5	248.0	0.0	248.0

Maximum concrete compression strain (‰): 0.04
Maximum concrete compression stress (psi): 163
Resultant tension force (lb): 1482
Resultant compression force (lb): 3449
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
300.00	225.00	2.50	1.000	0.800	1.00	1.000	9503	0.65	4942

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	$\tau_{k,cr}$ (psi)
435	1.00	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na}/A_{Na0})\,\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
211.92	150.57	6.14	2.50	1.000	0.822	1.000	4271	0.55	2039

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7730	0.8	0.65	0.75	3015

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	322.36	150.57	0.822	1.000	1.000	4271	7518

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
435.00	225.00	1.000	0.800	1.000	1.000	9503	14698	0.70

ϕV_{cpg} (lb)
10525

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	741	9660	0.08	Pass
Concrete breakout	1482	4942	0.30	Pass
Adhesive	**1482**	**2039**	**0.73**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	62	3015	0.02	Pass
Pryout	**248**	**10525**	**0.02**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.73	0.00	72.7%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6L

Project description:
Location: Herriman, UT
Fastening description: Forebay Single Output Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 8.00 x 21.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 2.9.7376.0

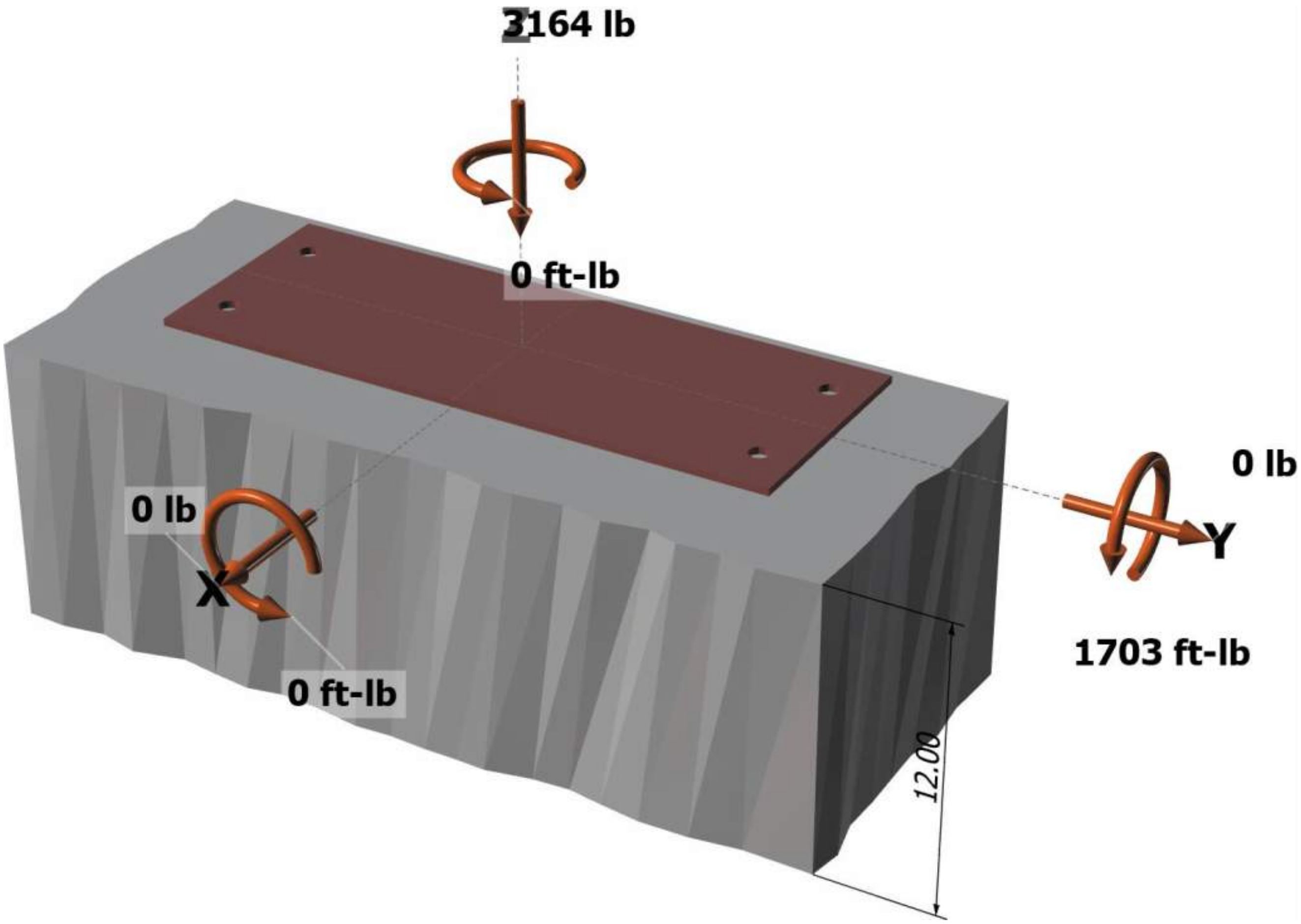
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	2/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -3164
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1703
M_{uz} [ft-lb]: 0

<Figure 1>



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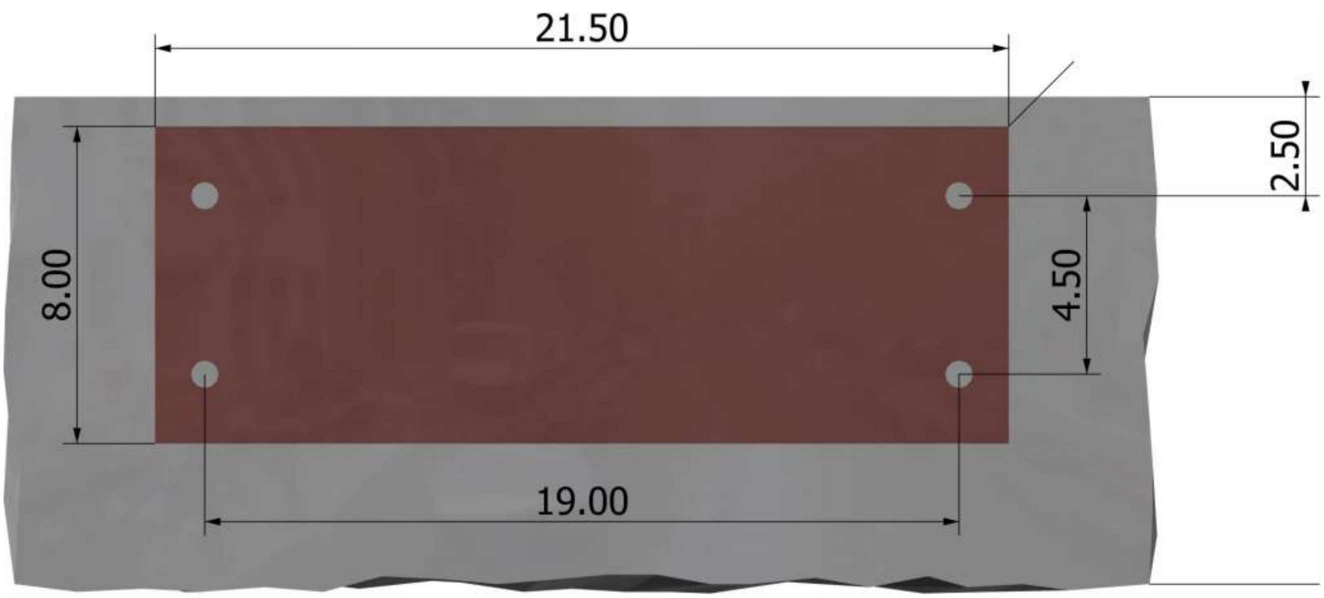
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>

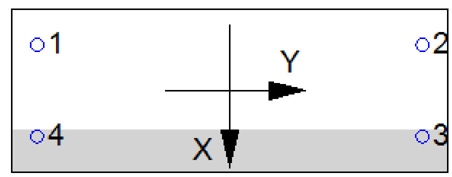


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	902.7	0.0	0.0	0.0
2	902.7	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	1805.5	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.05
Maximum concrete compression stress (psi): 219
Resultant tension force (lb): 1805
Resultant compression force (lb): 4971
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
300.00	225.00	2.50	1.000	0.800	1.00	1.000	9503	0.65	6589

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\,(A_{Na}/A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
211.92	150.57	6.14	2.50	1.000	0.822	1.000	4271	0.55	2718

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Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	903	9660	0.09	Pass
Concrete breakout	1805	6589	0.27	Pass
Adhesive	**1805**	**2718**	**0.66**	**Pass (Governs)**

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

CROSS COLLECTOR DRIVE

LOADS

D

WEIGHT OF DRIVE BASE – 24 lb
WEIGHT OF DRIVE – 104 lb + 40 lb = 144 lb △1
WEIGHT OF SPROCKET ASSEMBLY – 69 lb
237 lb ↓

L

DRIVE CP – 826 lb ↓
DRIVE CHAIN – 20 ft (1.4 plf) = 28 lb ↓

W

$q_z G C_f = 24.46$ psf$(0.85)(1.6) = 33.3$ psf
33.3 psf (2.25 ft)(3.5 ft) = 263 lb @ 1.2 ft ↗
M = 316 lb·ft EITHER DIRECTION

E

$F_p = 0.428(237 \text{ lb}) = 101$ lb ↗
$E_V = 0.2(0.95)(237 \text{ lb}) = 45$ lb ↕

NO HYDRODYNAMIC FORCES

LOAD COMBINATIONS – LRFD △1

1.4D
$1.4(237\text{ lb}) = 332\text{ lb}\ \downarrow$

1.2D+1.6L
$1.2(237\text{ lb}) + 1.6(826\text{ lb} + 28\text{ lb}) = 1651\text{ lb}\ \downarrow$
$M = 1.6(826\text{ lb} + 28\text{ lb})(10") = 13664\text{ lb}\cdot\text{in} = 1139\text{ lb}\cdot\text{ft}$

1.2D + W + L
$1.2(237\text{ lb}) + (826\text{ lb} + 28\text{ lb}) = 1138\text{ lb}\ \downarrow$
$263\text{ lb}\ \nearrow$
$M = (826\text{ lb} + 28\text{ lb})(10") + 316\text{ lb}\cdot\text{ft}\left(\frac{12"}{1'}\right) = 12332\text{ lb}\cdot\text{in} = 1028\text{ lb}\cdot\text{ft}$

$(1.2 + 0.2S_{DS})D + \Omega_0 E + L$
$[1.2 + 0.2(0.95)](237\text{ lb}) + (826\text{ lb} + 28\text{ lb}) = 1183\text{ lb}\ \downarrow$
$2(101\text{ lb}) = 202\text{ lb}\ \nearrow$
$M = (826\text{ lb} + 28\text{ lb})(10") + 2(101\text{ lb})(1.2\text{ ft})\left(\frac{12"}{1'}\right) = 11449\text{ lb}\cdot\text{in} = 954\text{ lb}\cdot\text{ft}$

$(0.9 - 0.2S_{DS})D + \Omega_0 E + L$
$[0.9 - 0.2(0.95)](237\text{ lb}) + (826\text{ lb} + 28\text{ lb}) = 1022\text{ lb}\ \downarrow$
$2(101\text{ lb}) = 202\text{ lb}\ \nearrow$
$M = (826\text{ lb} + 28\text{ lb})(10") + 2(101\text{ lb})(1.2\text{ ft})\left(\frac{12"}{1'}\right) = 11449\text{ lb}\cdot\text{in} = 954\text{ lb}\cdot\text{ft}$

CHECK 5/8" DIA. 316 SS ANCHOR RODS USING SIMPSON SET-XP

SPACING 16" & 9", 3.0" EDGE DISTANCE

ANCHORS ARE OK AT 5" EMBEDMENT

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	1/6
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 0.9D + E + L

Project description:
Location: Herriman, UT
Fastening description: Cross Collector Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 14.25 x 18.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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Version 2.9.7376.0

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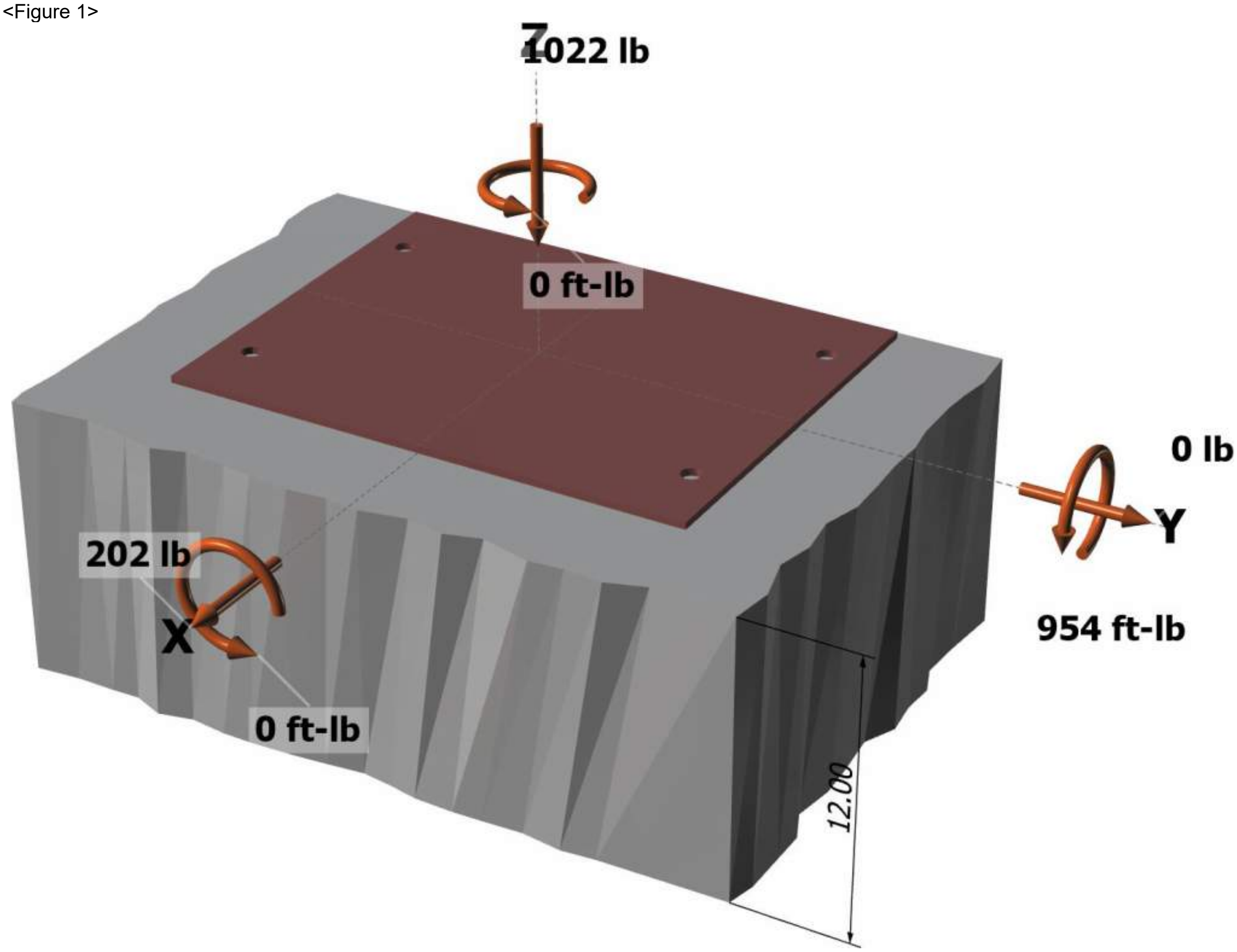
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -1022
V_{uax} [lb]: 202
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 954
M_{uz} [ft-lb]: 0

<Figure 1>



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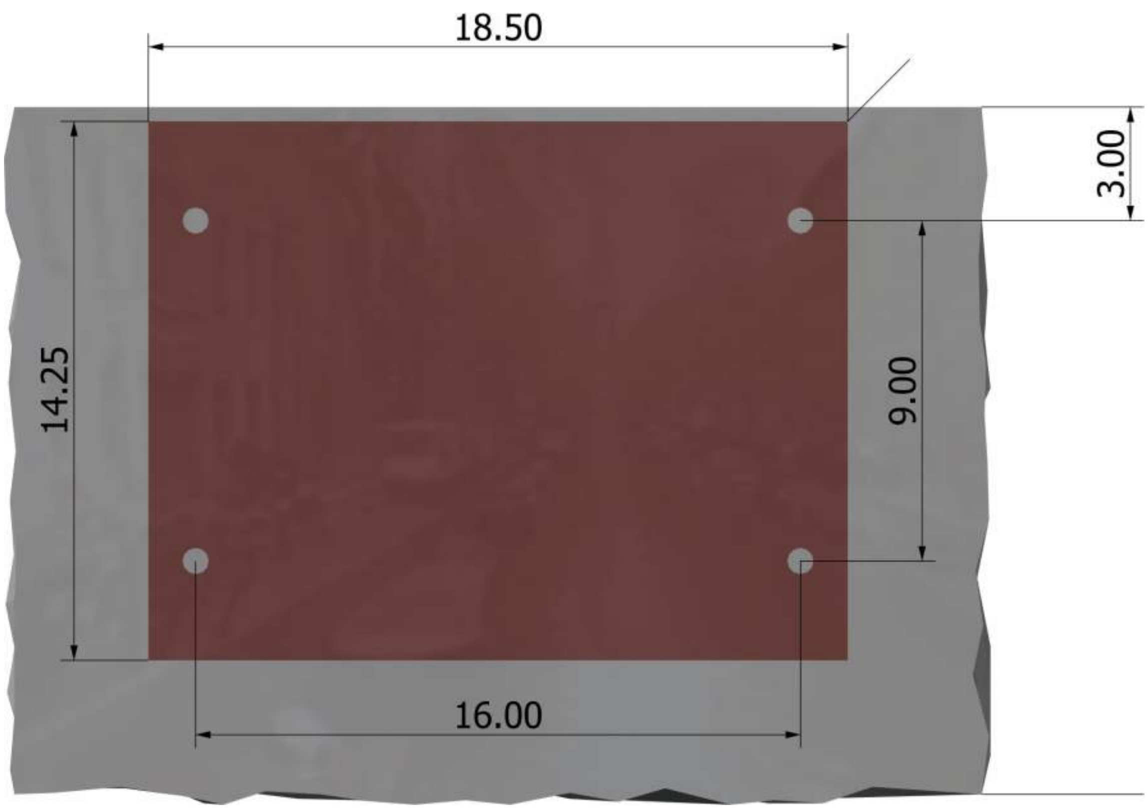
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



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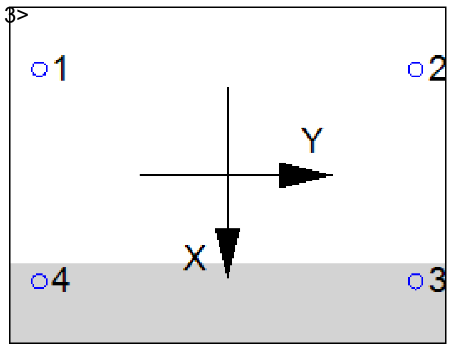
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	252.6	50.5	0.0	50.5
2	252.6	50.5	0.0	50.5
3	0.0	50.5	0.0	50.5
4	0.0	50.5	0.0	50.5
Sum	505.2	202.0	0.0	202.0

Maximum concrete compression strain (‰): 0.01
Maximum concrete compression stress (psi): 49
Resultant tension force (lb): 505
Resultant compression force (lb): 1527
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
315.00	225.00	3.00	1.000	0.820	1.00	1.000	9503	0.65	5319

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	$\tau_{k,cr}$ (psi)
435	1.00	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\,\Psi_{ed,Na}\,\Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
224.19	150.57	6.14	3.00	1.000	0.847	1.000	4271	0.55	2221

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Phone:			
E-mail:	gevers@csd-eng.com		

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
7730	0.8	0.65	0.75	3015

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	445.06	150.57	0.847	1.000	1.000	4271	10688

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
585.00	225.00	1.000	0.820	1.000	1.000	9503	20261	0.70

ϕV_{cpg} (lb)
14963

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	253	9660	0.03	Pass
Concrete breakout	505	5319	0.09	Pass
Adhesive	**505**	**2221**	**0.23**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	**51**	**3015**	**0.02**	**Pass (Governs)**
Pryout	202	14963	0.01	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.23	0.00	22.7%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

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Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

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Anchor Designer™
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Company:	CSD	Date:	3/17/2022
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Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + 1.6L

Project description:
Location: Herriman, UT
Fastening description: Cross Collector Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 14.25 x 18.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

SIMPSON Strong-Tie® Anchor Designer™ Software
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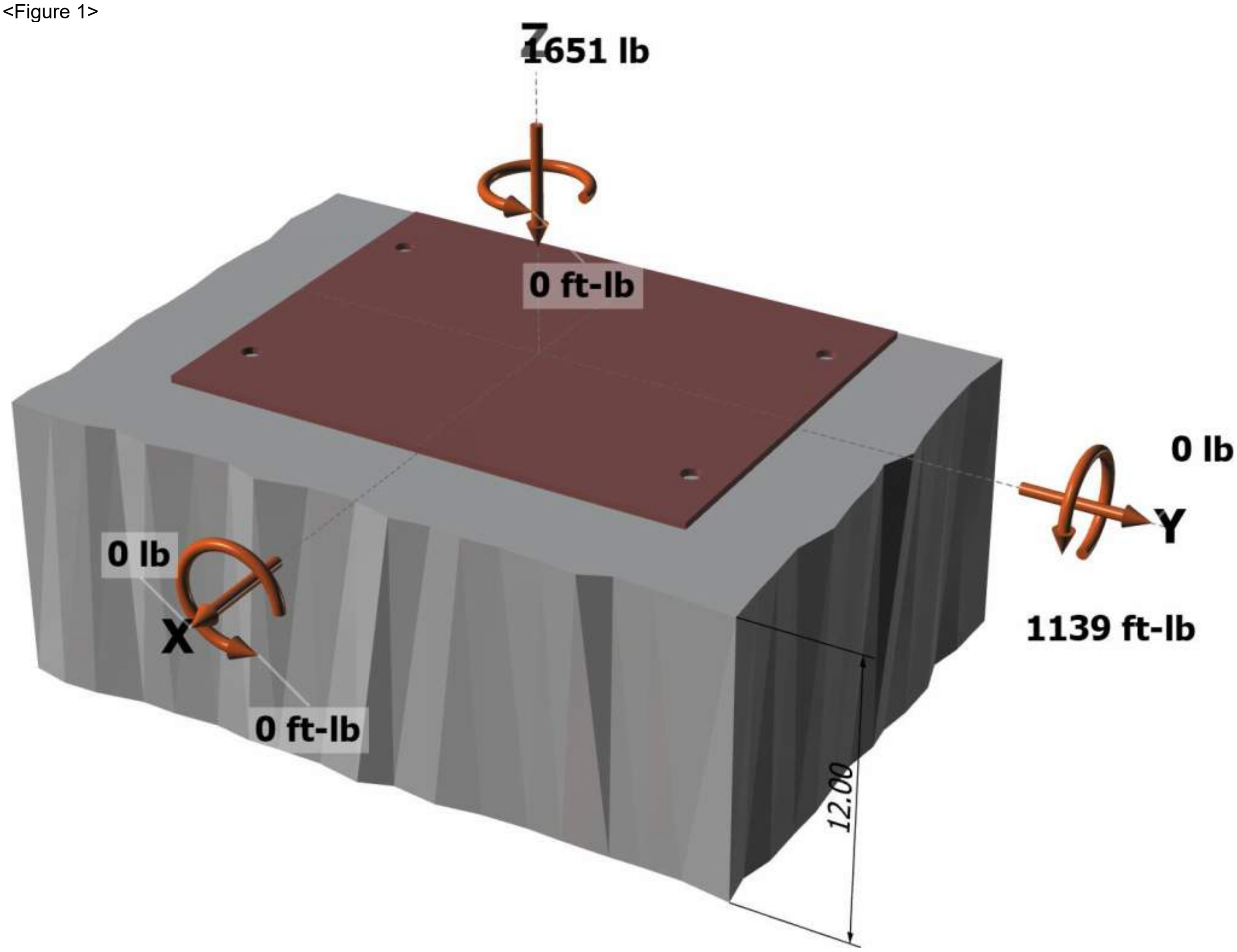
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -1651
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1139
M_{uz} [ft-lb]: 0

<Figure 1>



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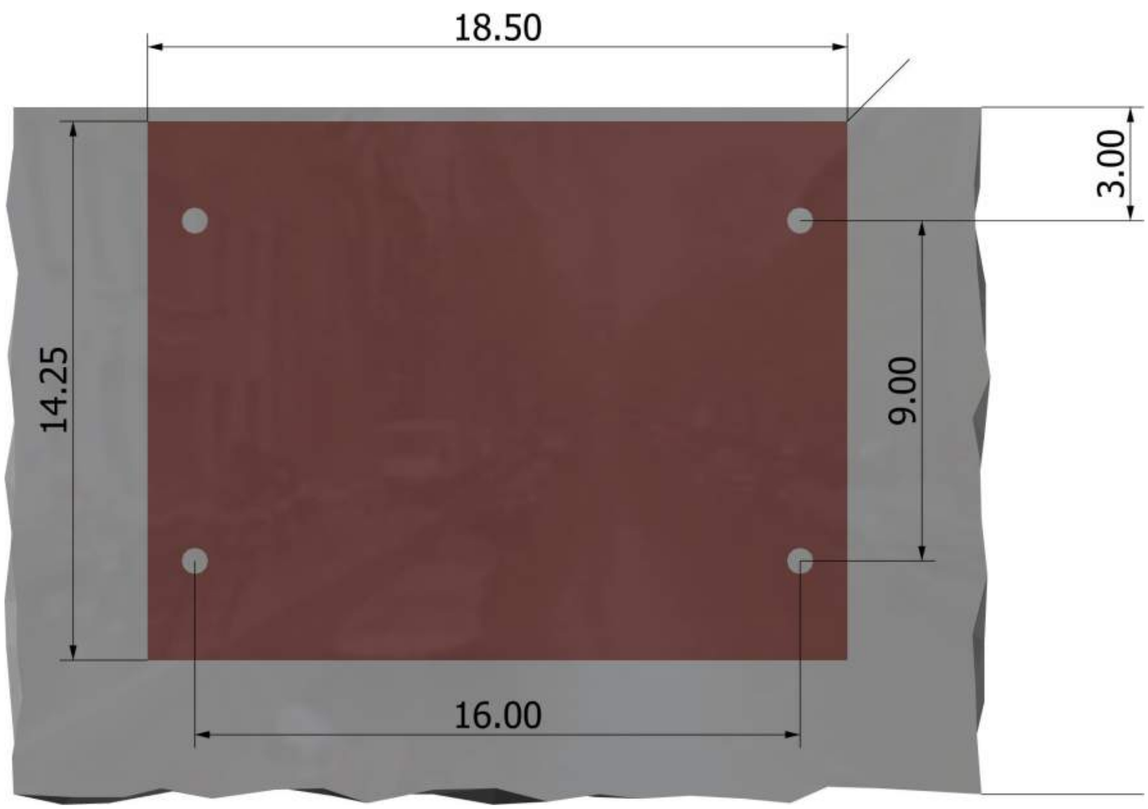
E-mail:	gevers@csd-eng.com		

<Figure 2>



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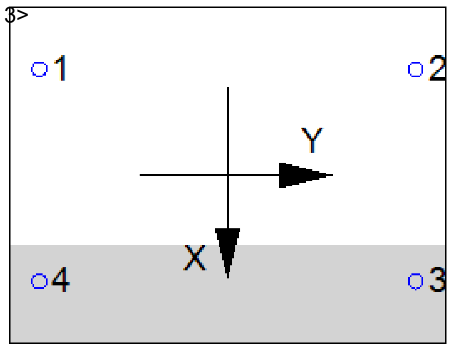
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	203.9	0.0	0.0	0.0
2	203.9	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
Sum	407.9	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.01
Maximum concrete compression stress (psi): 54
Resultant tension force (lb): 408
Resultant compression force (lb): 2059
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\ (A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
315.00	225.00	3.00	1.000	0.820	1.00	1.000	9503	0.65	7091

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\ (A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
224.19	150.57	6.14	3.00	1.000	0.847	1.000	4271	0.55	2961

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Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	204	9660	0.02	Pass
Concrete breakout	408	7091	0.06	Pass
Adhesive	**408**	**2961**	**0.14**	**Pass (Governs)**

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.

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Anchor Designer™ Software
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Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

1.Project information

Customer company: Evoqua Water Technologies
Customer contact name:
Customer e-mail:
Comment: 1.2D + W + L

Project description:
Location: Herriman, UT
Fastening description: Cross Collector Drive

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: A193 Grade B8/B8M (304/316SS)
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 5.000
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 8.13
c_{ac} (inch): 6.85
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Periodic
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: Yes

Base Plate
Length x Width x Thickness (inch): 14.25 x 18.50 x 0.25

Recommended Anchor
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS)
Code Report: ICC-ES ESR-2508

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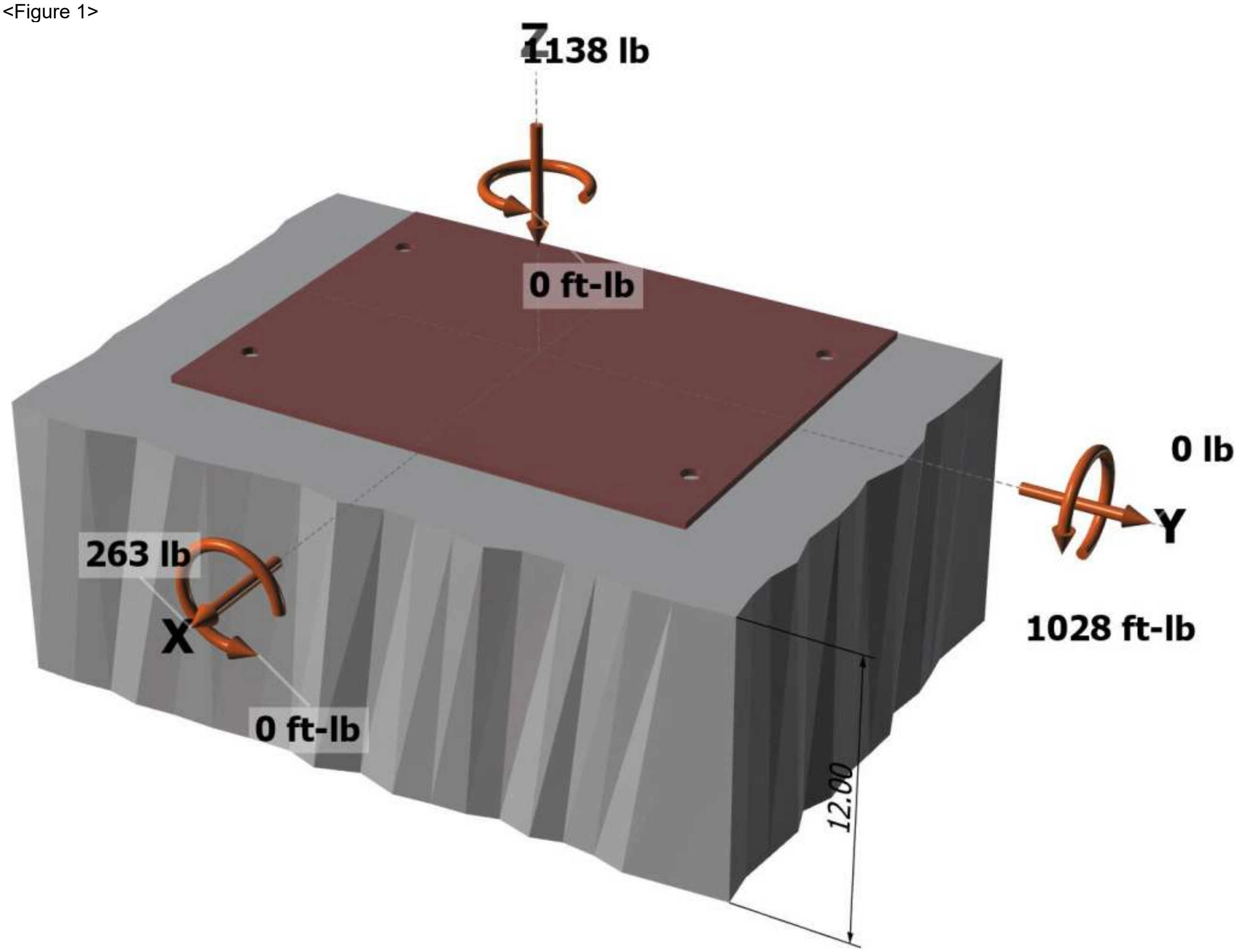
Phone:			
E-mail:	gevers@csd-eng.com		

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: No
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -1138
V_{uax} [lb]: 263
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 1028
M_{uz} [ft-lb]: 0

<Figure 1>



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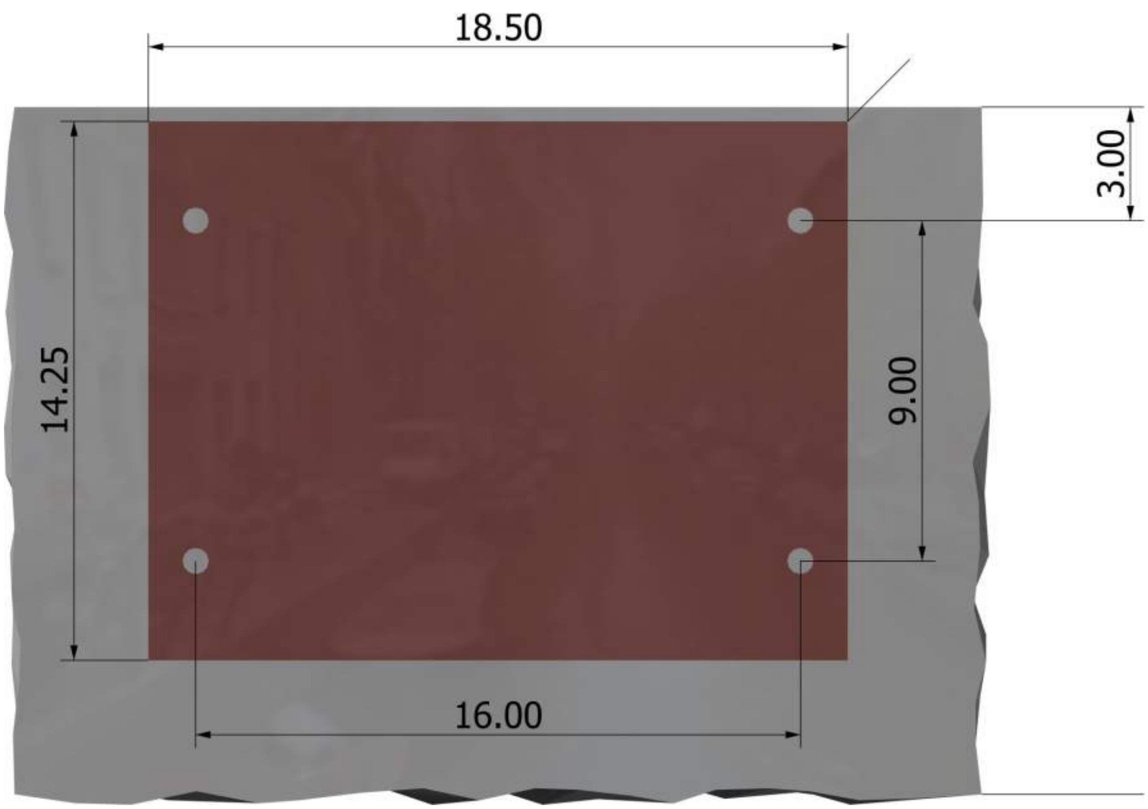
Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	3/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 2.9.7376.0

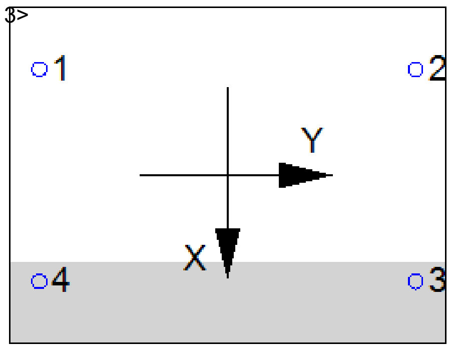
Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	4/5
Project:	Herriman, UT WTP		
Address:	8989 N. Port Washington Rd. Milwaukee WI		
Phone:			
E-mail:	gevers@csd-eng.com		

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	263.6	65.8	0.0	65.8
2	263.6	65.8	0.0	65.8
3	0.0	65.8	0.0	65.8
4	0.0	65.8	0.0	65.8
Sum	527.3	263.0	0.0	263.0

Maximum concrete compression strain (‰): 0.01
Maximum concrete compression stress (psi): 53
Resultant tension force (lb): 527
Resultant compression force (lb): 1665
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
12880	0.75	9660

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	5.000	9503

$\phi N_{cbg} = \phi\ (A_{Nc} / A_{Nco})\ \Psi_{ec,N}\ \Psi_{ed,N}\ \Psi_{c,N}\ \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
315.00	225.00	3.00	1.000	0.820	1.00	1.000	9503	0.65	7091

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\tau_{k,cr}$ (psi)
435	1.00	1.00	435

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	435	0.63	5.000	4271

$\phi N_{ag} = \phi\ (A_{Na} / A_{Na0})\ \Psi_{ec,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	ϕN_{ag} (lb)
224.19	150.57	6.14	3.00	1.000	0.847	1.000	4271	0.55	2961

Anchor Designer™ Software
Version 2.9.7376.0

Company:	CSD	Date:	3/17/2022
Engineer:	GJE	Page:	5/5
Project:	Herriman, UT WTP		
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Phone:			
E-mail:	gevers@csd-eng.com		

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
7730	0.8	0.65	4020

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\,;\,k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na}/A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\,;\,k_{cp}(A_{Nc}/A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	445.06	150.57	0.847	1.000	1.000	4271	10688

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
585.00	225.00	1.000	0.820	1.000	1.000	9503	20261	0.70

ϕV_{cpg} (lb)
14963

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	264	9660	0.03	Pass
Concrete breakout	527	7091	0.07	Pass
Adhesive	**527**	**2961**	**0.18**	**Pass (Governs)**

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	66	4020	0.02	Pass
Pryout	**263**	**14963**	**0.02**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.18	0.00	17.8%	1.0	Pass

SET-XP w/ 5/8"Ø A193 Gr. B8/B8M (304/316SS) with hef = 5.000 inch meets the selected design criteria.

12. Warnings

- When cracked concrete is selected, concrete compressive strength used in concrete breakout strength in tension, adhesive strength in tension and concrete pryout strength in shear for SET-XP adhesive anchor is limited to 2,500 psi per ICC-ES ESR-2508 Section 5.3.

- Designer must exercise own judgement to determine if this design is suitable.

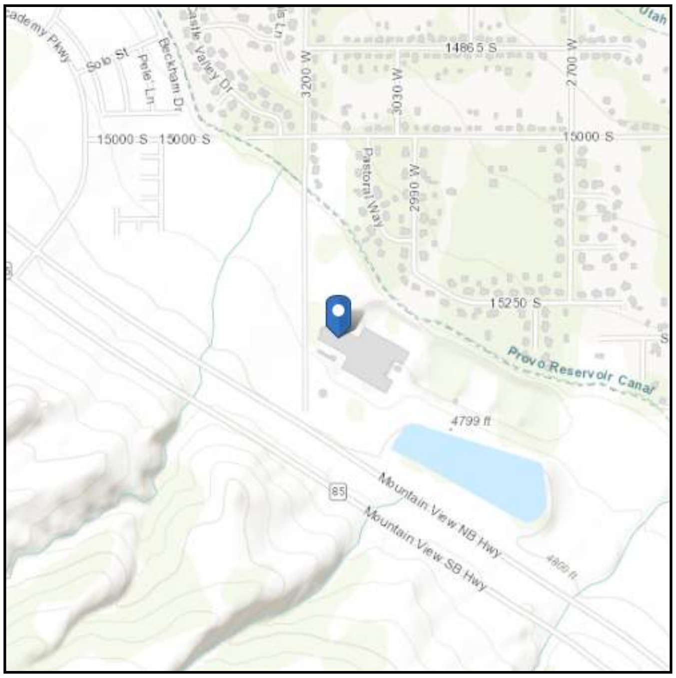
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

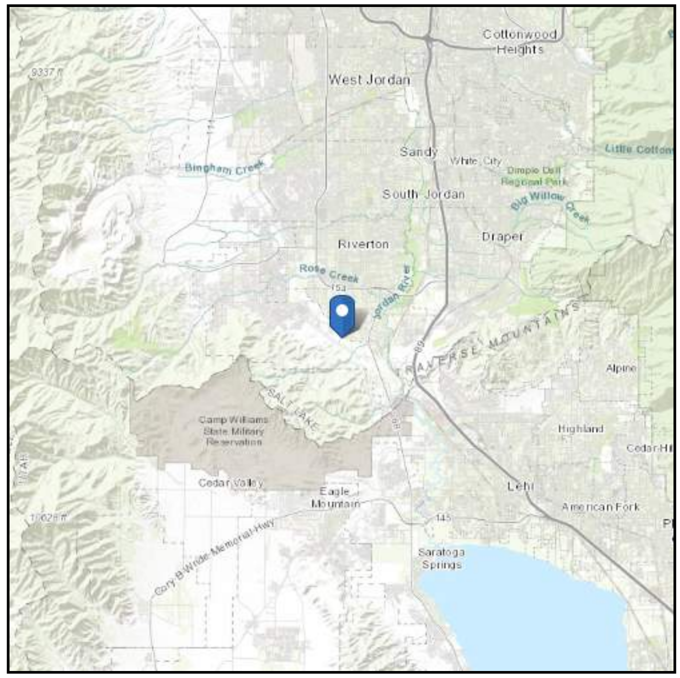
Appendix

ASCE 7 Hazards Report

Address:
15305 S 3200 W
Riverton, Utah
84065

Standard:	ASCE/SEI 7-16
Risk Category:	IV
Soil Class:	D - Default (see Section 11.4.3)
Elevation:	4736.66 ft (NAVD 88)
Latitude:	40.47324
Longitude:	-111.966198





Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.176	S_{D1} :	N/A
S_1 :	0.426	T_L :	8
F_a :	1.2	PGA :	0.521
F_v :	N/A	PGA_M :	0.626
S_{MS} :	1.411	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1.5
S_{DS} :	0.941	C_v :	1.335

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Wed Dec 15 2021

Date Source: USGS Seismic Design Maps

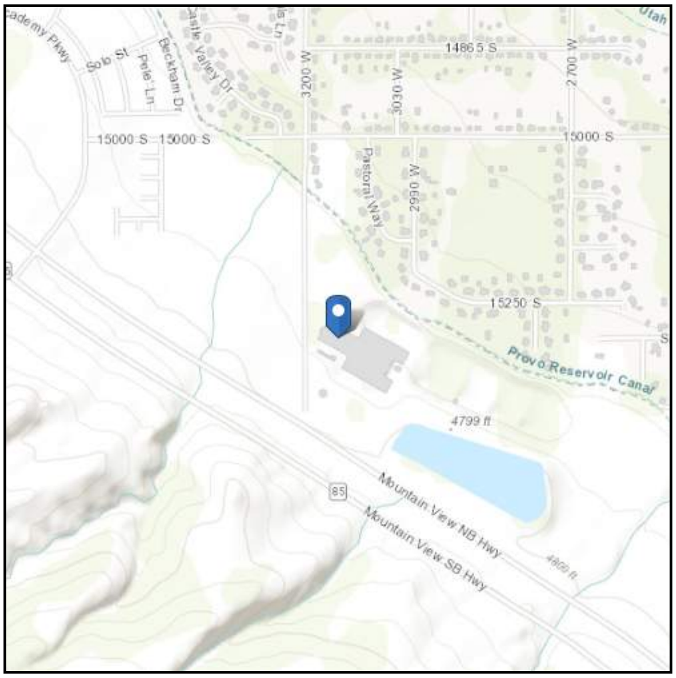
AMERICAN SOCIETY OF CIVIL ENGINEERS

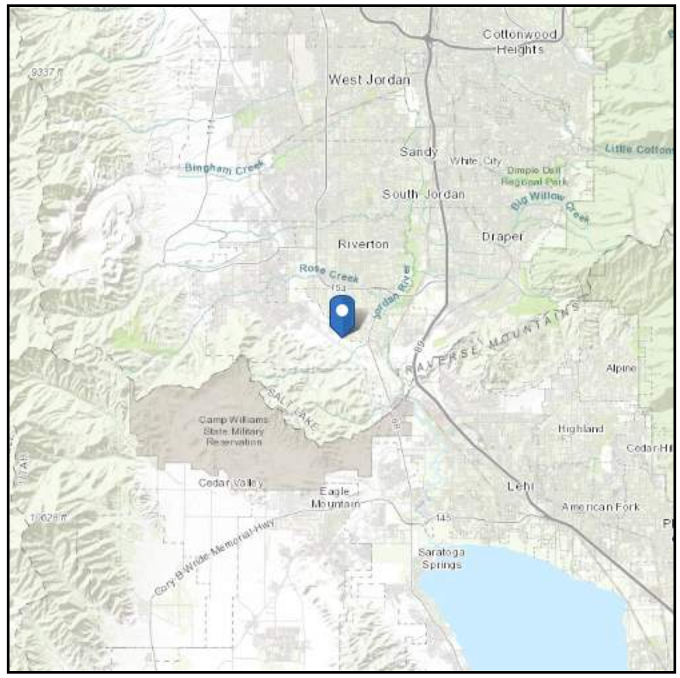
ASCE 7 Hazards Report

Address:
15305 S 3200 W
Riverton, Utah
84065

Standard: ASCE/SEI 7-16
Risk Category: IV
Soil Class: D - Default (see Section 11.4.3)

Elevation: 4736.66 ft (NAVD 88)
Latitude: 40.47324
Longitude: -111.966198





Wind

Results:

Wind Speed	113 Vmph
10-year MRI	73 Vmph
25-year MRI	79 Vmph
50-year MRI	84 Vmph
100-year MRI	89 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1D and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Wed Dec 15 2021

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 1.6% probability of exceedance in 50 years (annual exceedance probability = 0.00033, MRI = 3,000 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Project Name: 419383-01 **Location: Jordan Valley, UT - Aft Bays**
User: AJK **Date / Time: 3/10/2022 1:44:27 PM**

Dimensions Are In Inches

For SA Wall Bearings ONLY

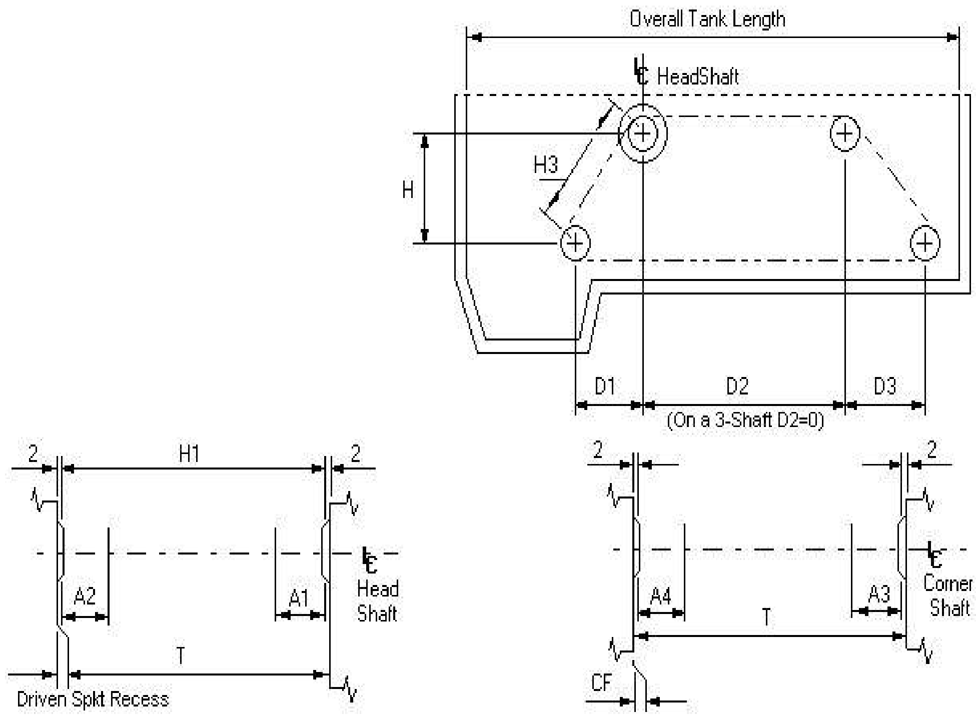
D1 =	**2.25**	**H1 =**	**228.50**
D2 =	**2698.6875**	**A1 =**	**22.00**
D3 =	**100.5625**	**A2 =**	**22.50**
H =	**101.3125**	**A3 =**	**22.00**
T =	**230.00**	**A4 =**	**20.00**

CF - Corner Fill = 4.00

Z - CounterWeight = 0.00

S - Flight Spacing = 10

S4 - Flight Speed = 2



Drive Chain =	**ENV78B**	**Collector Chain =**	**HS730**
HeadShaft Sprocket - No. Teeth =	**12**	**CornerShaft Sprocket - No. Teeth =**	**17**
Flight Type =	**3 x 8 Diamond**	**Shoes / Wear STR =**	**Poly/Steel**
Filler Bar Weight =	**0**		
Average Sludge Load Along Flight =	**4.5**	**Design Criteria =**	**Standard Allow Deflection = 1/360 Span HDSHFT Stress = 12500 PSI Other SHFT Stress = 24000 PSI KM = 1.5 KT = 1**

Driven Sprocket Material:	**Polyurethane**	**Collector Sprocket Material:**	**Polyurethane**

Project Name: 419383-01 **Location: Jordan Valley, UT - Aft Bays**
User: AJK **Date / Time: 3/10/2022 1:44:38 PM**

DRY TANK

Allowable HeadShaft Stress (Shear) =	12500	PSI
Allowable Stress In Other Shafts =	24000	PSI
Allowable Deflection =	1/360	Of Span
Bending Moment Factor =	1.500	
Torsional Moment Factor =	1.000	
Coeffient of Friction (Wear Shoes on Track) =	0.330	
Coeffient of Friction At All Bearings =	0.050	
The Ass'y Flight Weight / Foot =	2.400	Lb./Ft.
The Ass'y Chain Weight / Foot =	1.780	Lb./Ft.
Average Sludge Load / Feet of Flight =	0.000	Lb./Ft.
Height Of Collector =	8.443	Ft.
CounterWeight =	0.000	Lb./Flight
Total Collector Chain Pull =	2110	Lb.
Design Single Strand Collector Chain Pull =	1519	Lbs.
Drive Chain Pull =	1545	Lbs.
HeadShaft Drive Bearing Reaction =	209	Lb.
Torque At Reducer Output Shaft (with 1.0 S.F.) =	5390	In./Lb.
Required Output Speed of Reducer =	1.183	R.P.M.

Flight Spacing =	10.000	Ft.
Bottom Sprocket Center Distance =	233.458	Ft.
Top Sprocket Center Distance =	224.891	Ft.
Tank Width =	19.167	Ft.
Headshaft Brg to Brg Length =	228.500	In.
Cornershaft Brg to Brg Length =	226.000	In.
Number of Teeth on Driven Sprocket =	40	
Number of Teeth on Drive Sprocket =	11	
Distance From Brg Center To Sprocket Center =	22.000	In.
Short Distance On HeadShaft To Sprocket =	22.000	In.
Long Distance On HeadShaft To Sprocket =	22.500	In.
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	0.101	HP
Flight Speed =	2.000	Ft./Min.
Drive Chain Type =	HB78	
The Horizontal Length Of the Catenary =	N/A	Ft.
The Pretension in The Catenary =	629.554	Lbs.
The Chain Length / Side =	483.006	Ft.
The Chain Length / Basin =	966.011	Ft.

The Following Are Selected Shaft Sizes for DRY TANK Conditions. They Differ From The Recommended Sizes.

DRY TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	4.5	0.635	0.450	4202	32
Take Up	4	0.628	0.465	7469	32
Effluent Corner	4	0.628	0.536	8545	32
Influent Corner	4.5	0.628	0.221	3750	32

Project Name: 419383-01 **Location: Jordan Valley, UT - Aft Bays**
User: AJK **Date / Time: 3/10/2022 1:44:44 PM**

WET TANK

Allowable HeadShaft Stress (Shear) =	12500	PSI
Allowable Stress In Other Shafts =	24000	PSI
Allowable Deflection =	1/360	Of Span
Bending Moment Factor =	1.500	
Torsional Moment Factor =	1.000	
Coeffient of Friction (Wear Shoes on Track) =	0.248	
Coeffient of Friction At All Bearings =	0.050	
The Ass'y Flight Weight / Foot =	2.400	Lb./Ft.
The Ass'y Chain Weight / Foot =	1.780	Lb./Ft.
Average Sludge Load / Feet of Flight =	4.500	Lb./Ft.
Height Of Collector =	8.443	Ft.
CounterWeight =	0.000	Lb./Flight
Total Collector Chain Pull =	2813	Lb.
Design Single Strand Collector Chain Pull =	2025	Lbs.
Drive Chain Pull =	2059	Lbs.
HeadShaft Drive Bearing Reaction =	72	Lb.
Torque At Reducer Output Shaft (with 1.0 S.F.) =	9279	In./Lb.
Required Output Speed of Reducer =	1.183	R.P.M.

Flight Spacing =	10.000	Ft.
Bottom Sprocket Center Distance =	233.458	Ft.
Top Sprocket Center Distance =	224.891	Ft.
Tank Width =	19.167	Ft.
Headshaft Brg to Brg Length =	228.500	In.
Cornershaft Brg to Brg Length =	226.000	In.
Number of Teeth on Driven Sprocket =	40	
Number of Teeth on Drive Sprocket =	11	
Distance From Brg Center To Sprocket Center =	22.000	In.
Short Distance On HeadShaft To Sprocket =	22.000	In.
Long Distance On HeadShaft To Sprocket =	22.500	In.
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	0.174	HP
Flight Speed =	2.000	Ft./Min.
Drive Chain Type =	HB78	
The Horizontal Length Of the Catenary =	N/A	Ft.
The Pretension in The Catenary =	222.274	Lbs.
The Chain Length / Side =	483.030	Ft.
The Chain Length / Basin =	966.061	Ft.

The Following Are Selected Shaft Sizes for WET TANK Conditions. They Differ From The Recommended Sizes.

WET TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	4.5	0.635	0.508	4803	32
Take Up	4	0.628	0.378	6235	32
Effluent Corner	4	0.628	0.363	6031	32
Influent Corner	4.5	0.628	0.301	4771	32

Evoqua Water Technologies

Confidential

Project Name: 419383-01 **Location: Jordan Valley, UT - Fore Bays**
User: AJK **Date / Time: 5/24/2022 7:47:12 PM**

Chain and Scraper Design Program - Inputs

Dimensions Are In Inches

For SA Wall Bearings ONLY

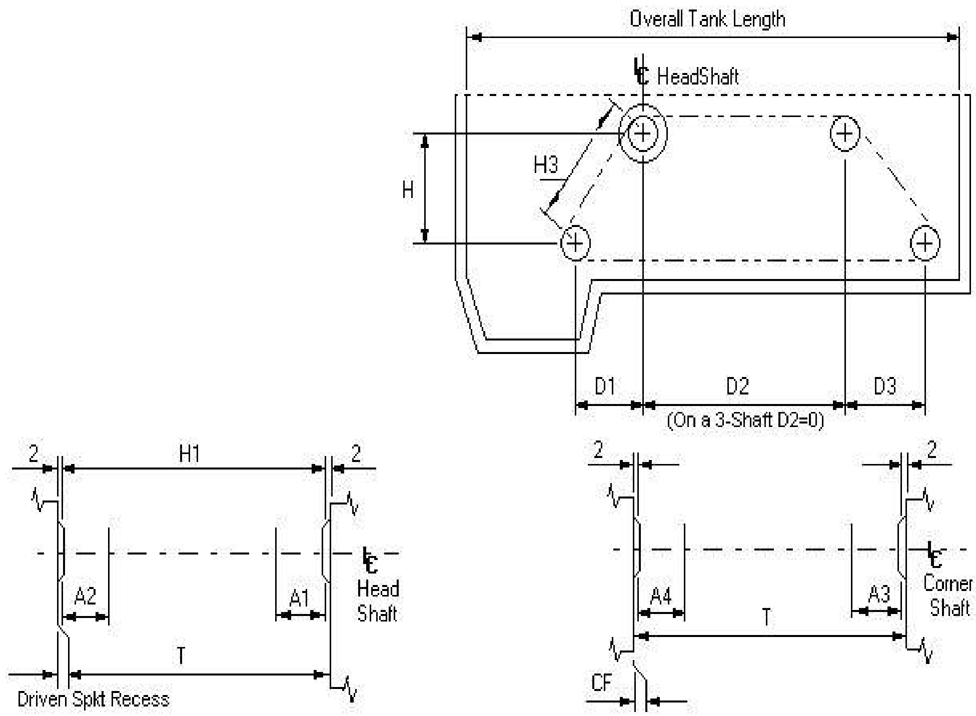
D1 =	**2.25**	**H1 =**	**228.50**
D2 =	**1251.75**	**A1 =**	**22.00**
D3 =	**101.50**	**A2 =**	**22.50**
H =	**109.875**	**A3 =**	**22.00**
T =	**230.00**	**A4 =**	**20.00**

CF - Corner Fill = 4.00

Z - CounterWeight = 0.00

S - Flight Spacing = 10

S4 - Flight Speed = 1



Drive Chain = **NH78**

Collector Chain = **HS730S**

HeadShaft Sprocket - No. Teeth = **12**

CornerShaft Sprocket - No. Teeth = **17**

Flight Type = **3 x 8 Diamond**

Shoes / Wear STR = **Poly/Steel**

Filler Bar Weight = **0**

Average Sludge Load Along Flight = **9.1**

Design Criteria = **Standard**
Allow Deflection = 1/360 Span
HDSHFT Stress = 12500 PSI
Other SHFT Stress = 24000 PSI
KM = 1.5 KT = 1

Sprocket Information

Driven Sprocket Material: **Polyurethane**

Collector Sprocket Material: **Polyurethane**

Project Name: 419383-01 **Location: Jordan Valley, UT - Fore Bays**
User: AJK **Date / Time: 5/24/2022 7:47:25 PM**

DRY TANK

Allowable HeadShaft Stress (Shear) =	**12500**	**PSI**
Allowable Stress In Other Shafts =	**24000**	**PSI**
Allowable Deflection =	**1/360**	**Of Span**
Bending Moment Factor =	**1.500**	
Torsional Moment Factor =	**1.000**	
Coeffient of Friction (Wear Shoes on Track) =	**0.330**	
Coeffient of Friction At All Bearings =	**0.050**	
The Ass'y Flight Weight / Foot =	**2.400**	**Lb./Ft.**
The Ass'y Chain Weight / Foot =	**1.780**	**Lb./Ft.**
Average Sludge Load / Feet of Flight =	**0.000**	**Lb./Ft.**
Height Of Collector =	**9.156**	**Ft.**
CounterWeight =	**0.000**	**Lb./Flight**
Total Collector Chain Pull =	**1034**	**Lb.**
Design Single Strand Collector Chain Pull =	**745**	**Lbs.**
Drive Chain Pull =	**757**	**Lbs.**
HeadShaft Drive Bearing Reaction =	**427**	**Lb.**
Torque At Reducer Output Shaft (with 1.0 S.F.) =	**2698**	**In./Lb.**
Required Output Speed of Reducer =	**0.592**	**R.P.M.**

Flight Spacing =	**10.000**	**Ft.**
Bottom Sprocket Center Distance =	**112.958**	**Ft.**
Top Sprocket Center Distance =	**104.313**	**Ft.**
Tank Width =	**19.167**	**Ft.**
Headshaft Brg to Brg Length =	**228.500**	**In.**
Cornershaft Brg to Brg Length =	**226.000**	**In.**
Number of Teeth on Driven Sprocket =	**40**	
Number of Teeth on Drive Sprocket =	**11**	
Distance From Brg Center To Sprocket Center =	**22.000**	**In.**
Short Distance On HeadShaft To Sprocket =	**22.000**	**In.**
Long Distance On HeadShaft To Sprocket =	**22.500**	**In.**
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	**0.025**	**HP**
Flight Speed =	**1.000**	**Ft./Min.**
Drive Chain Type =	**NH78**	
The Horizontal Length Of the Catenary =	**N/A**	**Ft.**
The Pretension in The Catenary =	**291.848**	**Lbs.**
The Chain Length / Side =	**243.217**	**Ft.**
The Chain Length / Basin =	**486.434**	**Ft.**

The Following Are S

DRY TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	4.5	0.635	0.362	3321	32
Take Up	4	0.628	0.398	6522	32
Effluent Corner	4	0.628	0.385	6336	32
Influent Corner	4	0.628	0.231	3945	32

Confidential

Project Name: 419383-01 **Location: Jordan Valley, UT - Fore Bays**
User: AJK **Date / Time: 5/24/2022 7:47:34 PM**

WET TANK

Allowable HeadShaft Stress (Shear) =	**12500**	**PSI**
Allowable Stress In Other Shafts =	**24000**	**PSI**
Allowable Deflection =	**1/360**	**Of Span**
Bending Moment Factor =	**1.500**	
Torsional Moment Factor =	**1.000**	
Coeffient of Friction (Wear Shoes on Track) =	**0.248**	
Coeffient of Friction At All Bearings =	**0.050**	
The Ass'y Flight Weight / Foot =	**2.400**	**Lb./Ft.**
The Ass'y Chain Weight / Foot =	**1.780**	**Lb./Ft.**
Average Sludge Load / Feet of Flight =	**9.100**	**Lb./Ft.**
Height Of Collector =	**9.156**	**Ft.**
CounterWeight =	**0.000**	**Lb./Flight**
Total Collector Chain Pull =	**2389**	**Lb.**
Design Single Strand Collector Chain Pull =	**1720**	**Lbs.**
Drive Chain Pull =	**1749**	**Lbs.**
HeadShaft Drive Bearing Reaction =	**153**	**Lb.**
Torque At Reducer Output Shaft (with 1.0 S.F.) =	**8172**	**In./Lb.**
Required Output Speed of Reducer =	**0.592**	**R.P.M.**

Flight Spacing =	**10.000**	**Ft.**
Bottom Sprocket Center Distance =	**112.958**	**Ft.**
Top Sprocket Center Distance =	**104.313**	**Ft.**
Tank Width =	**19.167**	**Ft.**
Headshaft Brg to Brg Length =	**228.500**	**In.**
Cornershaft Brg to Brg Length =	**226.000**	**In.**
Number of Teeth on Driven Sprocket =	**40**	
Number of Teeth on Drive Sprocket =	**11**	
Distance From Brg Center To Sprocket Center =	**22.000**	**In.**
Short Distance On HeadShaft To Sprocket =	**22.000**	**In.**
Long Distance On HeadShaft To Sprocket =	**22.500**	**In.**
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	**0.077**	**HP**
Flight Speed =	**1.000**	**Ft./Min.**
Drive Chain Type =	**NH78**	
The Horizontal Length Of the Catenary =	**N/A**	**Ft.**
The Pretension in The Catenary =	**103.032**	**Lbs.**
The Chain Length / Side =	**243.242**	**Ft.**
The Chain Length / Basin =	**486.483**	**Ft.**

The Following Are Se

WET TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	**4.5**	**0.635**	**0.473**	**4439**	**32**
Take Up	**4**	**0.628**	**0.356**	**5925**	**32**
Effluent Corner	**4**	**0.628**	**0.339**	**5681**	**32**
Influent Corner	**4**	**0.628**	**0.411**	**5749**	**32**

Evoqua Water Technologies

Project Name: 419383-01 **Location: Jordan Valley, UT - Cross Coll.**
User: AJK **Date / Time: 12/13/2021 6:35:30 PM**

Chain and Scraper Design Program - Inputs

Dimensions Are In Inches

For SA Wall Bearings ONLY

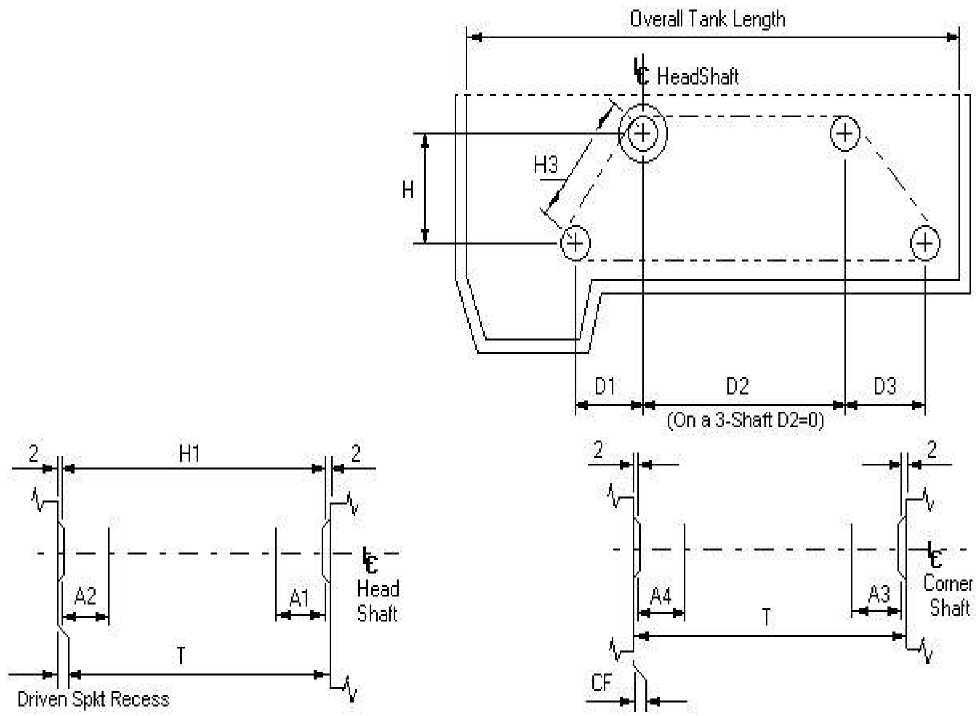
D1 =	**173.25**	**H1 =**	**71.50**
D2 =	**0**	**A1 =**	**16.00**
D3 =	**462.25**	**A2 =**	**19.50**
H =	**137.3125**	**A3 =**	**16.00**
T =	**72.00**	**A4 =**	**16.00**

CF - Corner Fill = **0**

Z - CounterWeight = **0**

S - Flight Spacing = **5**

S4 - Flight Speed = **2**



Drive Chain =	**NH78**	**Collector Chain =**	**HS730S**
HeadShaft Sprocket - No. Teeth =	**12**	**CornerShaft Sprocket - No. Teeth =**	**17**
Flight Type =	**3 x 8 Diamond**	**Shoes / Wear STR =**	**Poly/Poly**
Filler Bar Weight =	**0**		
Average Sludge Load Along Flight =	**15**	**Design Criteria =**	**Standard** **Allow Deflection = 1/360 Span** **HDSHFT Stress = 12500 PSI** **Other SHFT Stress = 24000 PSI** **KM = 1.5 KT = 1**

Sprocket Information

Driven Sprocket Material:	**Polyurethane**	**Collector Sprocket Material:**	**Polyurethane**

Project Name: 419383-01 **Location: Jordan Valley, UT - Cross Coll.**
User: AJK **Date / Time: 12/13/2021 6:35:38 PM**

DRY TANK

Allowable HeadShaft Stress (Shear) =	**12500**	**PSI**
Allowable Stress In Other Shafts =	**24000**	**PSI**
Allowable Deflection =	**1/360**	**Of Span**
Bending Moment Factor =	**1.500**	
Torsional Moment Factor =	**1.000**	
Coeffient of Friction (Wear Shoes on Track) =	**0.150**	
Coeffient of Friction At All Bearings =	**0.050**	
The Ass'y Flight Weight / Foot =	**2.400**	**Lb./Ft.**
The Ass'y Chain Weight / Foot =	**1.960**	**Lb./Ft.**
Average Sludge Load / Feet of Flight =	**0.000**	**Lb./Ft.**
Height Of Collector =	**11.443**	**Ft.**
CounterWeight =	**0.000**	**Lb./Flight**
Total Collector Chain Pull =	**349**	**Lb.**
Design Single Strand Collector Chain Pull =	**251**	**Lbs.**
Drive Chain Pull =	**255**	**Lbs.**
HeadShaft Drive Bearing Reaction =	**192**	**Lb.**
Torque At Reducer Output Shaft (with 1.0 S.F.) =	**1243**	**In./Lb.**
Required Output Speed of Reducer =	**1.183**	**R.P.M.**

Flight Spacing =	**5.000**	**Ft.**
Bottom Sprocket Center Distance =	**52.958**	**Ft.**
Top Sprocket Center Distance =	**0.000**	**Ft.**
Tank Width =	**6.000**	**Ft.**
Headshaft Brg to Brg Length =	**71.500**	**In.**
Cornershaft Brg to Brg Length =	**68.000**	**In.**
Number of Teeth on Driven Sprocket =	**40**	
Number of Teeth on Drive Sprocket =	**11**	
Distance From Brg Center To Sprocket Center =	**16.000**	**In.**
Short Distance On HeadShaft To Sprocket =	**16.000**	**In.**
Long Distance On HeadShaft To Sprocket =	**19.500**	**In.**
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	**0.023**	**HP**
Flight Speed =	**2.000**	**Ft./Min.**
Drive Chain Type =	**NH78**	
The Horizontal Length Of the Catenary =	**19.550**	**Ft.**
The Pretension in The Catenary =	**0.000**	**Lbs.**
The Chain Length / Side =	**118.182**	**Ft.**
The Chain Length / Basin =	**236.365**	**Ft.**

DRY TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	2.5	0.199	0.050	2655	32
Effluent Corner	2.5	0.189	0.020	2741	32
Influent Corner	2.5	0.189	0.029	3038	32

Project Name: 419383-01 **Location: Jordan Valley, UT - Cross Coll.**
User: AJK **Date / Time: 12/13/2021 6:35:43 PM**

WET TANK

Allowable HeadShaft Stress (Shear) =	**12500**	**PSI**
Allowable Stress In Other Shafts =	**24000**	**PSI**
Allowable Deflection =	**1/360**	**Of Span**
Bending Moment Factor =	**1.500**	
Torsional Moment Factor =	**1.000**	
Coeffient of Friction (Wear Shoes on Track) =	**0.113**	
Coeffient of Friction At All Bearings =	**0.050**	
The Ass'y Flight Weight / Foot =	**2.400**	**Lb./Ft.**
The Ass'y Chain Weight / Foot =	**1.960**	**Lb./Ft.**
Average Sludge Load / Feet of Flight =	**15.000**	**Lb./Ft.**
Height Of Collector =	**11.443**	**Ft.**
CounterWeight =	**0.000**	**Lb./Flight**
Total Collector Chain Pull =	**1128**	**Lb.**
Design Single Strand Collector Chain Pull =	**812**	**Lbs.**
Drive Chain Pull =	**826**	**Lbs.**
HeadShaft Drive Bearing Reaction =	**456**	**Lb.**
Torque At Reducer Output Shaft (with 1.0 S.F.) =	**4024**	**In./Lb.**
Required Output Speed of Reducer =	**1.183**	**R.P.M.**

Flight Spacing =	**5.000**	**Ft.**
Bottom Sprocket Center Distance =	**52.958**	**Ft.**
Top Sprocket Center Distance =	**0.000**	**Ft.**
Tank Width =	**6.000**	**Ft.**
Headshaft Brg to Brg Length =	**71.500**	**In.**
Cornershaft Brg to Brg Length =	**68.000**	**In.**
Number of Teeth on Driven Sprocket =	**40**	
Number of Teeth on Drive Sprocket =	**11**	
Distance From Brg Center To Sprocket Center =	**16.000**	**In.**
Short Distance On HeadShaft To Sprocket =	**16.000**	**In.**
Long Distance On HeadShaft To Sprocket =	**19.500**	**In.**
Horsepower At Reducer Output Shaft (with 1.0 S.F.) =	**0.076**	**HP**
Flight Speed =	**2.000**	**Ft./Min.**
Drive Chain Type =	**NH78**	
The Horizontal Length Of the Catenary =	**19.550**	**Ft.**
The Pretension in The Catenary =	**0.000**	**Lbs.**
The Chain Length / Side =	**118.182**	**Ft.**
The Chain Length / Basin =	**236.365**	**Ft.**

WET TANK

Shaft	Selected Diameter	Allowed Deflection	Actual Deflection	Actual Stress	Sprocket Weight
HeadShaft	2.5	0.199	0.094	6528	32
Effluent Corner	2.5	0.189	0.014	1695	32
Influent Corner	2.5	0.189	0.143	15035	32

George Evers

From: Mahmoud Maamouri
Sent: Wednesday, December 15, 2021 9:27 AM
To: Josh Buckholt; George Evers
Cc: Tom Dienhart
Subject: FW: (419383-01; 2033/001724.P.01; Jordan Valley WTP, Herriman, UT) RFQ for Anchor Calculations
Attachments: 419383-01 NCOLLEST (Fore Bay, 9.4 lb Sludge, Overwritten Shafts).pdf; 419383-01 NCOLLEST (Aft Bay, 3.5 lb Sludge, Overwritten Shafts).pdf; 419383-01 NCOLLEST (Cross, 15 lb Sludge, Overwritten Shafts).pdf; 419383-101.pdf

Hi Josh and George,

Here is a project for Evoqua that we need to do anchorage calcs for. Our Job Number is J211052.

I placed the information we received on 12/6 when we quoted the project in the job folder.

Tom and Sue have done many projects like this one and Tom will sit down with you to go over this when you are ready to start.

Recent Chain and Scraper projects that Sue worked on are J210259, J210828, and J21880. Feel free to review these calcs. Also, Tom has other reference projects and developed a couple of handy spreadsheets as well.

Thank you,

Mahmoud

Mahmoud Maamouri, PhD, PE, SE
CSD STRUCTURAL ENGINEERS
O (414) 247-2843
M (414) 326-0516

From: Kluessendorf, Anthony J <anthony.kluessendorf@evoqua.com>
Sent: Tuesday, December 14, 2021 10:56 PM
To: Mahmoud Maamouri <mmaamouri@csd-eng.com>
Cc: McDonald, Jordan M <jordan.mcdonald@evoqua.com>; Halase, Garth L <garth.halase@evoqua.com>; Tom Dienhart <tdienhart@csd-eng.com>
Subject: RE: (419383-01; 2033/001724.P.01; Jordan Valley WTP, Herriman, UT) RFQ for Anchor Calculations

Hi Mahmoud,

Attached are the NCOLLEST calculations for the Forebay, Aftbay, and Cross Collector Mechanisms.

For the C&S Components, most of the equipment hasn't been detailed yet, but we can estimate the weights as follows:

- Headshafts, Longitudinal 1043 lbs each 316SS
- Headshafts, Cross 336 lbs each 316SS
- Cornershafts, Longitudinal 815 lbs each 316SS
- Cornershafts, Cross 253 lbs each 316SS

Wall Bearing Housing	37 lbs each	316SS
Hub Balls (Headshafts, Long.)	3.7 lbs each	Poly
Hub Balls (Cornershafts, Long.)	4.7 lbs each	Poly
Hub Balls (All Cross)	7.0 lbs each	Poly
Set Collars (Headshafts, Long.)	0.9 lbs each	UHMW
Set Collars (Cornershafts, Long.)	0.8 lbs each	UHMW
Set Collars (All Cross)	0.6 lbs each	UHMW
Driven Sprocket	93 lbs each	Poly
Collector Sprocket (Headshaft, Long.)	28.5 lbs each	Poly
Collector Sprocket (Cornershaft, Long.)	19.0 lbs each	Poly
Collector Sprocket (Headshaft, Cross)	26.2 lbs each	Poly
Collector Sprocket (Cornershaft, Cross)	16.0 lbs each	Poly
Collector Chain	1.6 lbs/ft	Poly
Drive Chain	1.4 lbs/ft	Poly
Return Track Supports	27 lbs each	316SS
Return Tracks	3.0 lbs/ft	316SS (72.1 lbs per 20'-0" track)
Flight (Longitudinal)	49.0 lbs each	FRP
Flight (Cross)	15.8 lbs each	FRP
Filler Block	0.5 lbs each	Poly
Wear Shoe (Carry)	0.5 lbs each	UHMW
Wear Shoe (Return)	0.6 lbs each	UHMW
Drive Base (Dual Output, Long.)	42 lbs each	304SS
Drive Base (Single Output, Long.)	26 lbs each	304SS
Drive Base (Cross)	24 lbs each	304SS
Drive Assembly (Dual Output, Long.)	305 lbs each	(265 lbs for Reducer, 40 lbs for Motor)
Drive Assembly (Single Output, Long.)	205 lbs each	(165 lbs for Reducer, 40 lbs for Motor)
Drive Assembly (Cross)	188 lbs each	(148 lbs for Reducer, 40 lbs for Motor)
Drive Sprocket Assembly	69 lbs each	316SS / CI / Poly (22 lbs for Bibbigard Torque Limiter, 47 lbs for Shear Pin Hub)

We will also be updating the GA drawings, as revisions were made to the longitudinal shafting diameters and the drive assemblies. The spec page was also updated to reflect these changes (see attached 419383-101 for reference).

We'll send updated GA drawings by the end of the week. So, if you could review the drive anchors last, that would help to buy us some time to complete them. Otherwise, all of the wall bearing and return track anchor positions will remain as shown on the GA's.

Let me know if you need anything else. Have a great day.

Tony Kluessendorf, P.E.
Sr. Project Engineer

Evoqua Water Technologies LLC
Tel. +1 (262) 521-8252
Anthony.Kluessendorf@evoqua.com

From: Kluessendorf, Anthony J
Sent: Monday, December 13, 2021 4:47 PM
To: Mahmoud Maamouri <mmaamouri@csd-eng.com>
Cc: McDonald, Jordan M <jordan.mcdonald@evoqua.com>; Halase, Garth L <garth.halase@evoqua.com>; Tom Dienhart <tdienhart@csd-eng.com>
Subject: RE: (419383-01; 2033/001724.P.01; Jordan Valley WTP, Herriman, UT) RFQ for Anchor Calculations

Hi Mahmoud,

I'm finishing up the calculations and am working to get equipment weights ready as well. I anticipate that they will be ready by tomorrow.

George Evers

From:	Kluessendorf, Anthony J <anthony.kluessendorf@evoqua.com>
Sent:	Thursday, March 10, 2022 5:17 PM
To:	Josh Buckholt
Cc:	McDonald, Jordan M; Halase, Garth L; Mahmoud Maamouri; Tom Dienhart; George Evers; Wilson, Scott L; Hindman, Donald W
Subject:	RE: (419383-01; 2033/001724.P.01; Jordan Valley WTP, Herriman, UT) RFQ for Anchor Calculations
Attachments:	419383-01 NCOLLEST (Aft Bay, 4.5 lb Sludge, Overwritten Shafts).pdf

Email From Outside CSD

Hey Josh,

Sorry for the delay in getting you the updated NCOLLEST run for the Aft Bay mechanisms. We had a call earlier this week with the Customer to get our arms around all of the miscellaneous changes that they are discussing. A lot of the topics are conceptual, but some may come to fruition in the next few weeks / months.

Anyway, we are changing the sludge loading of the equipment for the Aft Bay mechanisms, which is increasing from 3.5 lbs / ft of flight length to 4.5 lbs / ft of flight length. Attached is the updated NCOLLEST run for review by CSD. Below is a summary of the items that changed with this increased sludge loading:

- Design Single Strand Collector Chain Pull load increased from 1705 lbs to 2025 lbs.
- Drive Chain Pull increased from 1733 lbs to 2059 lbs.
    - This increase pull required us to change the drive chain used with the aft bay mechanisms from NH78 non-metallic (1.4 lbs / ft weight) to ENV78B SS (3.9 lbs / ft weight).
- The lower influent cornershaft diameter increased from 4” to 4.50”

The Fore Bay mechanisms and Cross Collector mechanisms have not changed, so the previously provided NCOLLEST results are still applicable. No changes are occurring to the equipment previously identified, at this time.

Also, all of the drives are also being modified from SEW Eurodrive to Nord equivalents. Below is a summary of the changes.

- 4-Shaft Aft Bay, Dual Output Gear Reducer
    - Was SEW Eurodrive KA87B R57AM56C (23,900 in-lbs of torque, 260 lbs weight)
    - Change to Nord SK 9053.1 (42480 in-lbs of torque, 459 lbs weight)
- 4-Shaft Aft Bay, Single Output Gear Reducer
    - Was SEW Eurodrive KA77B R37AM56C (13,720 in-lbs of torque, 150 lbs weight)
    - Change to Nord SK 9033.1 (13,718 in-lbs of torque, 154 lbs weight)
- 3-Shaft Fore Bay, Dual Output Gear Reducer
    - Was SEW Eurodrive KA87B R57AM56C (23,900 in-lbs of torque, 260 lbs weight)
    - Change to Nord SK 9043.1 (24,780 in-lbs of torque, 287 lbs weight)
- 3-Shaft Fore Bay, Single Output Gear Reducer
    - Was SEW Eurodrive KA77B R37AM56C (13,720 in-lbs of torque, 150 lbs weight)
    - Change to Nord SK 9033.1 (13,718 in-lbs of torque, 154 lbs weight)
- 3-Shaft Cross Collector Gear Reducer
    - Was SEW Eurodrive KA67B R37AM56C (7,260 in-lbs of torque, 97 lbs weight)
    - Change to Nord SK 9023.1 (7,611 in-lbs of torque, 104 lbs weight)

That should do it from an equipment update. Please let me know if there are any additional items that you need for updating the CSD Calculation package.

Have a great day.

Tony Kluessendorf, P.E.
Sr. Project Engineer

JORDAN VALLEY WATER TREATMENT PLANT

HERRIMAN, UTAH

EVOQUA WATER TECHNOLOGIES
(12) FORE BAY PRIMARY CHAIN AND SCRAPER SLUDGE COLLECTORS, (12) AFT BAY PRIMARY CHAIN AND SCRAPER SLUDGE COLLECTORS & (4) CROSS COLLECTORS

DRAWING NO	REV	DESCRIPTION
419383-100	C	GENERAL ARRANGEMENT - COVER SHEET & DWG LIST
419383-101	B	GENERAL ARRANGEMENT - SPECIFICATIONS CHAIN & SCRAPER SLUDGE COLLECTORS
419383-102	C	GENERAL ARRANGEMENT - PLAN VIEW CSSC
419383-103 (SHT 1 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 2 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 3 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 4 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-104 (SHT 1 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 2 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 3 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 4 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-105	B	GENERAL ARRANGEMENT - CROSS COLLECTOR ELEVATION VIEW CSSC
419383-106 (SHT 1 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 2 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 3 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 4 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-107 (SHT 1 OF 2)	B	GENERAL ARRANGEMENT - INSTALLATION DETAILS CSSC
419383-107 (SHT 2 OF 2)	B	GENERAL ARRANGEMENT - INSTALLATION DETAILS CSSC
419383-108	B	GENERAL ARRANGEMENT - DRIVE ARRANGEMENT, AFT BAY LONG CSSC
419383-109	B	GENERAL ARRANGEMENT - DRIVE ARRANGEMENT, FORE BAY LONG & CROSS CSSC
419383-110	A	GENERAL ARRANGEMENT - WEAR STRIP INSTALLATION DETAILS

GENERAL ARRANGEMENT DRAWING NOTES:

1. ORIGINAL SUBMITTAL DRAWINGS WILL INCLUDE A STAMP DESIGNATING DRAWINGS AS "FOR APPROVAL ONLY". UPON APPROVAL, DRAWINGS WILL BE REISSUED AS REVISION 0, "ISSUED FOR CONSTRUCTION".
2. ITEM BALLOONS LEFT BLANK ON SUBMITTAL DRAWINGS WILL BE FILLED IN WITH THE APPROPRIATE NUMBERS UPON APPROVAL AND COMPLETION OF THE BILL OF MATERIALS FOR THE PROJECT.
3. TWO & THREE DIGIT ITEM NUMBERS (1 THROUGH 199) CORRESPOND WITH NUMBERED ITEMS ON THE BILL OF MATERIALS. THREE DIGIT ITEM NUMBERS (200 AND ABOVE) CORRESPOND WITH NUMBERED ITEMS ON THE FIELD HARDWARE DRAWING.

(11) FIELD HARDWARE DRAWING

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED DRAWING SET	4/8/22	GLH	AJK	SW	
B	REVISED DRAWING SET	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	11/5/21	GLH	AJK	JMM	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - COVER SHEET & DRAWING LIST (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-100	1 OF 1	C

STD 22x34_D v4.0

BAR = 1" AT PLOT SCALE

CHAIN AND SCRAPER SLUDGE COLLECTOR

COLLECTOR CHAIN

THE COLLECTOR CARRYING CHAIN WILL BE HS730 POLYMERIC TYPE, HAVING 6" PITCH LINKS WITH AN AVERAGE WEIGHT OF 1.6 LBS/FT. THE CHAIN WILL HAVE A MINIMUM PUBLISHED WORKING LOAD OF 4,500 LBS BASED UPON STRENGTH, FATIGUE AND WEAR CONSIDERATIONS, AND A MINIMUM ULTIMATE TENSILE STRENGTH OF 20,000 LBS.

CHAIN SIDE BARS WILL BE OF FIBERGLASS COMPOSITE CONSTRUCTION HAVING CONTINUOUS FIBERGLASS FILAMENTS ORIENTED PARALLEL WITH THE SIDE BARS. THE SIDE BARS WILL BE OF A LOOP CONFIGURATION TO MINIMIZE STRESS CONCENTRATIONS WITHIN THE MEMBER AND SHALL INCLUDE PROVISIONS TO MAINTAIN PIN ORIENTATION. THE CHAIN PINS WILL NOT BE LESS THAN 1" DIAMETER PULTRUDED FIBERGLASS ROD HAVING NOT LESS THAN 70% UNIDIRECTIONAL GLASS CONTENT. THE PIN WILL INCLUDE A POLYMERIC SLEEVE WHICH WILL ROTATE WITHIN POLYMERIC BUSHINGS FITTED INTO THE SIDE BARS TO ISOLATE THE ROTATING MEMBERS FROM THE GLASS CONTAINING COMPONENTS. THE POLYMERIC CHAIN BARREL WILL ROTATE ON THE PIN SLEEVE TO DISTRIBUTE WEAR FROM SPROCKET TOOTH CONTACT AROUND THE FULL PERIPHERY OF THE BARREL. CHAIN PINS WILL BE HELD IN PLACE BY TYPE 316 STAINLESS STEEL COTTERS.

THE HIGH STRENGTH LINKS WILL BE CONTINUOUS FOR THE FULL LENGTH OF THE CHAIN STRAND WITH NO INTERSPERSED ATTACHMENT LINKS. THE SCRAPER FLIGHTS WILL BE BOLTED TO POLYMERIC FLIGHT BRACKETS MOUNTED ON EXTENDED CHAIN PINS AND SECURED WITH TYPE 316 STAINLESS STEEL COTTERS. THE ATTACHMENT MOUNTING HOLE SPACING WILL CONFORM TO ANSI STANDARD B29.21M96 AND WILL ACCOMMODATE FOUR (4) 1/2" DIAMETER TYPE 316 STAINLESS STEEL HEX HEAD ATTACHMENT BOLTS. THE BOLTS WILL BE FASTENED WITH BRASS "NYLOCK" HEX LOCKNUTS AND TYPE 316 STAINLESS STEEL FLAT WASHERS.

EACH STRAND FOR THE AFT BAY LONGITUDINAL COLLECTORS WILL BE 483'-0" LONG, MADE UP OF (45) 10'-0" LONG SECTIONS & (3) 11'-0" LONG SECTION.

EACH STRAND FOR THE FORE BAY LONGITUDINAL COLLECTORS WILL BE 242'-0" LONG, MADE UP OF (22) 10'-0" LONG SECTIONS & (2) 11'-0" LONG SECTION.

EACH STRAND FOR THE CROSS COLLECTORS WILL BE 119'-0" LONG, MADE UP OF (12) 10'-0" LONG SECTIONS.

FLIGHTS (DIAMOND TYPE)

THE SLUDGE COLLECTOR LONGITUDINAL & CROSS FLIGHTS WILL BE 3" X 8" NOMINAL SIZE FIBERGLASS CONSTRUCTION, ESSENTIALLY RECTANGULAR IN CROSS SECTION. THE MEMBER WILL HAVE A PRODUCT OF THE MODULUS OF ELASTICITY (E, PSI) AND THE MOMENT OF INERTIA (I, IN^4) OF NOT LESS THAN 12.13 X 10^6 LBS-IN^2 ABOUT ITS MINOR AXIS (PARALLEL TO THE DIRECTION OF FLOW). THE FLIGHTS ARE OF PULTRUDED ISOPTHALIC POLYESTER COMPOSITE CONSTRUCTION WITH A MINIMUM FIBERGLASS CONTENT OF 60% BUT NO GREATER THAN 70%, TO INSURE MEMBER STRENGTH AND TOTAL ENCAPSULATION OF THE GLASS FIBERS TO PREVENT WICKING.

MAXIMUM WATER ABSORPTION IS NO GREATER THAN 0.6% AFTER IMMERSION FOR 48 HRS AT 23 DEGREES C (73.4 DEGREES F) IN ACCORDANCE WITH ASTM D-570. THE FLIGHT SECTION WILL INCLUDE A SCRAPER LIP ON THE LEADING EDGE OF THE FLIGHT TO OPTIMIZE CLEANING OF THE TANK FLOOR. POLYPROPYLENE FILLER BLOCKS WILL BE FURNISHED TO ALLOW THE FLIGHT TO BE SECURELY BOLTED TO THE CHAIN ATTACHMENT. THE BLOCKS WILL PROVIDE AN INTERFERENCE FIT WITH THE FLIGHT TO MAINTAIN PROPER POSITIONING DURING ASSEMBLY. THE FLIGHT SPACING WILL BE APPROXIMATELY 10'-0" FOR THE LONGITUDINAL COLLECTOR. THE FLIGHTS WILL BE ACCURATELY DRILLED AND NOTCHED AT THE FACTORY AND BANDED TOGETHER FOR SHIPMENT.

WEARING SHOES

ALL FLIGHT WILL BE PROVIDED WITH 1/2" THICK WEAR SHOES TO RUN ON THE EXISTING TANK FLOOR WEAR STRIPS AND THE NEW RETURN TRACKS. THE SHOES WILL BE MOLDED OF UHMW-POLYETHYLENE. THE WEAR SHOES RUNNING ON THE FLOOR WILL BE LOCATED CENTRAL TO THE CHAIN ATTACHMENT. THE RETURN RUN WEARING SHOES WILL INCLUDE A GUIDE LUG TO INSURE PROPER TRACKING OF THE FLIGHT ON THE RETURN TRACK. ALL WEARING SHOES WILL BE REVERSIBLE PROVIDING TWO (2) USABLE WEARING SURFACES.

COLLECTOR SPROCKETS

ALL SPROCKETS FOR THE SLUDGE COLLECTOR CARRYING CHAINS WILL BE MOLDED TOTALLY OF POLYURETHANE HAVING A WATER ABSORPTION RATE NOT TO EXCEED 1.3% AT THE SATURATION IN ACCORDANCE WITH ASTM D-570. THE SPROCKETS WILL BE OF SPLIT CONSTRUCTION. THE SPROCKET HALVES WILL BE ASSEMBLED ON THE SHAFTING WITH TWO (2) TYPE 316 STAINLESS STEEL CLAMPING BANDS WHICH EXERT COMPRESSIVE FORCE AROUND THE FULL PERIPHERY OF THE HUB, THEREBY CLAMPING THE SPROCKET TO THE SHAFT. THE CLAMPING BANDS WILL INCLUDE PROVISIONS TO RESTRICT THEIR LATERAL MOVEMENT ON THE HUB. TYPE 316 STAINLESS STEEL BOLTS OR WEDGE DOGS WILL BE LOCATED ALONG THE SPLIT LINE NEAR THE PERIPHERY TO DRAW THE SPROCKET HALVES TOGETHER IN LATERAL ALIGNMENT.

THE HEADSHAFT SPROCKETS WILL HAVE A KEYWAY MACHINED INTO THE HUB IN SUCH A WAY AS TO RESTRICT LATERAL MOVMENT OF THE KEY AND TO ENSURE CHAIN ALIGNMENT. THE HEADSHAFT SPROCKETS WILL NOT BE LESS THAN 23.18" PITCH DIAMETER AND HAVE 12 TEETH.

THE CORNERSHAFT SPROCKETS WILL NOT BE LESS THAN 16.61" PITCH DIAMETER AND HAVE 17 TEETH. THE CORNERSHAFT SPROCKETS WILL BE CLAMPED FIRMLY TO THE SHAFTING.

HEADSHAFT

ALL HEADSHAFT WILL BE SOLID 316 STAINLESS STEEL, STRAIGHT AND TRUE, HELD IN ALIGNMENT WITH SPLIT UHMW-POLYETHYLENE SET COLLARS. THE HEADSHAFT WILL CONTAIN KEYWAYS WITH FITTED KEYS AND WILL BE SIZED TO TRANSMIT THE POWER REQUIRED. THE HEADSHAFT WILL EXTEND ACROSS THE FULL WIDTH OF THE TANK AND TURN IN BEARINGS MOUNTED ON THE TANK WALLS. THE SHAFTING AND SPROCKETS WILL BE SHIPPED UNASSEMBLED TO PREVENT DAMAGE TO THE SPROCKETS DURING SHIPPING AND HANDLING.

ALL LONGITUDINAL HEADSHAFTS WILL BE 4.50" DIAMETER.
THE CROSS COLLECTOR HEADSHAFT WILL BE 2.50" DIAMETER.

CORNER SHAFTING

ALL CORNERSHAFTS IN THE LONGITUDINALS AND CROSS WILL BE SOLID 316 STAINLESS STEEL, STRAIGHT AND TRUE, HELD IN ALIGNMENT WITH SPLIT UHMW-POLYETHYLENE SET COLLARS. THE CORNERSHAFTS WILL EXTEND ACROSS THE FULL WIDTH OF THE TANK AND TURN IN BEARINGS MOUNTED ON THE TANK WALLS.

AFT BAY LOWER INFLUENT SHAFT SHALL BE 4.50"
B ALL OTHER CORNERSHAFTS WILL BE 4" DIAMETER.
THE CROSS COLLECTOR CORNERSHAFT WILL BE 2.50" DIAMETER.

SHAFTING SET COLLARS

SHAFTING SET COLLARS FOR THE HEADSHAFTS WILL BE MOLDED OF UHMW-POLYETHYLENE. THE COLLARS WILL BE OF A SPLIT CONSTRUCTION AND SHALL INCLUDE A SHOULDER AT EACH END TO CONTAIN THE CLAMPING BANDS.

BEARINGS

ALL SHAFT BEARINGS IN THE LONGITUDINALS AND CROSS SHALL BE OF A CAST TYPE 316 STAINLESS STEEL CONSTRUCTION PER ASTM A744, GRADE CF8M, WATER LUBRICATED, SELF ALIGNING TYPE, HAVING A POLYURETHANE BALL. THE HOUSING WILL BE OF A SPLIT DESIGN AND SPECIALLY DESIGNED TO PREVENT THE ACCUMULATION OF SETTLED SOLIDS ON ITS SURFACES. ALL BEARING HOUSINGS WILL HAVE 316 STAINLESS STEEL GREASE LINE TUBING ATTACHED TO THEM AND WILL BE RUN TO THE OPERATING FLOOR.

RETURN TRACKS

THE LONGITUDINAL COLLECTOR RETURN TRACKS WILL BE 12 GAUGE TYPE 316 STAINLESS STEEL, FORMED IN THE SHAPE OF AN INVERTED CAPITAL LETTER J. THE RETURN TRACK WILL HAVE A 2B POLISHED FINISH TO ALLOW THE SMOOTH TRAVEL OF THE FLIGHT WEAR SHOE WITHOUT THE NEED FOR ANY ADDITIONAL WEARING STRIPS. EACH J-TRACK SECTION WILL BE APPROXIMATELY 20 FEET LONG AND WILL HAVE MOUNTING HOLES SPACED APPROXIMATELY EVERY 24-INCHES TO ALLOW FOR VARYING WALL BRACKET SPACING. THE END SECTION IN EACH LINE WILL BE REQUIRED TO BE FIELD CUT TO THE PROPER LENGTH. THE J-TRACK SECTIONS ENDS WILL BE FIELD WELDED TOGETHER AND GROUND FOR A SMOOTH TRANSION FROM ONE SECTION TO THE NEXT. THE J-TRACK WILL BE SUPPORTED BY FABRICATED 1/4" THICK TYPE 316SS BRACKETS FROM THE TANK WALLS.

WEAR STRIPS

REPLACEABLE WEAR STRIPS WILL BE PROVIDED FOR THE COLLECTOR TANK FLOORS. THE WEAR STRIPS WILL BE 3/8" THICK 316 STAINLESS STEEL MATERIAL IN 10'-0" LONG SECTIONS WITH EACH SECTION HAVING (5) COUNTERSUNK HOLES. ALL WEAR STRIP SPLICES WILL BE MITERED AT 45 DEGREES TO ALLOW FOR A SMOOTH TRANSITION OF THE WEAR SHOES IN THE DIRECTION OF THE FLIGHT TRAVEL.

THE LONGITUDINAL & CROSS COLLECTOR WEAR STRIPS WILL BE ATTACHED TO THE TANK FLOOR USING TYPE 316 STAINLESS STEEL CONVEX WASHERS SPECIALLY DESIGNED FOR USE WITH 1/4" DIAMETER TYPE 316 STAINLESS STEEL FLAT HEAD SCREWS AND TYPE 316 STAINLESS STEEL DROP IN TYPE ANCHOR. THE ANCHORS WILL BE SET INTO PRE-DRILLED HOLES IN THE CONCRETE.

ALL ATTACHMENT HARDWARE WILL BE FURNISHED BY Evoqua Water Technologies, TO BE INSTALLED BY THE CLIENT'S CONTRACTOR.

DRIVE UNIT

THE SPEED REDUCER AND MOTOR WILL BE FACTORY ASSEMBLED AND WILL SHIP AS A COMPLETE UNIT TO ENSURE PROPER ASSEMBLY OF ALL COMPONENTS. EACH DRIVE UNIT WILL BE FIELD ASSEMBLED TO A FABRICATED 316 STAINLESS STEEL DRIVE BASE.

THE DRIVE UNIT SPEED REDUCERS IN THE LONGITUDINALS WILL BE A VARIABLE SPEED RIGHT ANGLE HORIZONTALLY MOUNTED HELICAL BEVEL GEAR TYPE, FULLY HOUSED, RUNNING IN OIL, WITH ANTI FRICTION BEARINGS THROUGHOUT.

THE MOTOR WILL CONFORM TO NEMA STANDARDS AND BE SUITABLE FOR OPERATION ON 460/230 VOLT, 3 PHASE, 60 HERTZ CURRENT. MOTORS WILL BE RATED FOR SEVERE DUTY IN A CLASS I, DIVISION 2, GROUP A, B, C, D ENVIRONMENT, AND WILL INCLUDE A 120 VOLT SPACE HEATER.

B AFT BAY DUAL OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9053.1
RATIO	2953.98 : 1
OUTPUT SPEED	0.59 RPM (AT 1700 INPUT)
OUTPUT TORQUE	42,480 IN-LBS (AT 1.0 SF)

B AFT BAY SINGLE OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9033.1
RATIO	2428.14 : 1
OUTPUT SPEED	0.72 RPM (AT 1700 INPUT)
OUTPUT TORQUE	13,718 IN-LBS (AT 1.0 SF)

B FORE BAY DUAL OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9043.1
RATIO	3026.98 : 1
OUTPUT SPEED	0.58 RPM (AT 1700 INPUT)
OUTPUT TORQUE	24,780 IN-LBS (AT 1.0 SF)

B FORE BAY SINGLE OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9033.1
RATIO	2428.14 : 1
OUTPUT SPEED	0.72 RPM (AT 1700 INPUT)
OUTPUT TORQUE	13,718 IN-LBS (AT 1.0 SF)

B CROSS COLLECTOR GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9023.1
RATIO	1504.07 : 1
OUTPUT SPEED	1.2 RPM (AT 1700 INPUT)
OUTPUT TORQUE	7,611 IN-LBS (AT 1.0 SF)

MOTOR FOR ALL DRIVES

MANUFACTURER	BALDOR
MODEL	CUSTOM
HORSEPOWER	1/2
R.P.M.	1800
VOLTAGE	460/230V, 3 PH, 60 HZ
ENCLOSURE	TEFC
SPACE HEATER	120V / 1PH. /60 HERTZ

DRIVE CHAIN

THE SLUDGE COLLECTOR DRIVE CHAIN FOR THE FORE BAY LONGITUDINAL COLLECTORS AND CROSS COLLECTORS WILL BE NH78 NON-METALLIC TYPE, HAVING 2.609" PITCH LINKS WITH AN AVERAGE WEIGHT OF 1.4 LBS/FT. THE CHAIN WILL HAVE A PUBLISHED WORKING LOAD OF NOT LESS THAN 1,750 LBS, BASED UPON STRENGTH AND FATIGUE CONSIDERATIONS. THE CHAIN LINKS WILL BE MANUFACTURED OF ACETAL RESIN AND CONNECTED WITH 7/16" DIAMETER STAINLESS STEEL PINS. THE PINS WILL BE CONSTRUCTED TO PREVENT ROTATION AND WILL BE HELD IN PLACE WITHOUT THE USE OF PINS OR COTTERS.

THE SLUDGE COLLECTOR DRIVE CHAIN FOR THE AFT BAY LONGITUDINAL COLLECTORS WILL BE ENV78B METALLIC TYPE, HAVING 2.609" PITCH LINKS WITH AN AVERAGE WEIGHT OF 3.9 LBS/FT. THE CHAIN WILL HAVE A PUBLISHED WORKING LOAD OF NOT LESS THAN 3,300 LBS, BASED UPON STRENGTH AND FATIGUE CONSIDERATIONS. THE CHAIN LINKS WILL BE MANUFACTURED OF TYPE 403 STAINLESS STEEL AND CONNECTED WITH 7/16" DIAMETER TYPE 403 STAINLESS STEEL PINS. THE CHAIN PINS WILL BE HELD IN PLACE BY TYPE 304 STAINLESS STEEL COTTERS.

B DRIVE SPROCKET

EACH DRIVE SPROCKET ASSEMBLY WILL CONSIST OF A CAST IRON SHEAR PIN HUB/TORQUE LIMITER COMBINATION. THE SPROCKET ASSEMBLY WILL INCLUDE A POLYMERIC PLATE SECTION BOLTED TO A CAST IRON RIM AND MOUNTED ON A CAST IRON SHEAR PIN HUB. THE SPROCKET PLATE SECTION WILL BE MOLDED TOTALLY OF POLYURETHANE. THE SPROCKET WILL NOT BE LESS THAN 9.26" PITCH DIAMETER AND HAVE 11 TEETH.

THE DRIVE SPROCKETS WILL BE FURNISHED WITH A SHEAR PIN DEVICE TO PROVIDE FOR PROTECTION OF THE DRIVE EQUIPMENT IN THE EVENT OF EXCESSIVE LOADING. ALUMINUM SHEAR PINS WILL BE FURNISHED TO TRANSMIT TORQUE FROM THE DRIVING HUB TO THE SPROCKET RIM AND WILL INCLUDE POLYMERIC SEPARATORS BETWEEN THE SHEAR FACES TO PREVENT SEIZING. THE SHEAR PINS WILL BE SHIPPED LOOSE AND ARE TO BE INSTALLED BY THE PURCHASER. NOTE THAT THE SHEAR PIN HUB WILL BE A SECONDARY PROTECTION FOR THE EQUIPMENT, THE TORQUE LIMITER, AS DESCRIBED BELOW, WILL BE THE PRIMARY OVERLOAD DEVICE.

THE TORQUE LIMITER FOR THE LONGITUDINALS AND CROSS WILL BE A BRUNEL BIBBIGARD SERIES JSE1-0200 BALL DETENT TYPE. THE TORQUE LIMITER WILL BE MANUFACTURED OF TYPE 316 STAINLESS STEEL AND WILL INCLUDE O-RING SEALS, SAFETY ELEMENT RELUBE PROVISIONS, GREASE FITTINGS AND GREASE RELIEF VALVES. THE TORQUE LIMITER IN THE LONGITUDINAL FORE BAY WILL BE FACTORY PRE-SET TO RELEASE AT 6100 IN-LBS. THE TORQUE LIMITER IN THE LONGITUDINAL AFT BAY WILL BE FACTORY PRE-SET TO RELEASE AT 6100 IN-LBS. THE TORQUE LIMITER IN THE CROSS COLLECTORS WILL BE FACTORY PRE-SET TO RELEASE AT 4000 IN-LBS. THE TORQUE LIMITERS WILL BE EXTERNALLY ADJUSTABLE & DISCONNECTABLE.

EACH TORQUE LIMITER INCLUDES A SAFETY ELEMENT THAT, UPON TORQUE OVERLOAD, WILL EXTEND AND CONTACT THE ACTUATOR ARM OF A DOUBLE THROW LIMIT SWITCH WHICH, IN TURN, WILL SHUT OFF THE MOTOR AND ENERGIZE AN ALARM CIRCUIT. THE LIMIT SWITCH WILL HAVE A NEMA 4/4X ENCLOSURE AND WILL BE PROVIDED WITH A TYPE 316 STAINLESS STEEL SUPPORT BRACKET FOR POSITIONING ADJACENT TO THE TORQUE LIMITER. ANY WIRING AND/OR ALARMS ARE NOT FURNISHED BY Evoqua Water Technologies.

DRIVEN SPROCKET

THE DRIVEN SPROCKET WILL CONSIST OF A POLYMERIC TOOTHED RIM BOLTED TO A SPLIT POLYMERIC DISHED BODY. THE RIM AND BODY WILL BE MOLDED OF POLYURETHANE. THE BODY WILL HAVE A MACHINED KEYWAY DESIGNED TO RESTRICT THE LATERAL MOVEMENT OF THE KEY.

THE SPROCKET RIM WILL NOT BE LESS THAN 33.25" PITCH DIAMETER AND HAVE 40 TEETH.

DRIVE CHAIN TIGHTENER

THE DRIVE CHAIN ARRANGEMENT WILL INCLUDE A CHAIN TIGHTENER TO TAKE UP EXCESSIVE SLACK IN THE DRIVE CHAIN. THE TIGHTENER ASSEMBLY WILL INCLUDE A TYPE 316 STAINLESS STEEL SLIDE BASE AND MOUNTING BRACKET WITH A SELF-CENTERING AND SELF-LUBRICATED POLYURETHANE IDLER SPROCKET.

CHAIN GUARD

THE DRIVE CHAIN AND SPROCKETS LOCATED ABOVE THE OPERATING FLOOR WILL BE COVERED WITH A REMOVABLE METAL GUARD OF 14GA TYPE 316 STAINLESS STEEL.

EQUIPMENT FASTENERS

ALL ASSEMBLY HARDWARE WILL BE TYPE 316 STAINLESS STEEL.

ANCHOR BOLTS

ALL ANCHOR BOLTS SUPPLIED WILL BE TYPE 316 STAINLESS STEEL THREADED ROD AND WILL BE SET USING SIMPSON STRONG-TIE AT-XP ADHESIVE. THEY WILL BE FURNISHED BY EVOQUA WATER TECHNOLOGIES AND WILL BE OF AMPLE SIZE AND STRENGTH FOR THE PURPOSE INTENDED. ALL ANCHOR BOLTS WILL BE SET IN PLACE BY THE CLIENT'S CONTRACTOR IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

PAINT NOTE

NO PAINTING REQUIRED ON THIS PROJECT.

NON-FERROUS MATERIAL, STAINLESS STEEL AND GALVANIZED SURFACES PROVIDED BY EVOQUA WATER TECHNOLOGIES TO REMAIN UNPAINTED.

DRIVE UNIT SPEED REDUCERS, MOTORS AND CONTROLS TO REMAIN MANUFACTURER'S STANDARD FINISH.

SAFETY HAZARD WARNING LABELS

LABELS ARE AFFIXED ON Evoqua Water Technologies EQUIPMENT WHEN A VISUAL WARNING IS APPROPRIATE. THE EQUIPMENT OWNER IS RESPONSIBLE FOR KEEPING THESE LABELS VISIBLE AND IN GOOD CONDITION. REPLACEMENT LABELS ARE AVAILABLE FROM THE EVOQUA WATER TECHNOLOGIES PARTS DEPARTMENT.

ERECTION INFORMATION

EVOQUA WATER TECHNOLOGIES IS NOT RESPONSIBLE FOR ENLARGING OR CLOSING CONCRETE OPENINGS, REMOVAL AND/OR CUTTING BACK EXISTING ANCHORS FLUSH WITH CONCRETE, REMOVING CONCRETE OBSTRUCTIONS, OR FILLING CONCRETE RECESSES TO ALLOW INSTALLATION OF NEW EQUIPMENT.

SPARE PARTS

SPARE PARTS FOR THE LONGITUDINAL COLLECTORS WILL BE FURNISHED BY EVOQUA WATER TECHNOLOGIES, IN ACCORDANCE WITH SECTION 46 43 11, 1.09B

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	20	W3T543034	FLIGHT; 3 X 8 DIAMOND (LONGS, STANDARD WIDTH)
2	8	W3T543035	FLIGHT; 3 X 8 DIAMOND (CROSS)
3	10	W2T319512	COLLECTOR CHAIN STRAND; HS730; 10'-0" LG.
4	18'	W2T119925	DRIVE CHAIN; NH78
5	18'	W3T472529	DRIVE CHAIN; ENV78B
6	1	W3T377627	12T SPROCKET; 4-1/2" BORE (LONG)
7	1	W3T425729	12T SPROCKET; 2-1/2" BORE (CROSS)
8	1	W3T331972	17T SPROCKET; 4-1/2" BORE (LONG)
9	1	W2T331969	17T SPROCKET; 4" BORE (LONG)
10	1	W2T331975	17T SPROCKET; 2-1/2" BORE (CROSS)
11	2	W3T373650	WALL BEARING HUB BALL; (4-1/2" DIA. FOR LONGS)
12	2	W3T366756	WALL BEARING HUB BALL; (4" DIA. FOR LONGS)
13	2	W3T380536	WALL BEARING HUB BALL; (2-1/2" DIA. FOR CROSS)
14	4	W3T555911	FLIGHT; 3 X 8 DIAMOND (LONGS, SHORTER WIDTH)
15	1	W3T368960	DRIVEN SPROCKET ASSEMBLY (LONG)
16	1	W3T307740	DRIVEN SPROCKET ASSEMBLY (CROSS)
17	34	W2T______	SHEAR PIN FOR SK9053.1
18	34	W2T______	SHEAR PIN FOR SK9043.1
19	34	W2T______	SHEAR PIN FOR SK9033.1
20	50	W2T	SHEAR PIN FOR SK9023.1

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250/
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

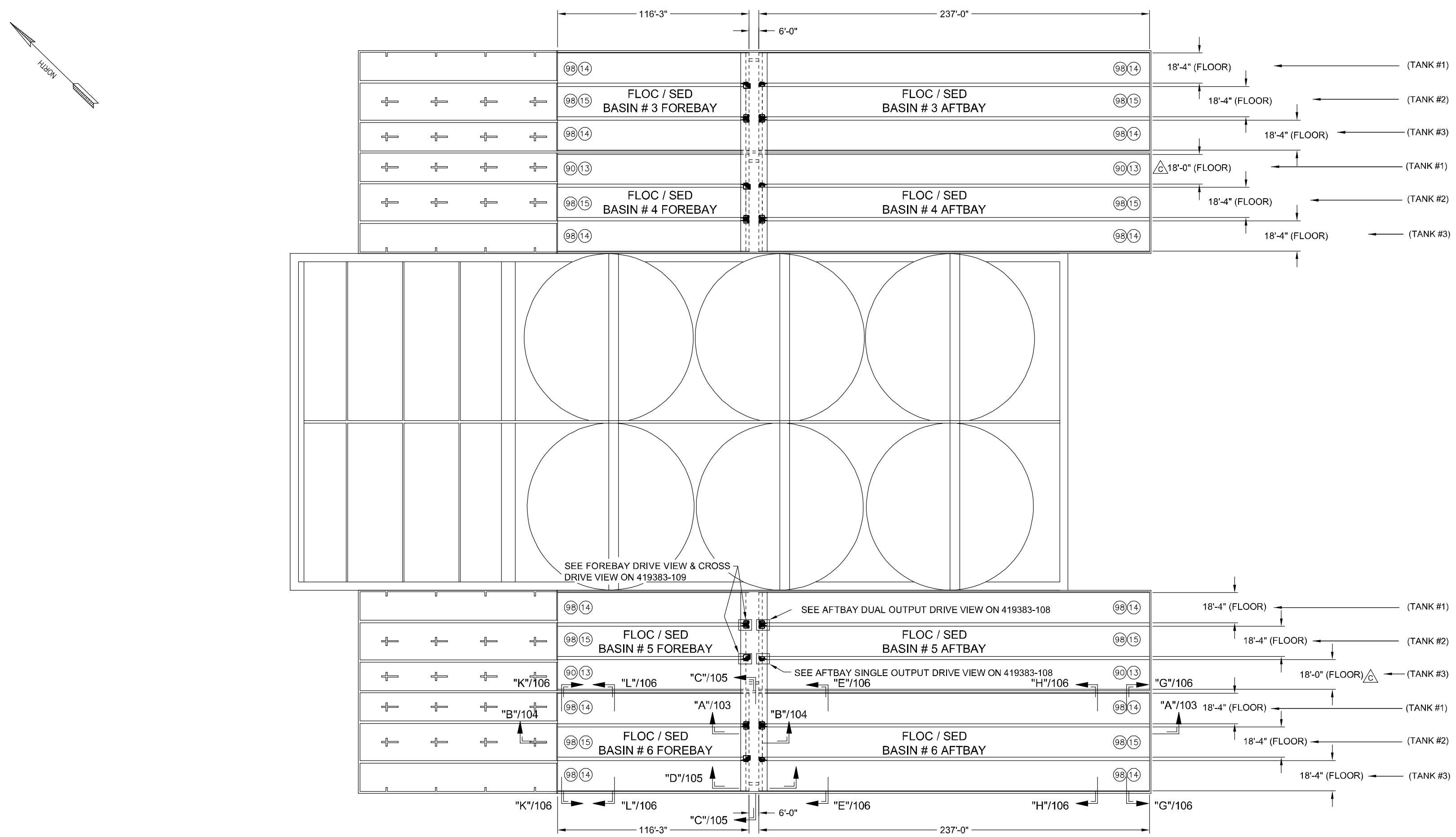
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES, REV'D CORNERSHAFTS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	11/5/21	GLH	AJK	JMM	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - SPECIFICATIONS CSSC (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES
MGD BY: J.MCDOND	SCALE NTS	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-101	1 OF 1	B

STD 24x36_D v4.0 BAR = 1" AT PLOT SCALE

A7.3



PLAN VIEW
PRIMARY SEDIMENTATION BASINS

SCALE: 1/16" = 1'-0"

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06; XXX ± .005; X/X ± 1/16; ANG ± 0.50°

MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REV'D TANK WIDTHS IN #4 & 5, CHGING FLIGHTS, HEADSHAFTS & CORNERSHAFTS		GLH	AJK	SW	
B	REVISED DRIVES FROM EURODRIVE TO NORD ADDED DUAL LIMIT SWITCHES	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	
PART NUMBER: N/A		

TITLE: GEN. ARRANGEMENT - PLAN VIEW CSSC
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS
& (4) CROSS COLLECTORS

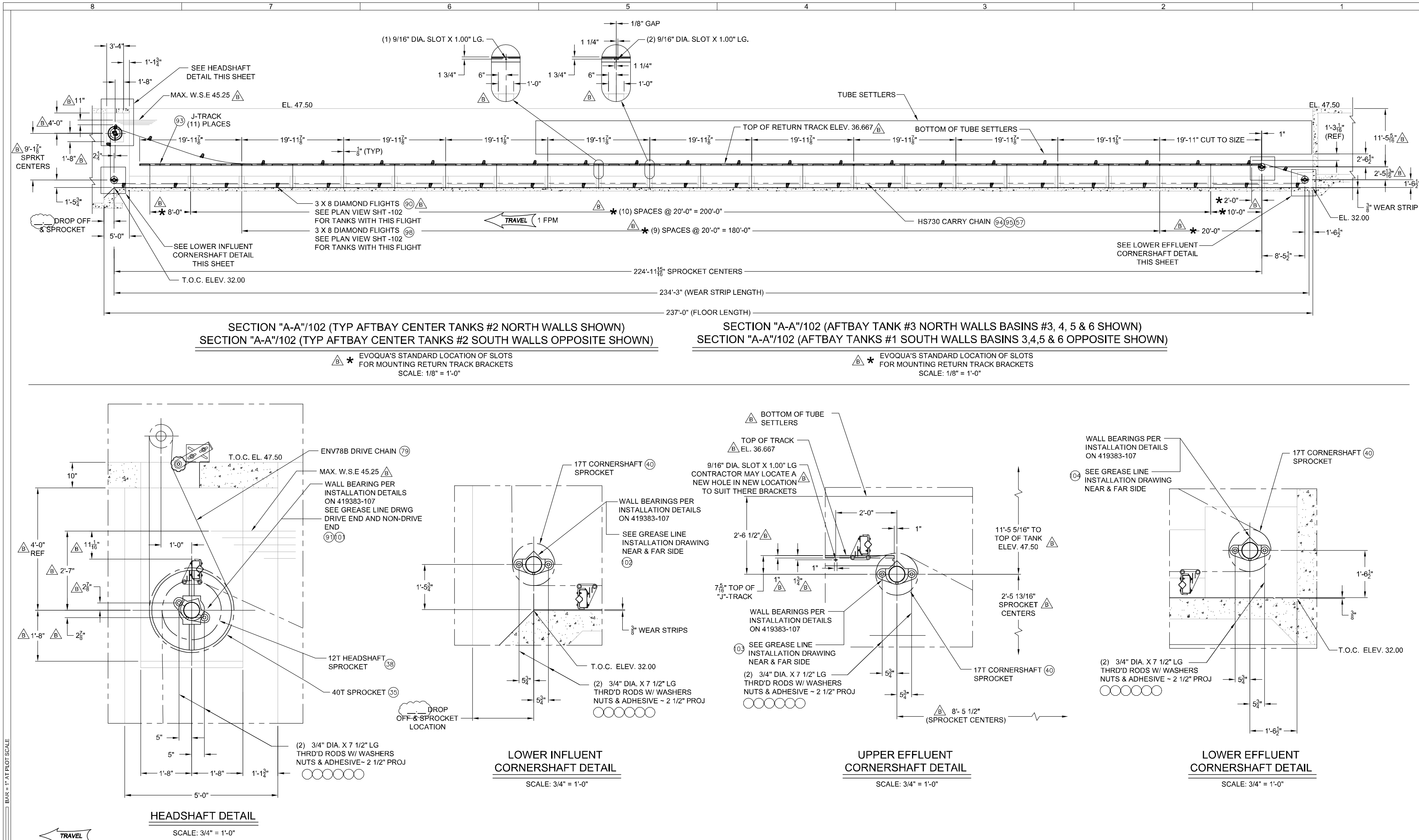
CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-102	1 OF 1	C

STD 22x34 D v4.0

BAR = 1" AT PLOT SCALE



FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES ALL WEIGHTS ARE POUNDS AND EACH DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, XXX ± .005, X/X ± 1/16, ANG ± 0.50°
MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS, REV'D HEADSHAFT LOCATION, ADDED TUBE SETTLER DIM'S, ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE DATE: 11/5/21
CKD BY: G.HALASE DATE: 11/5/21
APPD BY: A.KLUESS DATE: 11/5/21
MGD BY: J.MCDOND SCALE: NTS
PART NUMBER: N/A

TITLE: GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

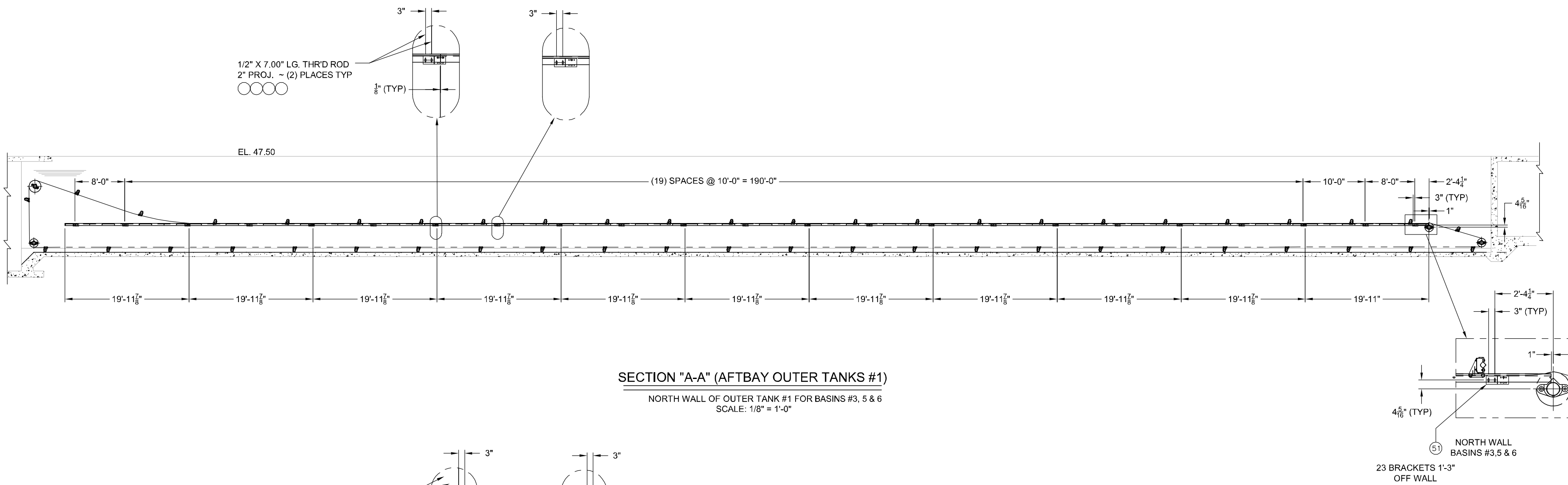
EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-103	1 OF 4	B

STD-22x34_D v4.0

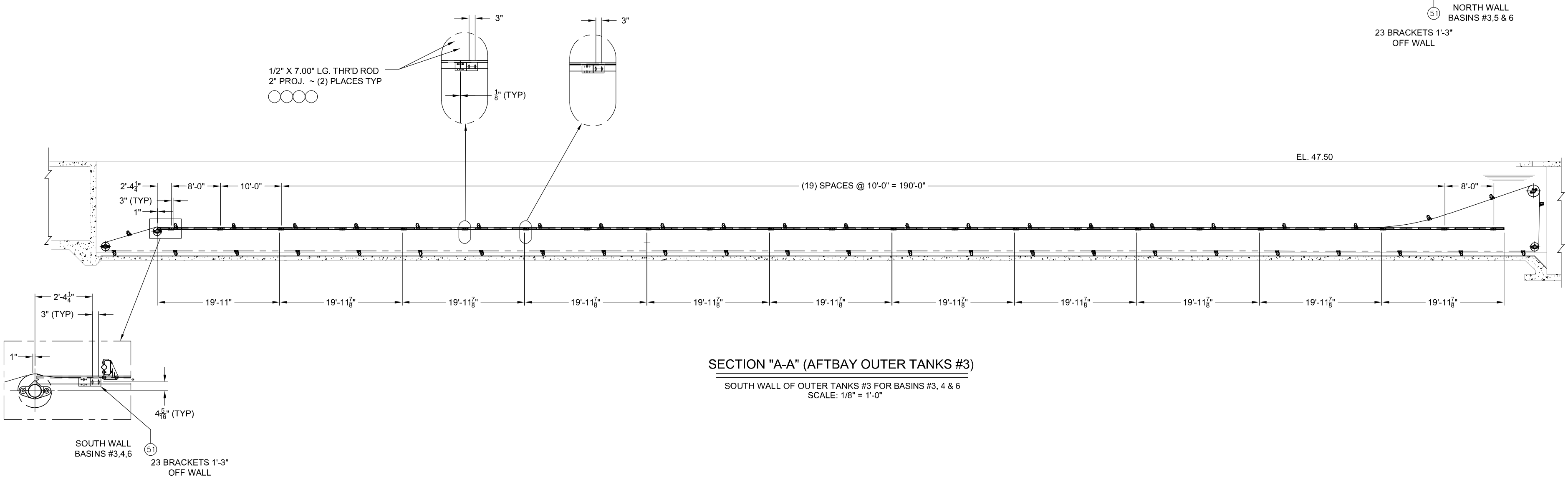
BAR = 1" AT PLOT SCALE

A7.4



SECTION "A-A" (AFTBAY OUTER TANKS #1)

NORTH WALL OF OUTER TANK #1 FOR BASINS #3, 5 & 6
SCALE: 1/8" = 1'-0"



SECTION "A-A" (AFTBAY OUTER TANKS #3)

SOUTH WALL OF OUTER TANKS #3 FOR BASINS #3, 4 & 6
SCALE: 1/8" = 1'-0"

FOR APPROVAL ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250/
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS, REV'D HEADSHAFT LOCATION, ADDED TUBE SETTLER DIM'S, ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	TITLE: GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE: NTS	

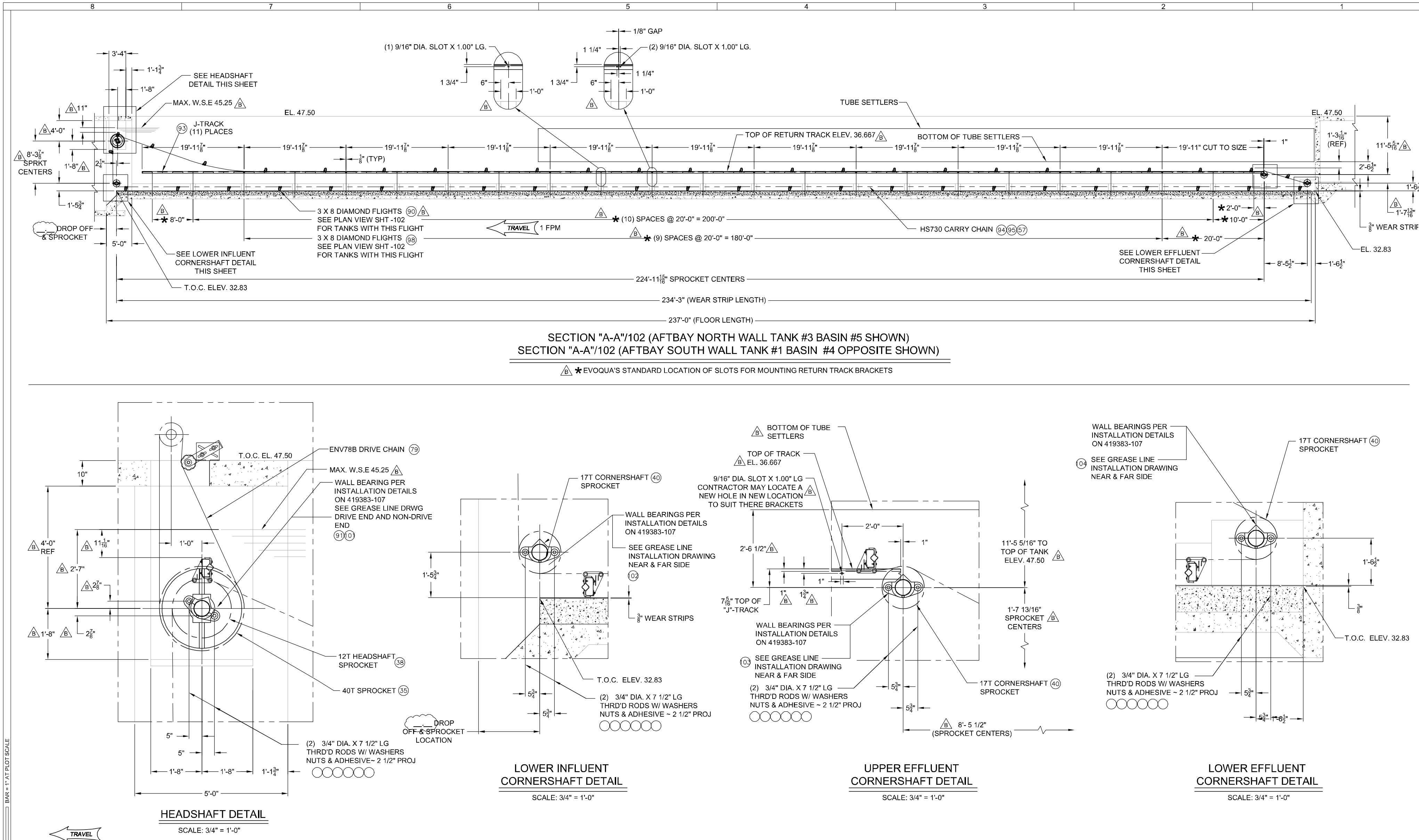
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-103	2 OF 4	B

BAR = 1" AT PLOT SCALE

STD-22x34_D v4.0

A7.5

A7.6



THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES ALL WEIGHTS ARE POUNDS AND EACH DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, XXX ± .005, X/X ± 1/16, ANG ± 0.50°

MACHINED SURFACES 250

FOR APPROVAL ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS, REV'D HEADSHAFT LOCATION, ADDED TUBE SETTLER DIM'S, ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE DATE: 11/5/21
CKD BY: G.HALASE DATE: 11/5/21
APP'D BY: A.KLUESS DATE: 11/5/21
MGD BY: J.MCDOND SCALE: NTS
PART NUMBER: N/A

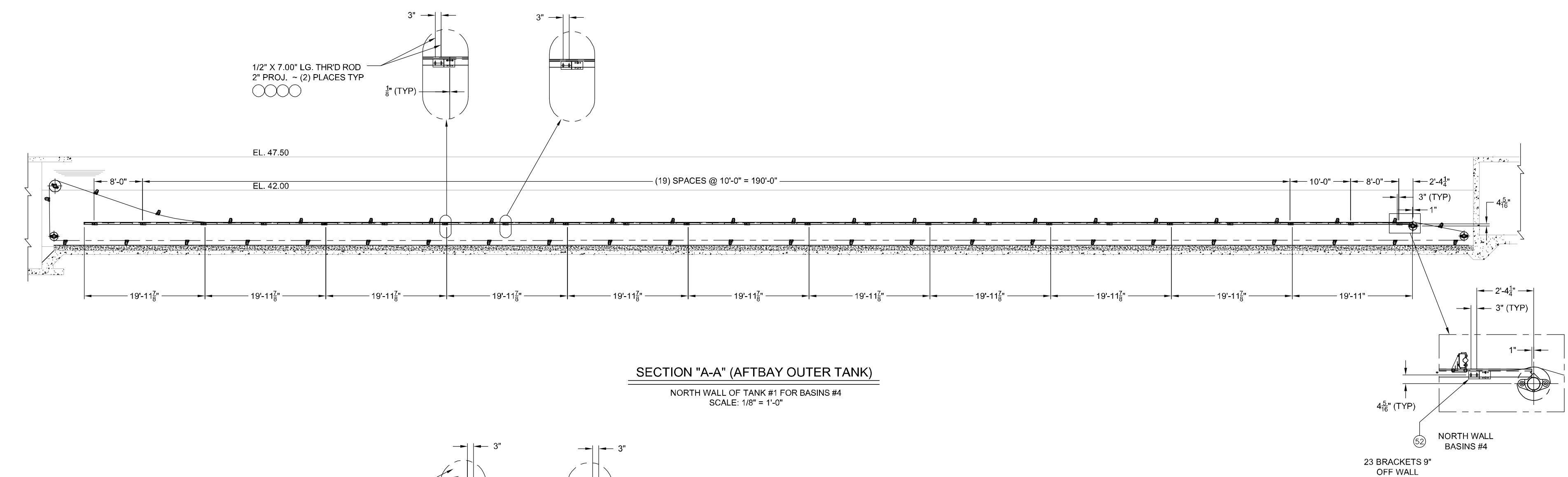
TITLE: GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

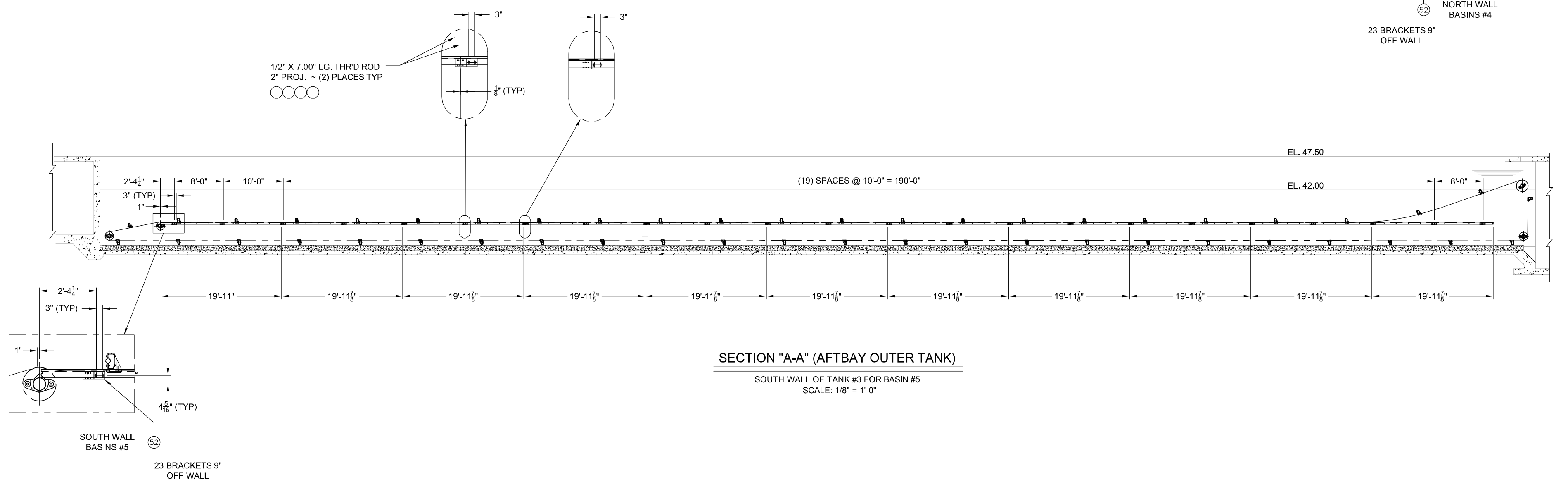
PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-103	3 OF 4	B

STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE



SECTION "A-A" (AFTBAY OUTER TANK)

NORTH WALL OF TANK #1 FOR BASINS #4
SCALE: 1/8" = 1'-0"



SECTION "A-A" (AFTBAY OUTER TANK)

SOUTH WALL OF TANK #3 FOR BASIN #5
SCALE: 1/8" = 1'-0"

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250/
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS, REV'D HEADSHAFT LOCATION, ADDED TUBE SETTLER DIM'S, ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY:	DATE
G.HALASE	11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDOND	SCALE NTS
PART NUMBER N/A	

TITLE GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

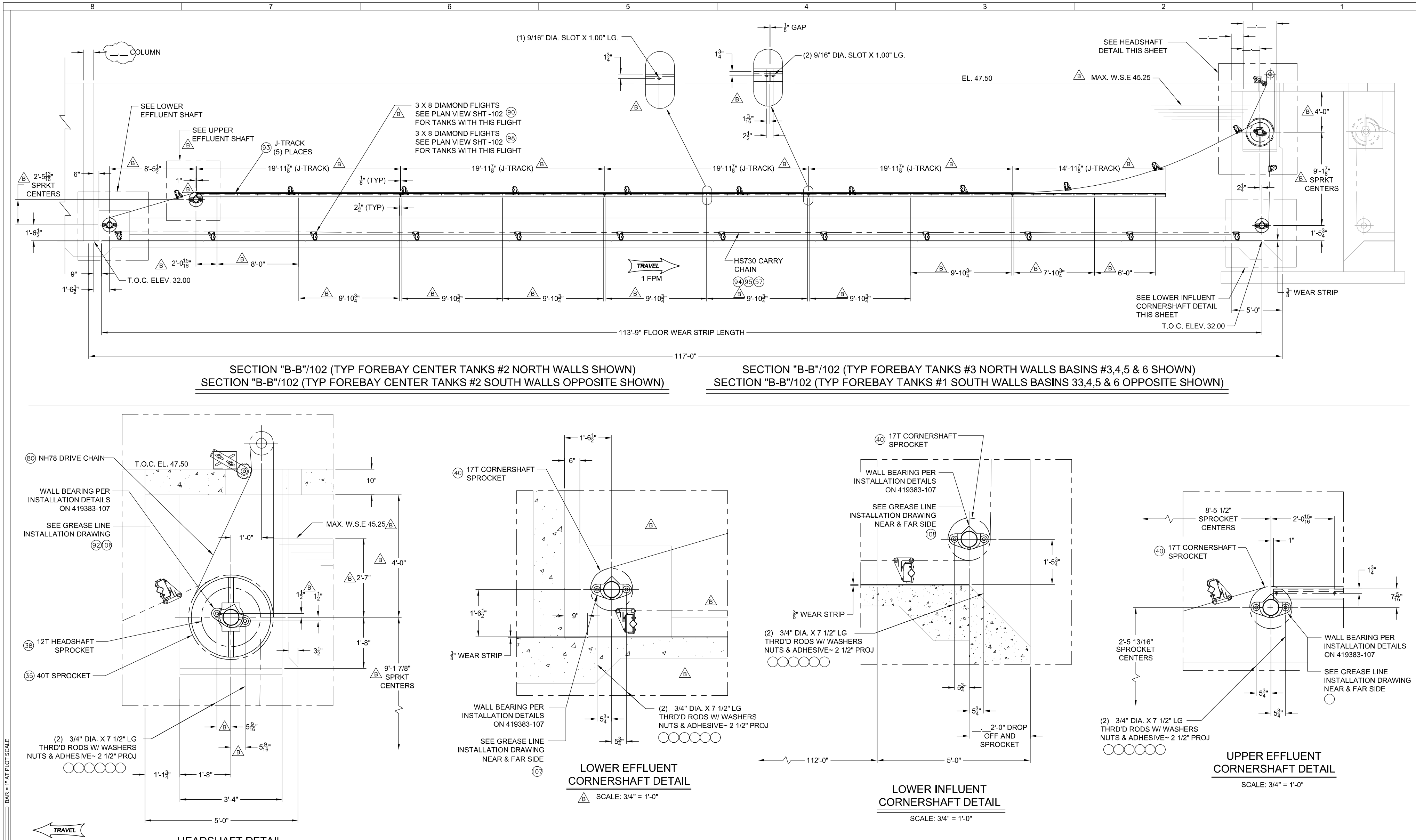
CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-103	4 OF 4	B

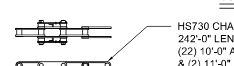
STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE

A7.7



TRAVEL

HEADSHAFT DETAIL
SCALE: 3/4" = 1'-0"



HS730 CHAIN
242'-0" LENGTH PER STRAND
(22) 10'-0" ATTACHMENT SPACINGS
& (2) 11'-0" ATTACHMENT SPACINGS
(94)(95)(57)

COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90, REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	

TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

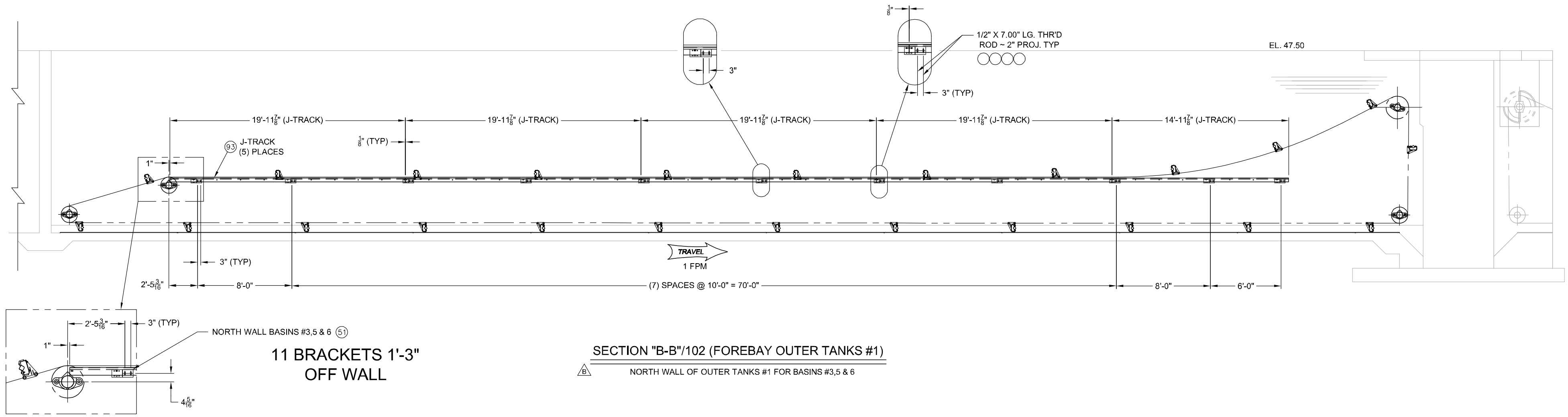
CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	1 OF 4	B

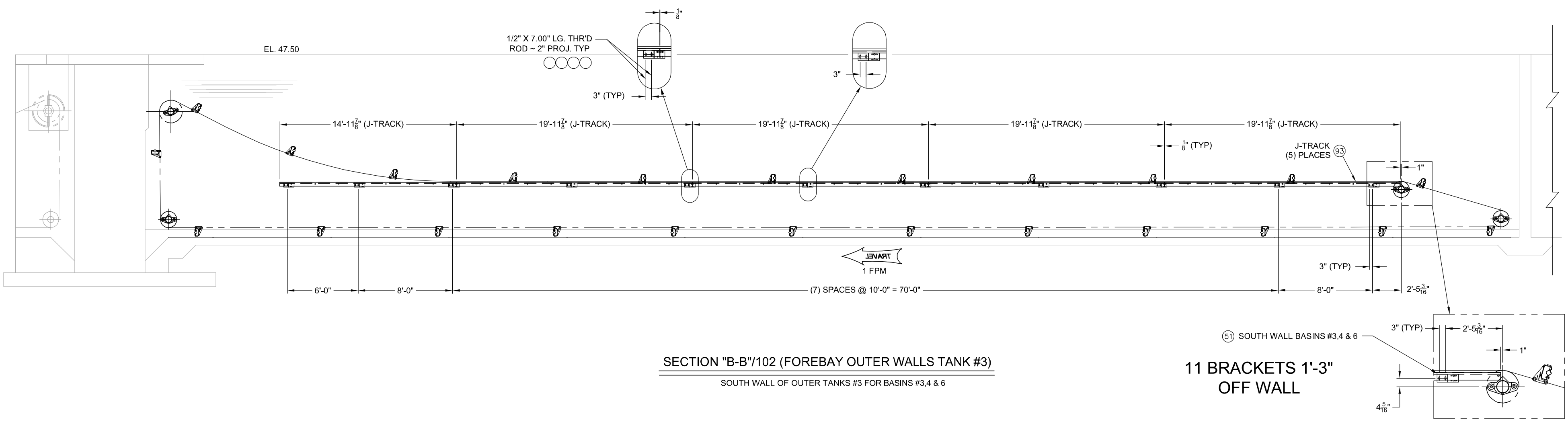
STD-22x34_D v4.0

BAR = 1" AT PLOT SCALE



SECTION "B-B"/102 (FOREBAY OUTER TANKS #1)

B NORTH WALL OF OUTER TANKS #1 FOR BASINS #3,5 & 6



SECTION "B-B"/102 (FOREBAY OUTER WALLS TANK #3)

SOUTH WALL OF OUTER TANKS #3 FOR BASINS #3,4 & 6

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

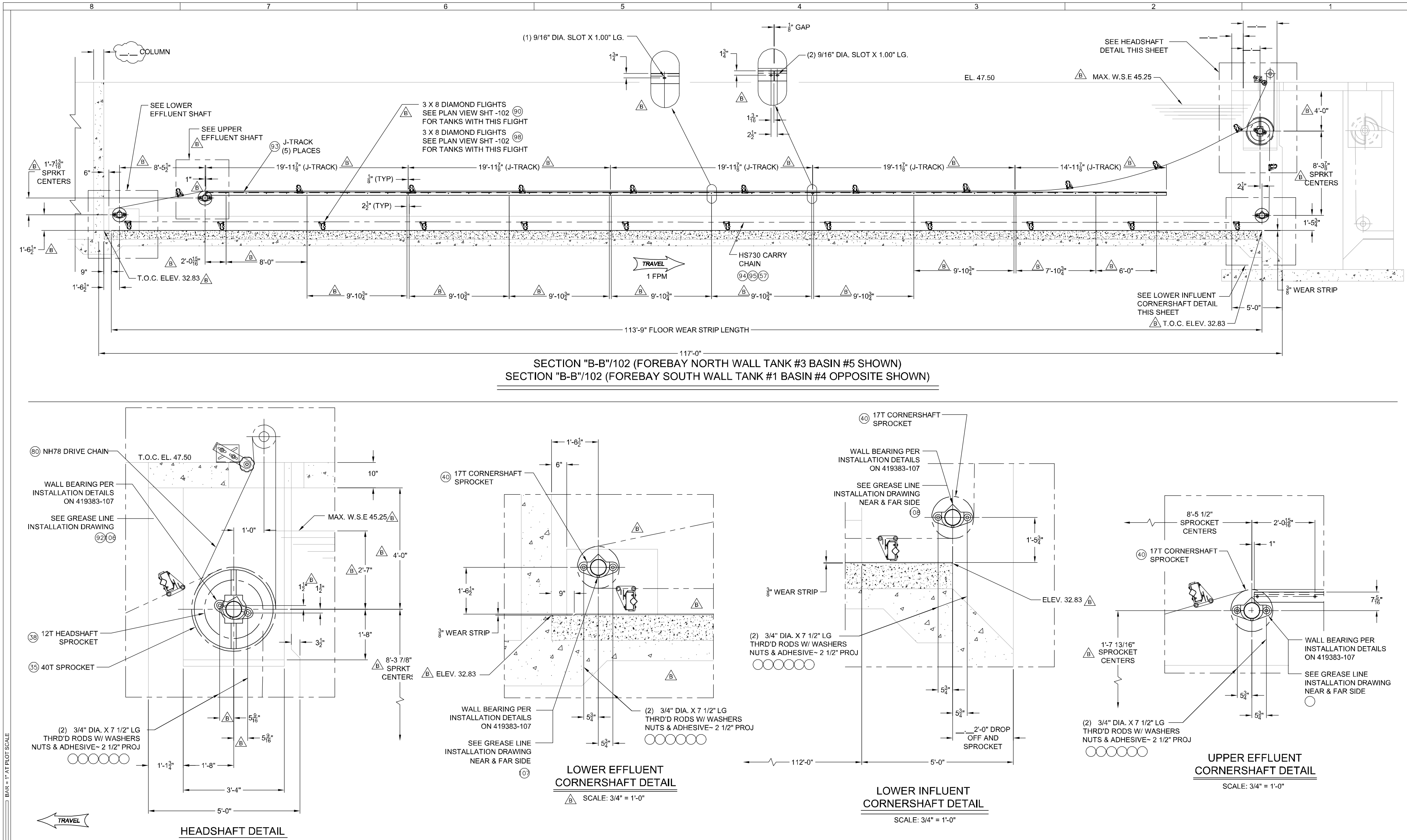
STANDARD TOLERANCE: .XX ± .06; .XXX ± .005; X/X ± 1/16; ANG ± 0.50°
MACHINED SURFACES: 250/

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90, REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21	EVOQUA WATER TECHNOLOGIES, WAUKESHA WI USA, +1 262-547-0141
MGD BY: J.MCDOND	SCALE: NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	2 OF 4	B

STD-22x34_D v4.0 BAR = 1" AT PLOT SCALE



FOR APPROVAL ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

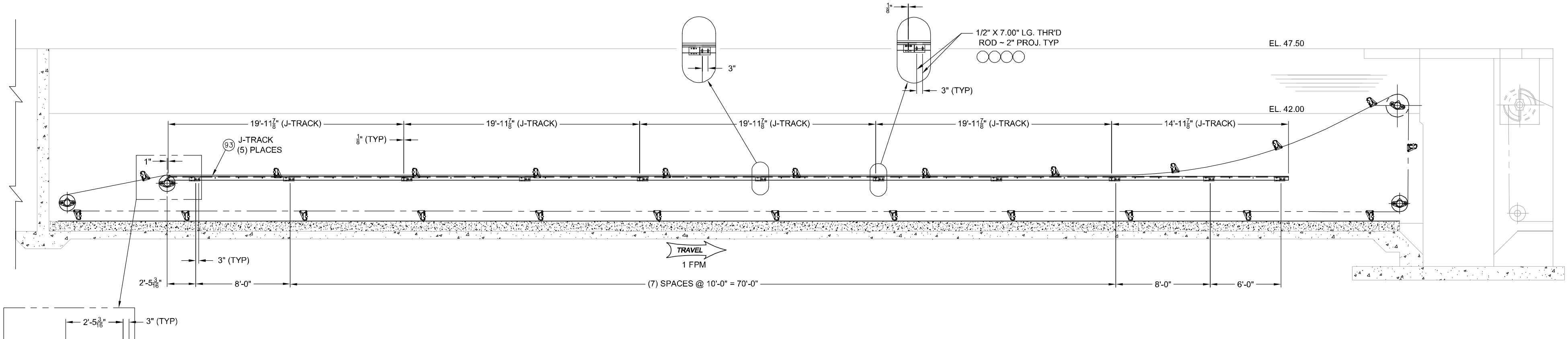
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES ALL WEIGHTS ARE POUNDS AND EACH DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90, REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE: NTS	
PART NUMBER: N/A	PROJ/PROD NUMBER: 2033/001724	CODE: M-GA01
FILE/DRAWING NUMBER: 419383-104	SHEET: 3 OF 4	REV: B

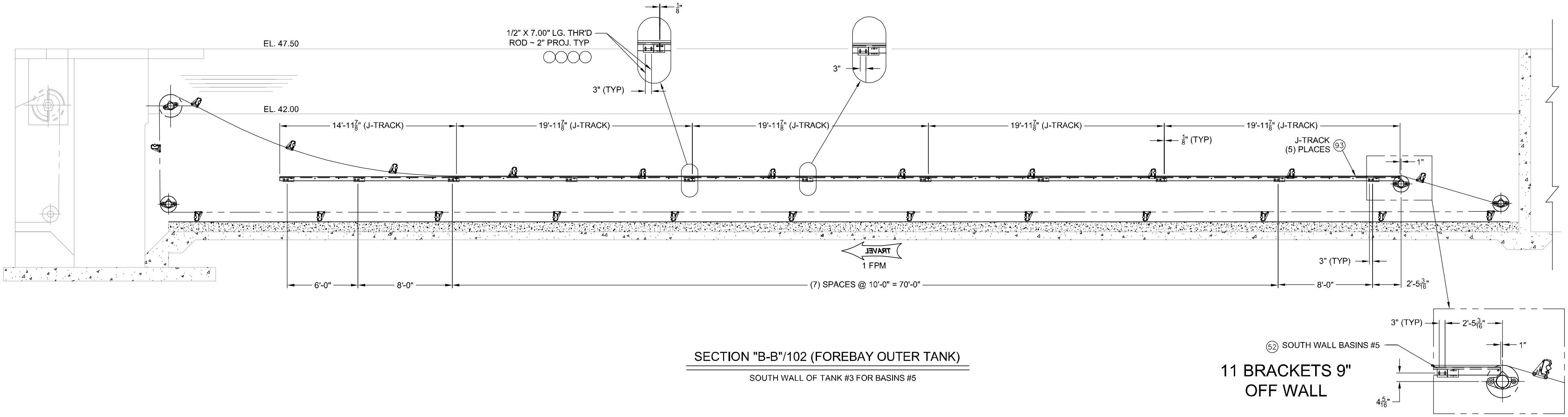
STD-22x34_D v4.0 — BAR = 1" AT PLOT SCALE



11 BRACKETS 9" OFF WALL

SECTION "B-B"/102 (FOREBAY OUTER TANK)

B NORTH WALL OF TANK #1 FOR BASINS #4



SECTION "B-B"/102 (FOREBAY OUTER TANK)

SOUTH WALL OF TANK #3 FOR BASINS #5

11 BRACKETS 9" OFF WALL

FOR APPROVAL ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES ALL WEIGHTS ARE POUNDS AND EACH DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90, REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

COMPANY CONFIDENTIAL INFORMATION
THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN, INCLUDING THE DESIGN CONCEPTS AND THOSE ARISING THEREFROM, ARE THE PROPERTY OF EVOQUA AND/OR ITS AFFILIATES AND ARE SUBMITTED IN CONFIDENCE. THEY MAY BE USED ONLY FOR THE EXPRESS PURPOSE FOR WHICH THEY ARE PROVIDED AND MUST NOT BE DISCLOSED, REPRODUCED OR COPIED IN ANY FORM, INCLUDING IN ELECTRONIC FORMAT, LOANED OR USED IN ANY OTHER MANNER WITHOUT THE EXPRESS WRITTEN CONSENT OF EVOQUA. ALL PATENT RIGHTS ARE RESERVED. THIS DOCUMENT AND DERIVATIVE WORKS THEREOF ARE PROTECTED UNDER APPLICABLE COPYRIGHT LAWS. UPON DEMAND OF EVOQUA, THIS DOCUMENT, ALONG WITH ALL COPIES AND EXTRACTS, AND ALL RELATED NOTES AND ANALYSES MUST BE RETURNED TO EVOQUA OR DESTROYED, AS INSTRUCTED BY EVOQUA. ACCEPTANCE OF THE DELIVERY OF THIS DOCUMENT CONSTITUTES AGREEMENT TO THESE TERMS.

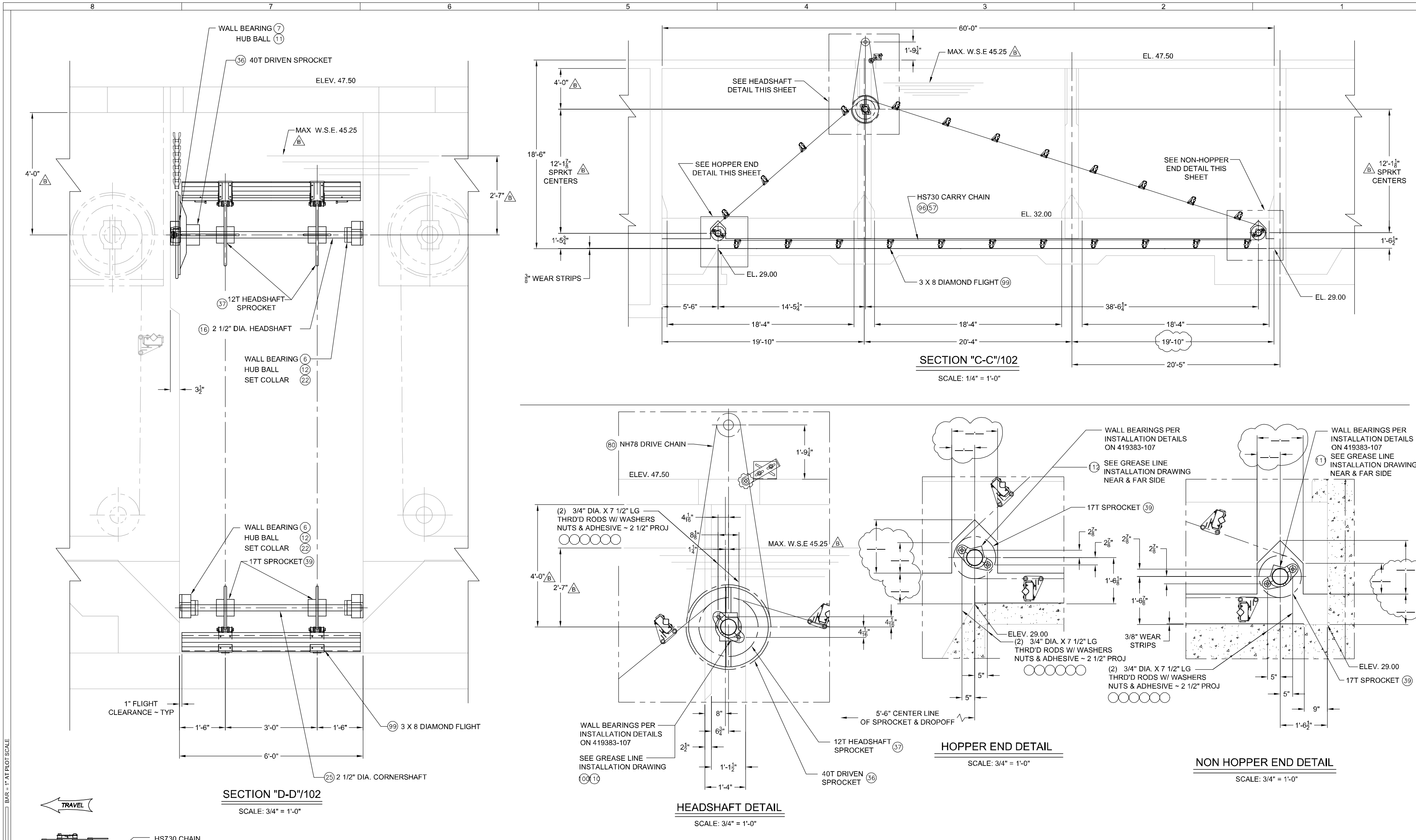
DWN BY: G.HALASE	DATE: 11/5/21	TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21	EVOQUA WATER TECHNOLOGIES
MOD BY: J.MCDOND	SCALE: NTS	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

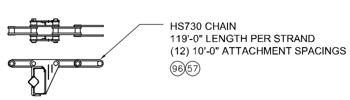
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	4 OF 4	B

STD-22x34_D v4.0

BAR = 1" AT PLOT SCALE

A7.12





COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REVISED HEADSHAFT & WATER ELEV.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	
PART NUMBER: N/A		

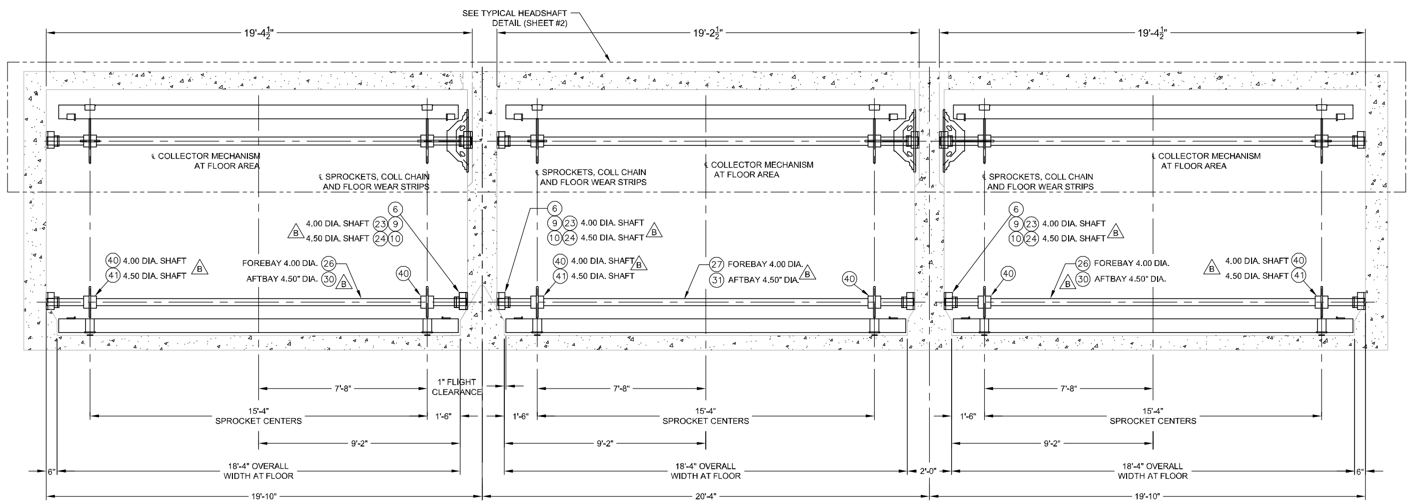
TITLE: GEN. ARRANGEMENT - CROSS COLLECTOR ELEVATION
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS
& (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

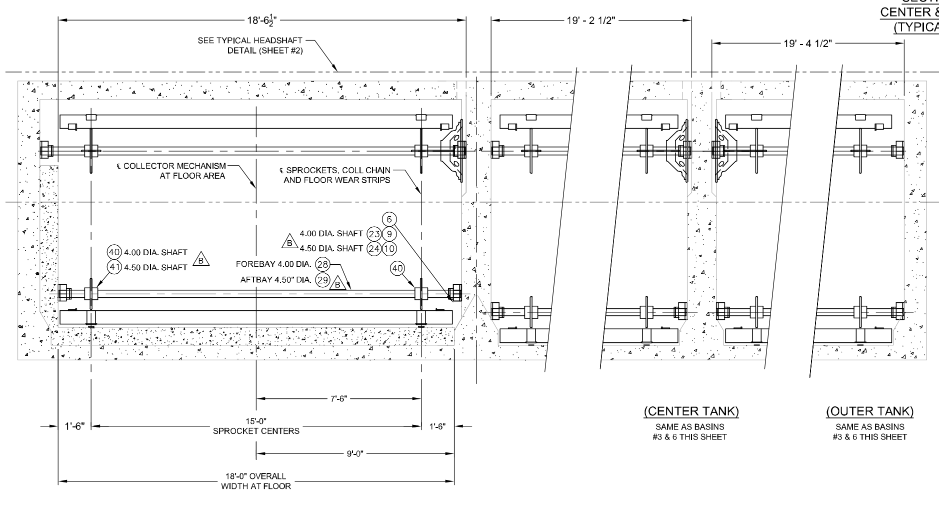
EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-105	1 OF 1	B

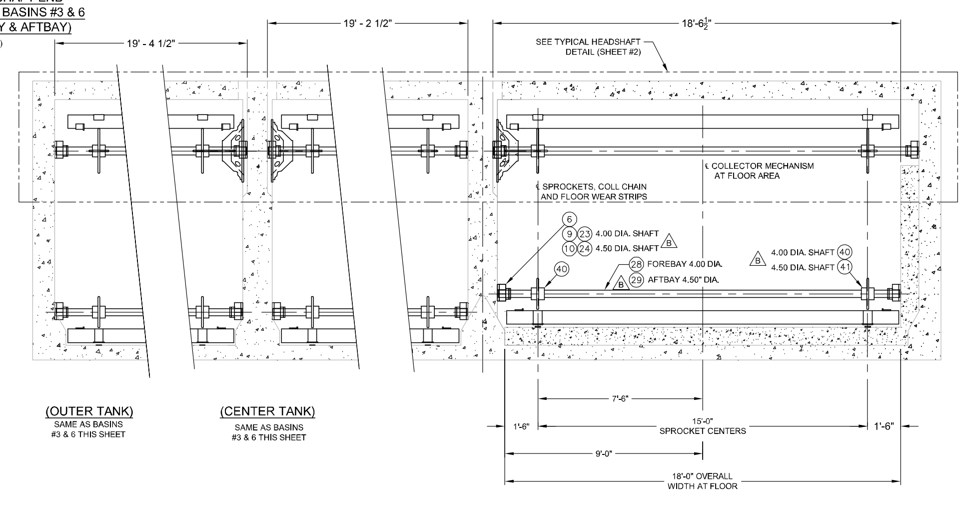
STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE



SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #3 & 6
(TYPICAL FOR FOREBAY & AFTBAY)
(SCALE: 3/8" = 1'-0")



SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #5 SHOWN
(TYPICAL FOR FOREBAY & AFTBAY)
(SCALE: 3/8" = 1'-0")



SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #4 SHOWN
(TYPICAL FOR FOREBAY & AFTBAY)
(SCALE: 3/8" = 1'-0")

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, .XXX ± .005, X/X ± 1/16, ANG ± 0.50°
MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	

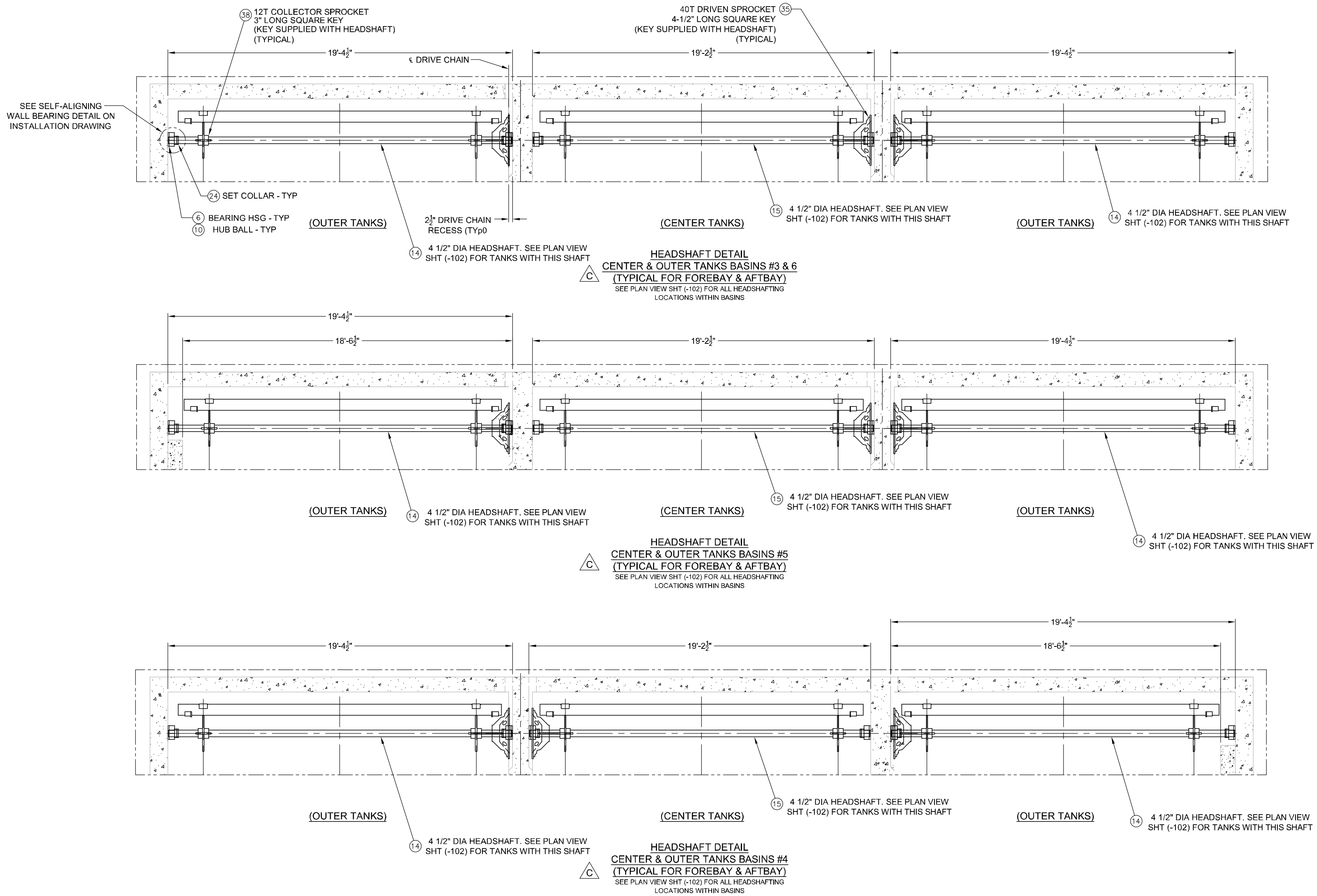
TITLE: GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-106	1 OF 4	C

STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE



INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED HEADSHAFT CALLOUTS & VIEWS	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDOND	SCALE NTS
PART NUMBER N/A	

TITLE GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS
& (4) CROSS COLLECTORS

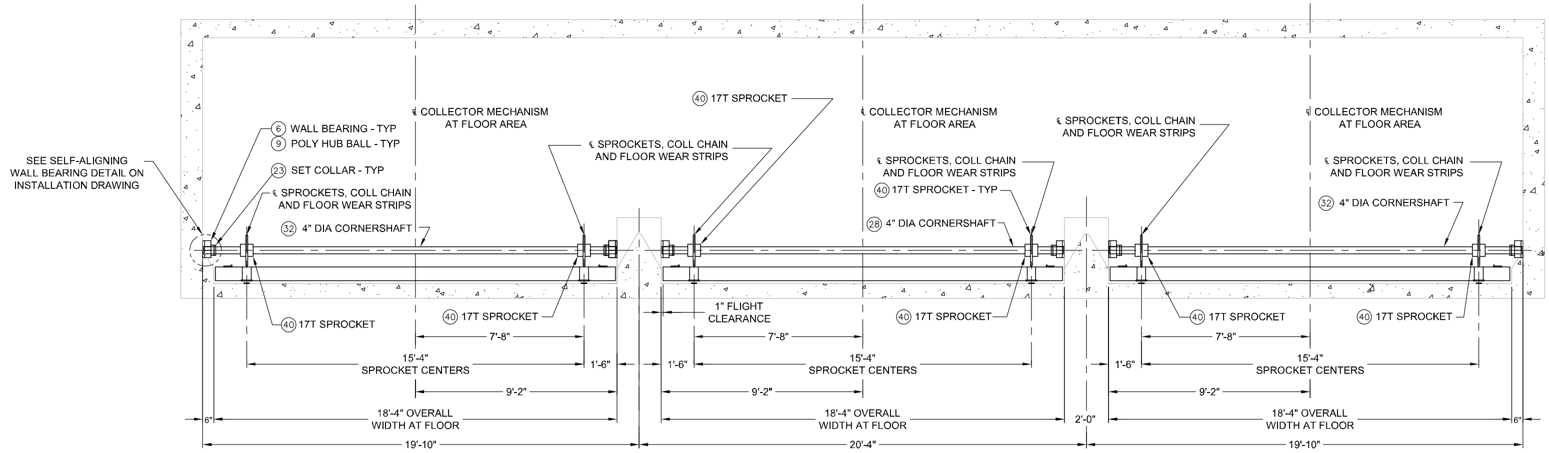
CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

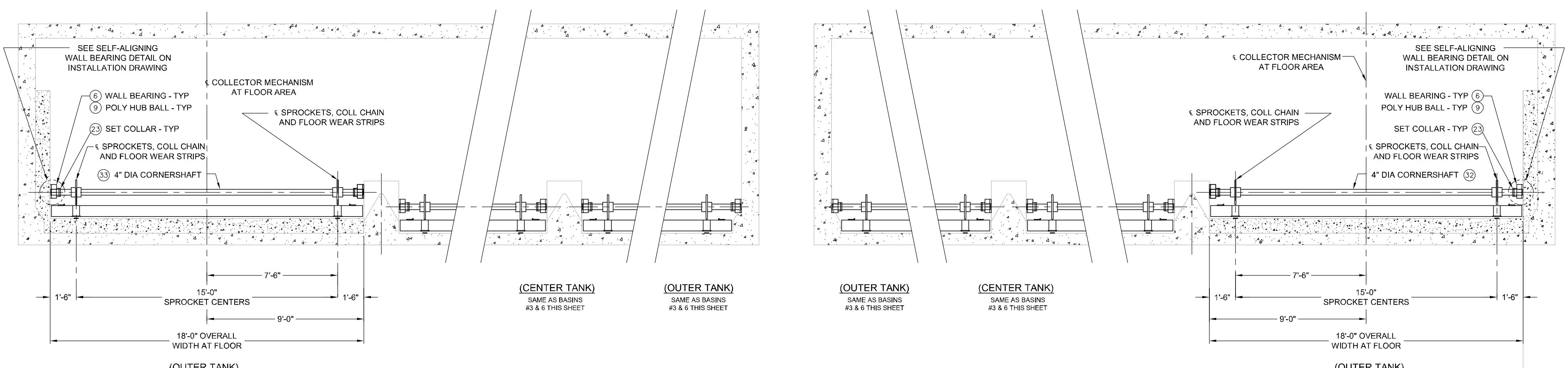
PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-106	2 OF 4	C

STD-22x34_D v4.0

BAR = 1" AT PLOT SCALE



SECTION "G-G" & K-K / 102
FOREBAY & AFTBAY BASINS #3 & 6
(LOWER EFFLUENT END OF TANK)
SEE SHEET (4 OF 4) FOR UPPER
EFFLUENT CORNERSHAFT CALLOUTS
(SCALE: 3/8" = 1'-0")



SECTION G-G & K-K /102 EFFLUENT END
CENTER & OUTER TANKS BASINS #5
(TYPICAL FOR FOREBAY & AFTBAY)
SEE SHEET (4 OF 4) FOR UPPER
EFFLUENT CORNERSHAFT CALLOUTS
(SCALE: 3/8" = 1'-0")

SECTION G-G & K-K /102 EFFLUENT END
CENTER & OUTER TANKS BASINS #4
(TYPICAL FOR FOREBAY & AFTBAY)
SEE SHEET (-107) FOR UPPER
EFFLUENT CORNERSHAFT CALLOUTS
(SCALE: 3/8" = 1'-0")

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

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NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250/
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED CORNERSHAFT CALLOUTS	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	
PART NUMBER: N/A		

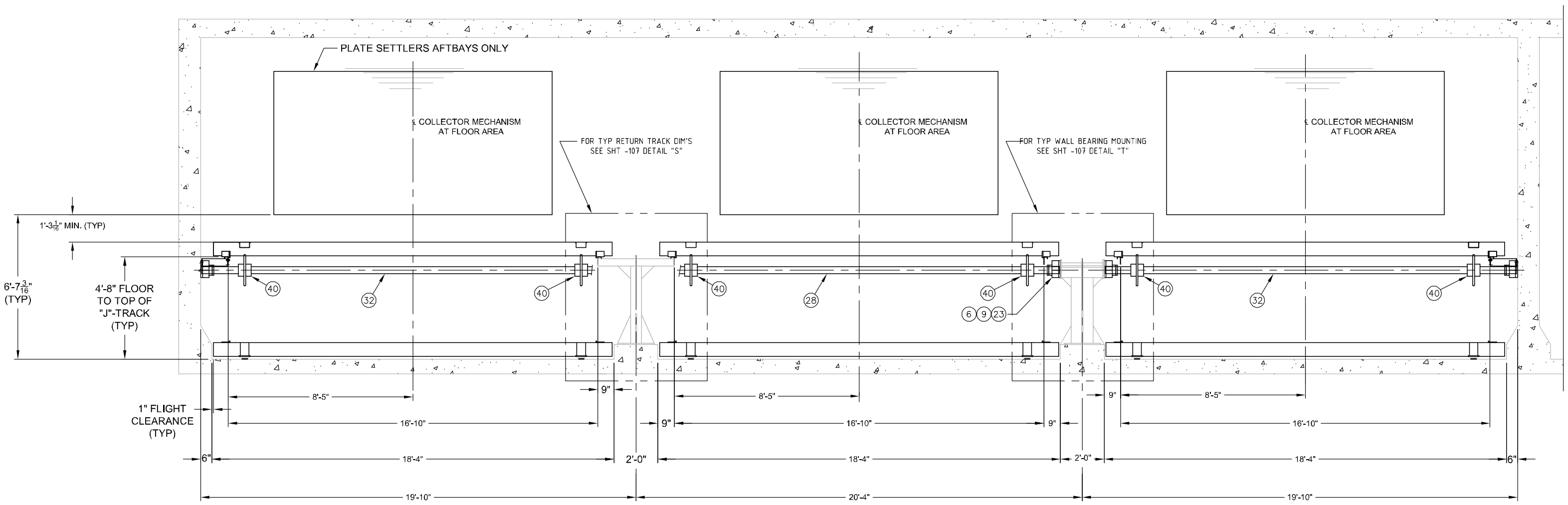
TITLE: GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS
& (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

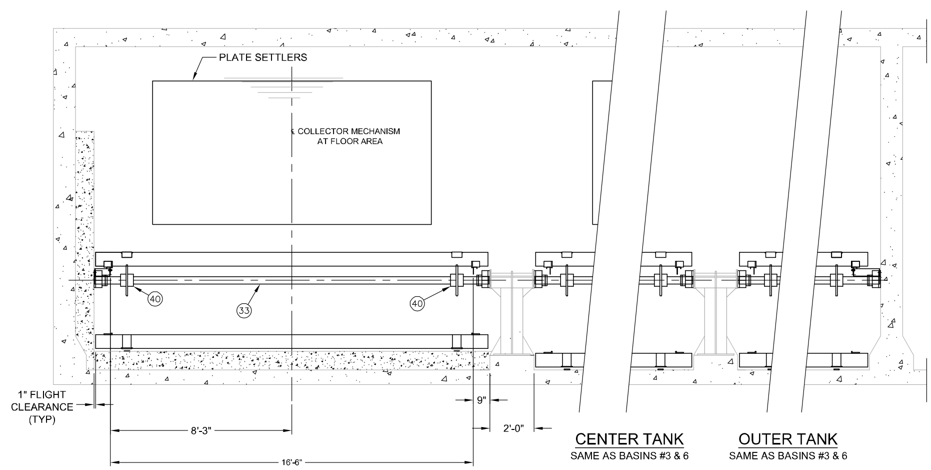
EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-106	3 OF 4	C

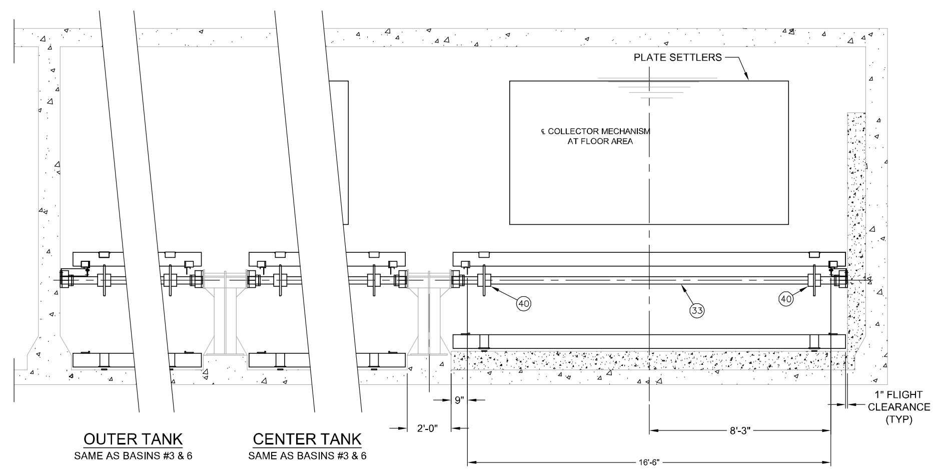
STD-22x34 D v4.0
BAR = 1" AT PLOT SCALE



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY BASINS #3 & 6
(SCALE : 3/8" = 1'-0")



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY
BASINS #5
(SCALE : 3/8" = 1'-0")



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY
BASINS #4
(SCALE : 3/8" = 1'-0")

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REV'D CORNERSHAFT CALLOUTS,REV'D WATER ELEV. LOWERED RETURN TRACKS. REV'D TANK WIDTH	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE: 11/5/21	
CKD BY: G.HALASE	DATE: 11/5/21	
APPD BY: A.KLUESS	DATE: 11/5/21	
MGD BY: J.MCDOND	SCALE: NTS	
PART NUMBER: N/A		

TITLE: GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

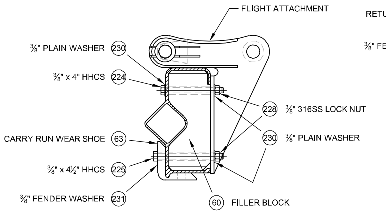
CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

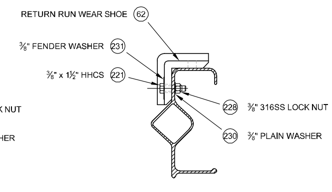
PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-106	4 OF 4	C

STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE

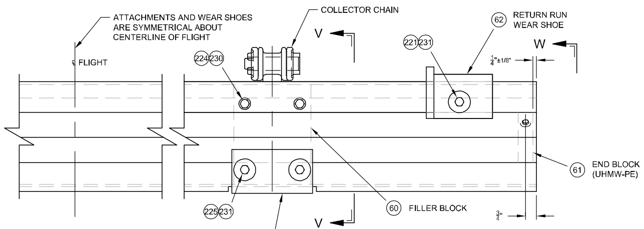
A7.16

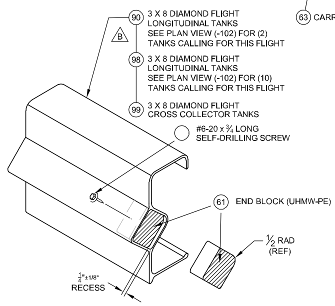


SECTION V-V
(SCALE: 3" = 1'-0")



SECTION W-W
(SCALE: 3" = 1'-0")





TYP END BLOCK INSTALLATION
(SCALE: 3" = 1'-0")

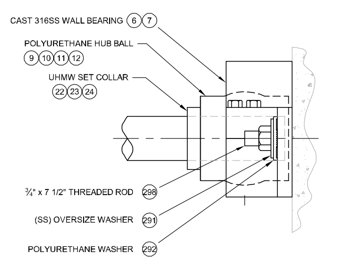
END BLOCK INSTALLATION INSTRUCTIONS:

1) INSTALL END BLOCK INTO END OF FLIGHT AS SHOWN. RECESS END BLOCK APPROXIMATELY ½" INTO END OF FLIGHT.

NOTE: ALIGN ½" RAD EDGE ON END BLOCK TO ½" RAD ON FLIGHT CAVITY.

2) FASTEN END BLOCK IN PLACE WITH (1) #6-20 SELF-DRILLING SCREW. LOCATE SCREW APPROXIMATELY IN CENTER OF END BLOCK (¾" FROM END OF FLIGHT).

FLIGHT ASSEMBLY DETAIL
(SCALE: 3" = 1'-0")



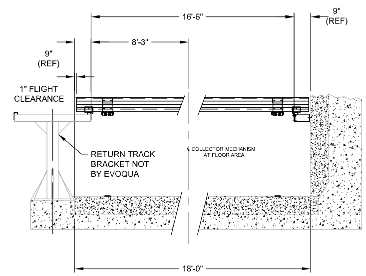
NOTES:

1) NO GROUT OR SHIMS REQUIRED BEHIND BEARINGS IF THE DISTANCE BETWEEN WALLS ARE HELD WITHIN ± 1/2". HOWEVER, IF GROUT IS REQUIRED, GROUT SHIELD PLATES ARE TO BE FURNISHED BY THE CONTRACTOR.

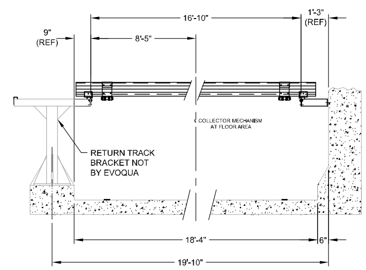
2) UHMW SET COLLARS ARE PROVIDED. TIGHTEN CLAMPING SCREWS TO 36 IN-LBS.

3) ANCHOR BOLT PATTERN MAY BE ROTATED IF ANCHORS INTERFER WITH EXISTING ANCHORS OR WITH ANCHORS FROM OPPOSITE SIDE OF WALL.

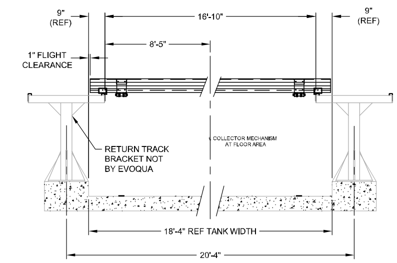
SELF-ALIGNING WALL BEARING DETAIL
(SCALE: 3" = 1'-0")



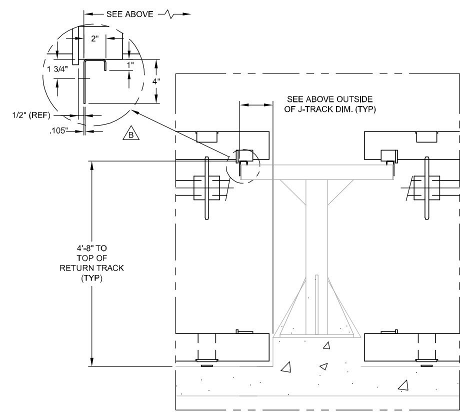
TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY@ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY@ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")

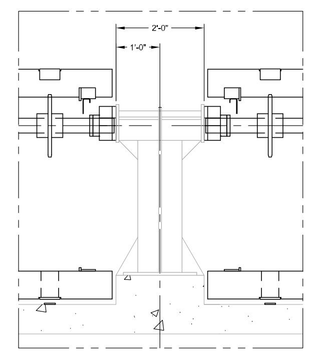


TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY @ KNEE WALLED CENTER TANKS
(SCALE : 1/16" = 1'-0")



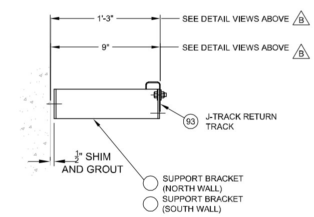
DETAIL "S" / 106 SHEET 4

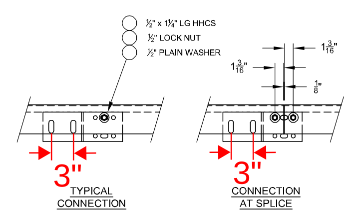
TYPICAL RETURN TRACK MOUNTING DIMENSIONS FOR INNER TANKS
(BRACKETS FOR SUPPORTING J-TRACK NOT BY EVOQUA WATER TECHNOLOGIES)



DETAIL "T" / 106 SHEET 4

TYPICAL WALL BEARING MOUNTING DIMENSIONS FOR INNER TANKS
(BRACKETS FOR SUPPORTING WALL BEARINGS NOT BY EVOQUA WATER TECHNOLOGIES)



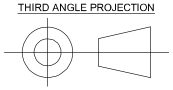


TYPICAL CONNECTION
TO OUTER WALLS ON OUTER TANKS
4-SHAFT AFTBAY

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION



REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90, ADDED & RESTRUCTED DWG		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

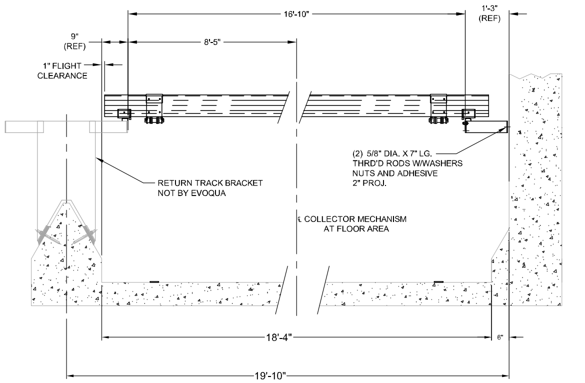
DWN BY: G.HALASE	DATE: 11/5/21	TITLE	GEN. ARRANGEMENT - INSTALLATION DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT	JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21		EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE: NTS		

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-107	1 OF 2	B

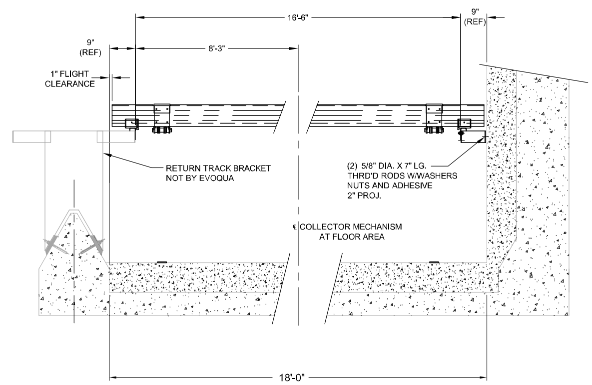
STD-22x34_D v4.0

BAR = 1" AT PLOT SCALE

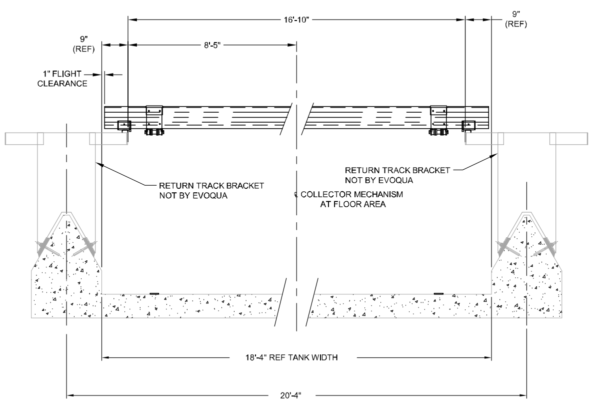
A7.17



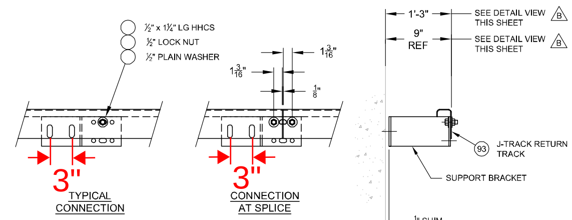
B TRACK CROSS SECTION VIEW OUTER TANKS
4-SHAFT FOREBAY @ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



B TRACK CROSS SECTION VIEW OUTER TANKS
4-SHAFT FOREBAY @ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



B TRACK CROSS SECTION VIEW
4-SHAFT FOREBAY @ KNEE WALLED CENTER TANKS
(SCALE : 1/16" = 1'-0")



TYPICAL CONNECTION
4-SHAFT FOREBAY AT LOWER EFFLUENT
SHAFT & OUTER WALLS

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED SECTION Y-Y, REVISED CROSS SECTION VIEWS		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

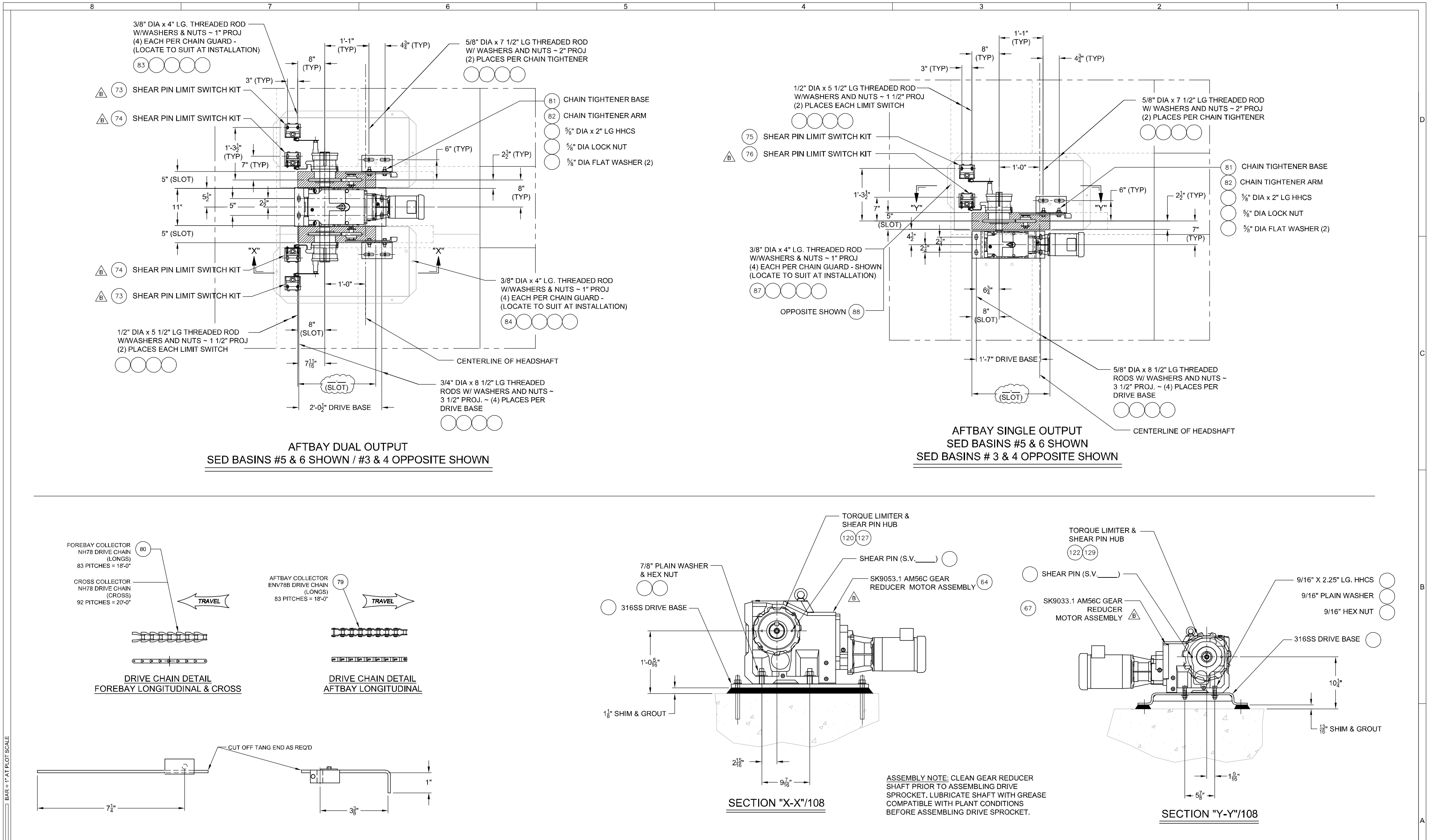
DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - INSTALLATION DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-107	2 OF 2	B

STD-22x34_D v4.0

BAR = 1" AT PLOT SCALE

A7.18

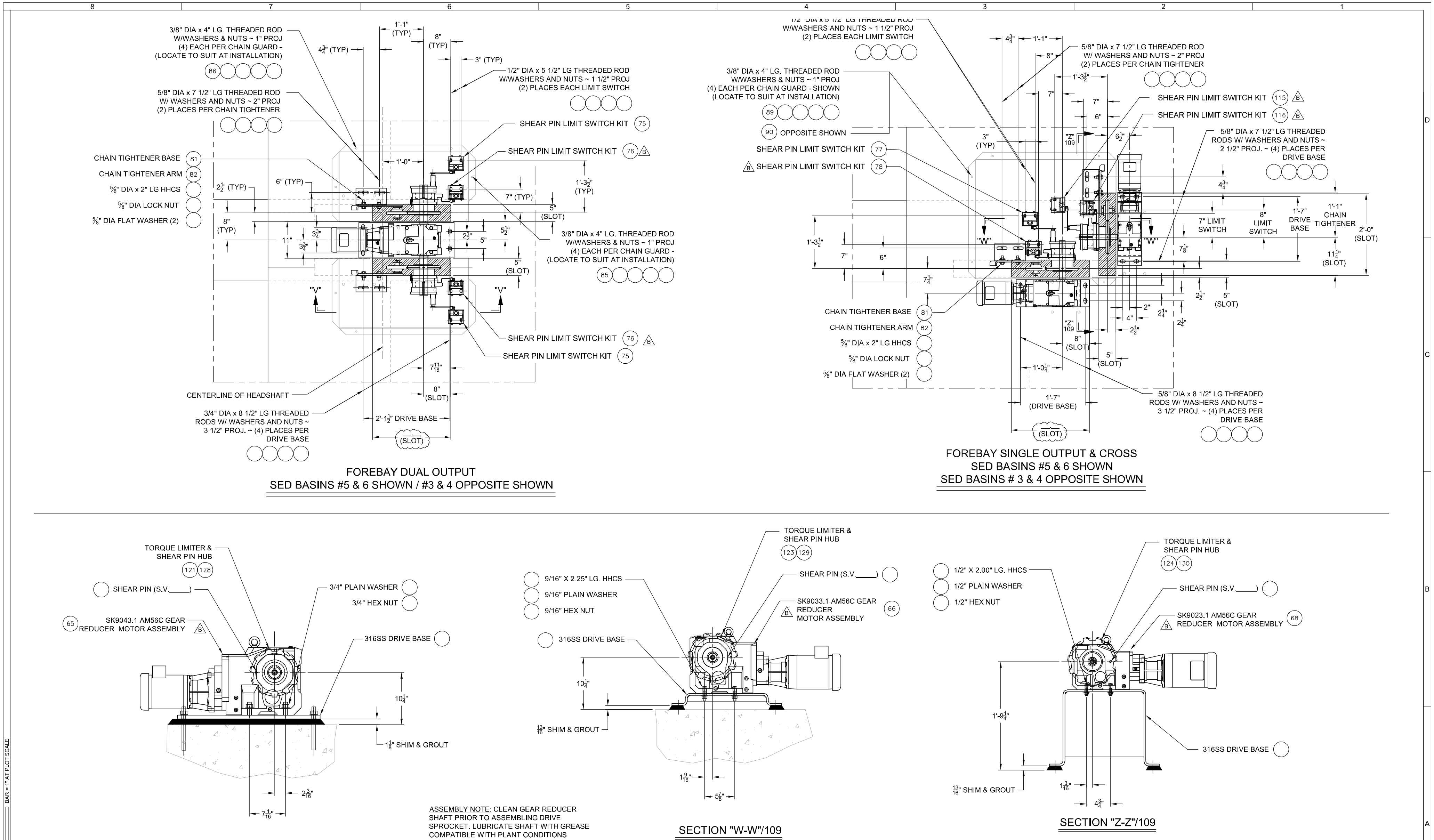


REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES FROM EURODRIVE TO NORD, ADDED LIMIT SWITCHES FOR SHEAR PIN HUBS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

COMPANY CONFIDENTIAL INFORMATION

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - DRIVE PLAN VIEW, AFT BAY (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-108	1 OF 1	B



ASSEMBLY NOTE: CLEAN GEAR REDUCER SHAFT PRIOR TO ASSEMBLING DRIVE SPROCKET. LUBRICATE SHAFT WITH GREASE COMPATIBLE WITH PLANT CONDITIONS BEFORE ASSEMBLING DRIVE SPROCKET.

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

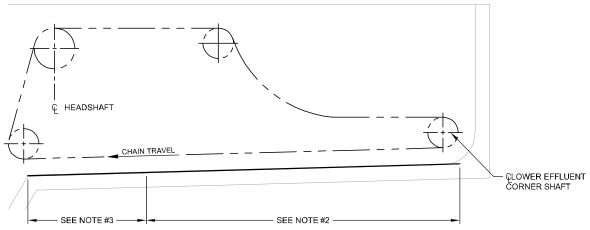
THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES FROM EURODRIVE TO NORD ADDED LIMIT SWITCH FOR SHEAR PIN HUBS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

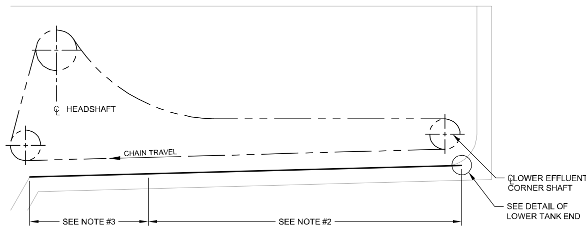
DWN BY: G.HALASE	DATE: 11/5/21	TITLE: GEN. ARRANGEMENT - DRIVE PLAN VIEW, FORE BAY & CROSS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE: 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE: 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE: NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-109	1 OF 1	B

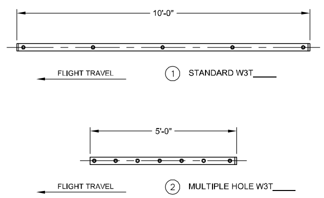
STD-22x34_D v4.0 — BAR = 1" AT PLOT SCALE



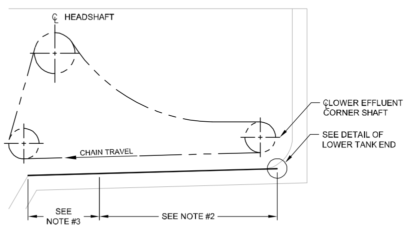
LONGITUDINAL COLLECTOR



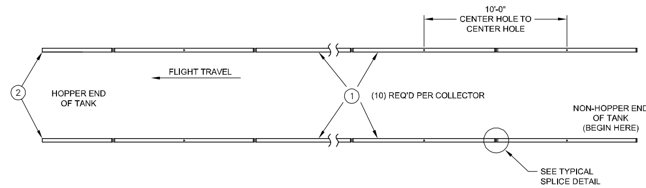
LONGITUDINAL COLLECTOR



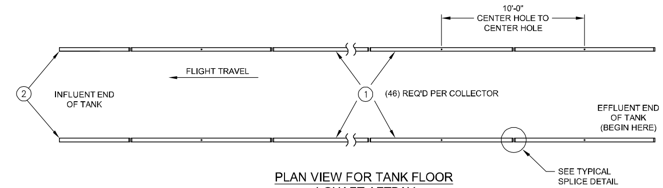
TYPICAL WEAR STRIP DETAILS



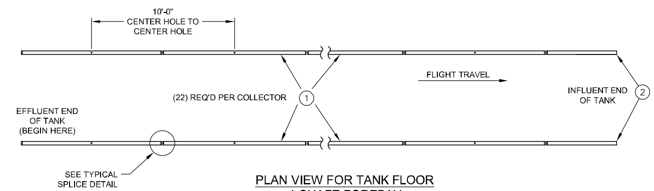
CROSS COLLECTOR



PLAN VIEW FOR TANK FLOOR
CROSS COLLECTOR
WEAR STRIP INSTALLATION



PLAN VIEW FOR TANK FLOOR
4-SHAFT AFTBAY
WEAR STRIP INSTALLATION



PLAN VIEW FOR TANK FLOOR
4-SHAFT FOREBAY
WEAR STRIP INSTALLATION

TYPICAL WEAR STRIP INSTALLATION INSTRUCTIONS

1. FASTEN WEAR STRIPS WITH CONVEX WASHERS & HARDWARE TO TANK FLOOR, SEE "TYPICAL FLOOR MOUNTING".

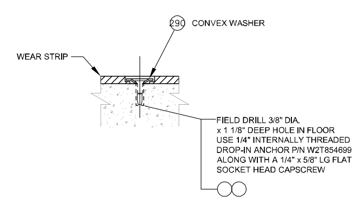
2. INSTALL (5) HOLE WEAR STRIPS W3T_____ (10'-0" LG SECTION) AS FOLLOWS:

   NOTE FLIGHT TRAVEL SHOWN ON THE "TYPICAL WEAR STRIP DETAILS". ALL BEVELLED WEAR STRIP ENDS ARE TO BE INSTALLED IN A DIRECTION TO PROVIDE A RAMP-UP OR LEAD-IN FOR THE FLIGHT WEAR SHOES.

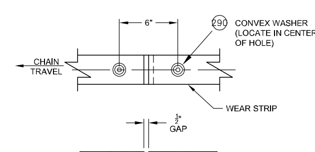
   ON THE TANK FLOOR, BEGIN AT THE EFFLUENT CORNER SHAFT END OF THE TANK AND WORK TOWARD THE HEADSHAFT END OF TANK.

   THE CENTER ANCHOR HOLES IN EACH (5) HOLE WEAR STRIP ARE TO BE LOCATED AT 10'-0" SPACINGS, REGARDLESS OF AMBIENT TEMPERATURE (SEE PLAN VIEWS).

3. MULTIPLE HOLE WEAR STRIPS W3T_____ (5'-0" LG SECTION) ARE TO BE FIELD CUT TO REQUIRED LENGTH AND INSTALLED WITH A CONVEX WASHER IN ALL HOLES. THIS SECTION IS TYPICALLY THE LAST INSTALLED IN A ROW. WHERE A W3T_____ (5'-0" LG SECTION) IS USED, INSTALL IT SUCH THAT THERE IS A 1/2" GAP BETWEEN IT AND THE LAST ADJACENT WEAR STRIP SECTION, ALSO TRIMMING THE LENGTH AS REQUIRED (SEE "TYPICAL SPLICE BETWEEN WEAR STRIPS" DETAIL).

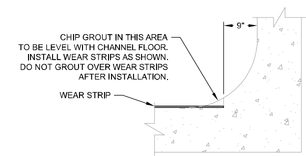


TYPICAL FLOOR MOUNTING



NOTE: THIS DIMENSION IS FOR REFERENCE ONLY. WEAR STRIPS TO BE SPACED AT 10'-0" CENTER HOLE TO CENTER HOLE. IF THE LAST SECTION IN A GIVEN ROW IS 5'-0" OR LESS, INSTALL THAT SECTION WITH A ½" GAP TO THE PREVIOUSLY INSTALLED, ADJACENT WEAR STRIPAS SHOWN IN THE VIEW ABOVE.

TYPICAL SPLICE BETWEEN WEAR STRIPS



LOWER TANK END
WEAR STRIP LOCATION
(SEE NOTE #1)

CONTRACTOR NOTE:

THE SUBSURFACE THAT THE WEAR STRIP(S) WILL BE ATTACHED TO MUST BE IN "SOUND" OR "AS NEW" CONDITION.

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21	TITLE: GEN. ARRANGEMENT - WEAR STRIP INSTALLATION DRAWING (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

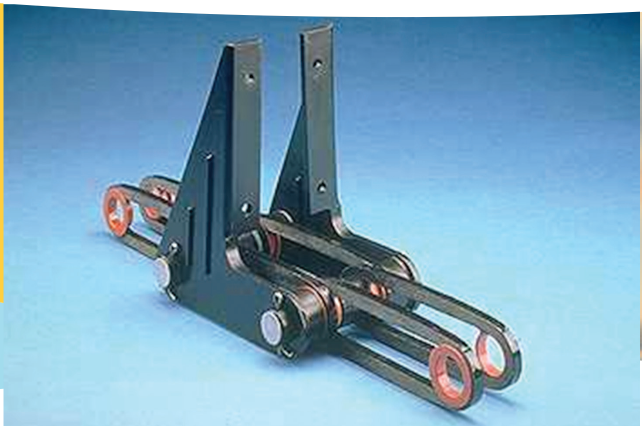
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-110	1 OF 1	A

STD-22x34_D v4.0 BAR = 1" AT PLOT SCALE

Section 5
Product Data

1. Chain, Collector - Evoqua, HS730

EVOQUA
WATER TECHNOLOGIES



ENVIREX® HS730 COLLECTOR CHAIN

The Envirex® HS730 Chain is constructed out of high-strength composite materials, Loop Chain is suited for collectors that are long or heavily loaded. It is the only non-metallic collector chain that offers strength nearly equal to cast and stainless steel chain at a faction of the weight. The Loop Chain has virtually no elongation in comparison to molded chain and is much more wear resistant including to abrasive materials such as sand and grit which can be carried through pretreatment systems. This translates to less frequent re-tensioning of the chain and scraper collector. The Loop Chain is Evoqua's standard chain used in API separators located in oil and gas refineries which demonstrates the chain's chemical resistance.

The HS730 chain has filament wound fiberglass side bars that will not stretch under loading due to water absorption, high temperature, or tension. The chain's composite construction has a live roller, thus the chain will provide longer wear life than conventional molded type chain or a fabricated steel chain having an integral or stationary barrel. This is because the roller rotates with each contact with a sprocket tooth, thus distributing the wear completely around the chain roller.

Features

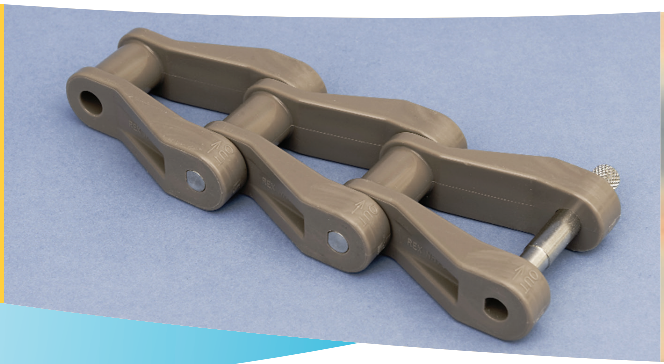
- 20,000 lbs. ultimate
- 10,000 lbs. proof-load
- 4,500 lbs. working load
- Filament wound fiberglass sidebars
- Acetal/Kevlar roller
- "Valox" bushings-polyester
- Fiberglass rod with Delrin sleeve
- Brackets-polyester (similar to molded chain attachment)
- Lightweight 1.6 lbs./ft.

EVOQUA
WATER TECHNOLOGIES

4800 North Point Parkway, Suite 250, Alpharetta, GA 30022

+1 (866) 926-8420 (toll-free) **+1 (978) 614-7233** (toll) **www.evoqua.com**

EVOQUA
WATER TECHNOLOGIES



ENVIREX® POLYMERIC DRIVE CHAIN

NH78 Drive Chain Specification

Envirex® NH78 drive chain is an optimal drive chain for typical chain and scraper collection systems. NH78 drive chain has sidebars molded from acetal, a plastic material that is known for excellent strength and durability. The sidebars are held in place by 300 series drive pins to properly seat and increase the durability of the drive chain. NH78 chain is lightweight and easy to install over the driven and driver sprocket.

Features of Envirex NH78 Drive Chain

- 1,750 lb (7.8 kN) working load
- Average weight of 1.4 lb/ft (2.08 kg/m)
- 2.609-in (66.3 mm) pitch links
- Acetal resin chain links
- Stainless steel pins constructed to prevent rotation and held in place without the use of cotters
- Lightweight, easy to assemble and install
- NSF/ANSI 61 Certification for drinking water applications

EVOQUA
WATER TECHNOLOGIES

N19 W23993 Ridgeview Parkway West, Suite 200, Pewaukee, WI 53188

+1 (866) 926-8420 (toll-free) **+1 (978) 614-7233** (toll) **www.evoqua.com**

3. Flights - Evoqua, Diamond

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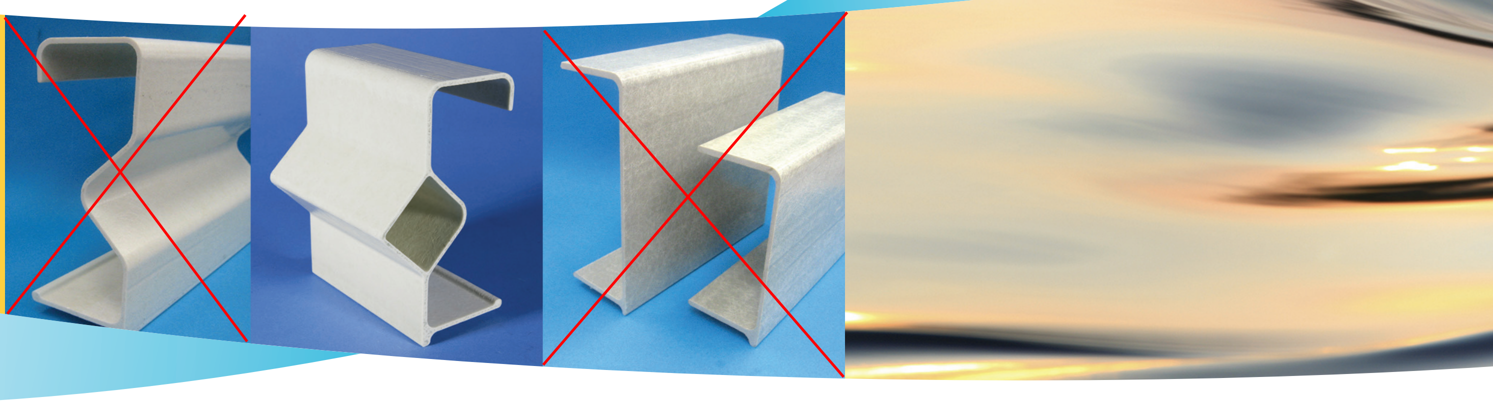

ENVIREX® FIBERGLASS FLIGHTS

~~Sigma Plus • 3″ x 8″~~

- ~~Competitive cost~~
- ~~Can handle normal loadings up to 25′ length~~
- ~~Moment of Inertia 2.01 in^4~~
- ~~Deflection strength:~~
  ~~y-y EI x 10^6 lbs-$inch^2$ horizontal = 6.83~~
- ~~Twist strength 0.0157 in^4~~

Diamond • 3″ x 8″

- Design for high loading capacity
- Maximum length of 10 meters available
- Must contact home office if longer than 10 meters is required
- Moment of Inertia 3.58 in^4
- Deflection strength:
  y-y EI x 10^6 lbs-$inch^2$ horizontal = 12.13
- Deflection strength:
  x-x EI x 10^6 lbs-$inch^2$ vertical = 65.14
- Twist strength 1.066 in^4

~~Channel • 3″ x 8″~~

- ~~Low cost~~
- ~~Can handle normal loadings up to 20 ft. length.~~
- ~~3″ x 6″ is also available~~
- ~~Moment of Inertia 1.1 in^4~~
- ~~Deflection strength:~~
  ~~y-y EI x 10^6 lbs-$inch^2$ horizontal = 3.77~~
- ~~Twist strength 1.066 in^4~~

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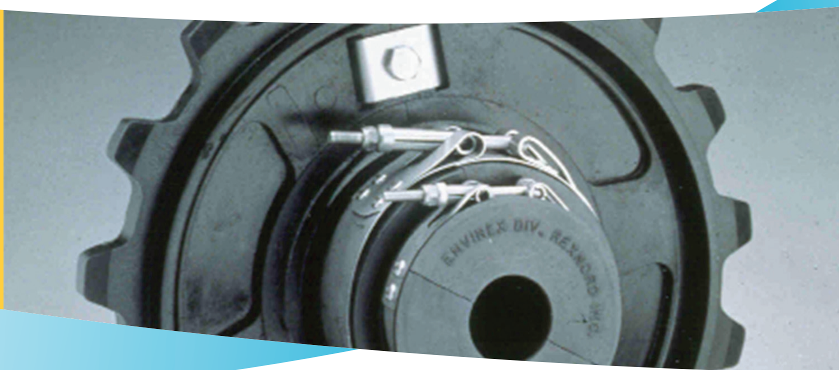

ENVIREX® POLYURETHANE SPROCKET

Collector Chain Sprockets Specification

Sprockets for the collector chains shall be molded totally of polyurethane having a water absorption rate not to exceed 1.3% at saturation in accordance with ASTM D-570 Sprockets shall be of split construction and have the double life tooth profile compatible with non-metallic chain. Sprocket halves shall be assembled on the shafting with two (2) type 316 stainless steel full width clamping bands which exert compressive force around the full periphery of the hub, thereby clamping the sprocket to the shaft where required. The clamping bands shall include provisions to restrict lateral movement. Stub shaft sprockets shall rotate freely on bearing sleeves clamped to the static shaft. Head sprockets shall have chain saver rims. The headshaft sprockets shall have the keyway machined in to the hub in such a way as to restrict lateral movement of the key and to insure chain alignment. Wedge dogs of type 316 stainless steel shall be located along the split line near the periphery and so designed to draw the sprocket halves together in diametrical and lateral alignment.

Headshaft sprockets shall not be less than 22.23” pitch diameter and have 23 teeth. Cornershaft sprockets shall not be less than 16.61” pitch diameter and have 17 teeth. Driving sprockets shall be keyed firmly to the headshaft and shall be clamped to the shaft by stainless steel band clamps.

Features of Envirex® Polyurethane Sprockets

- Special high performance polyurethane formulation
- Absorbs virtually no water
- Special stainless steel band clamps supply 360° clamping force on the hubs which is superior over bolted construction which can cause uneven loading.
- Headshaft sprockets have captive Keyways which eliminate set screw concerns.
- Rim savers are standard design.
- 15 Years experience with this sprocket design.
- Can be retrofitted.

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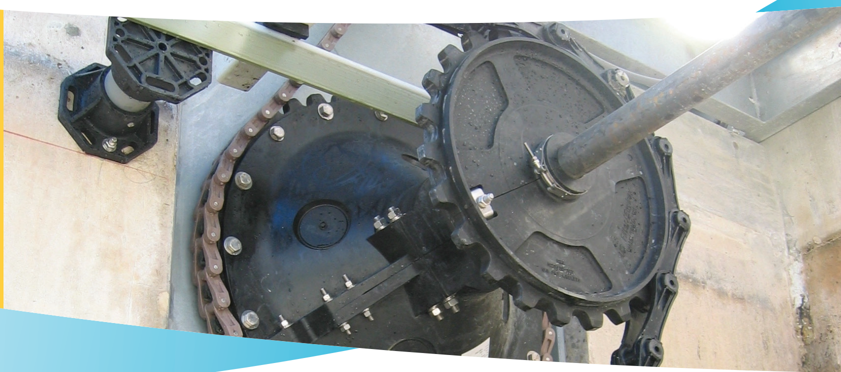

ENVIREX® DRIVEN SPROCKETS

Driven Sprocket Specification

The driven sprocket shall consist of a polymeric toothed rim bolted to a split polymeric dished body. The rim and body shall be molded of high performance polyurethane having a water absorption rate not to exceed 1.3% at saturation in accordance with ASTM D-570. The body shall be molded concentric and perpendicular to the bore with the rim mounting holes accurately located to insure concentricity of the sprocket assembly. The body halves shall be assembled on the headshaft with two (2) 316 stainless steel clamping bands to exert compressive force around the full periphery of the hub, thereby clamping the sprocket assembly to the shaft. 316 stainless steel wedge dogs shall be located along the split line near the periphery and so designed to draw the sprocket halves together in diametrical and lateral alignment. The body shall have a machined keyway designed to restrict the lateral movement of the key.

The rim shall be molded in four (4) segments and each segment shall be bolted to the body with four (4) 5/8″ diameter bolts. The sprocket rim shall be not less than 33.25″ pitch diameter and have 40 teeth. All sprocket hardware shall be Type 316 stainless steel.

Header photo: Evoqua provides a driven sprocket in a polyurethane body with tooth segments. Both shallow and deep dish design are available.

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DRIVE SPROCKET SPECIFICATION

Driven Sprocket Specification

The drive sprocket shall consist of a polymeric plate section bolted to a cast iron driving hub. The sprocket plate section shall be molded of polyurethane as described under the collector chain sprocket section. The sprocket shall be not less than 9.26 inch pitch diameter and have 11 teeth.

The drive sprocket shall be provided with a cast iron torque limiting device for protection of the drive equipment in the event of excessive loading. Aluminum shear pins shall be provided for torque overload protection and to transmit torque from the driving hub to the cast iron sprocket shear plate with bronze bushing grooved for grease lubrication and a polymeric gasket located between the shear faces to prevent seizing.

Option - Overload Alarm Trip

The driver sprocket hub shall also be provided with a trip lug that, upon torque overload, shall contact the actuator arm of the double throw limit switch which, in turn, shall shut off the motor and energize the alarm circuit. The limit switch shall be a combination NEMA 4X / 7 (IP67) enclosure and shall be provided with a stainless steel support bracket for positioning adjacent to the overload device. The audible alarm and silencing switch shall be furnished by the Electrical Contractor as detailed in Section ________.

Features

- 11 Teeth
- 9.26-in (235.2 mm) Pitch diameter
- Bolt-on replaceable teeth
- Molded polyurethane plate sprocket bolted to a cast iron driving hub
- Aluminum shear pins for torque overload protection and to transmit torque from the driving hub to the cast iron sprocket shear plate
- Shear plate with bronze bushing which is grooved for grease lubrication
- Polymeric gasket located between the shear faces to provide for free turning of driving hub at overload
- OPTIONAL - Combination NEMA 4X / 7 (IP67) enclosure torque overload limit switch for shutdown and alarm indication

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7. Return Track System - Evoqua, J-Track

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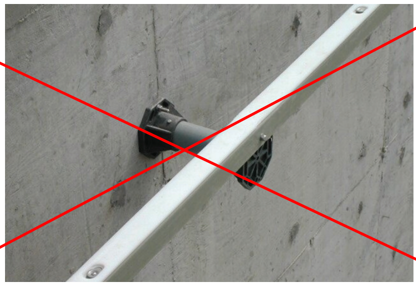
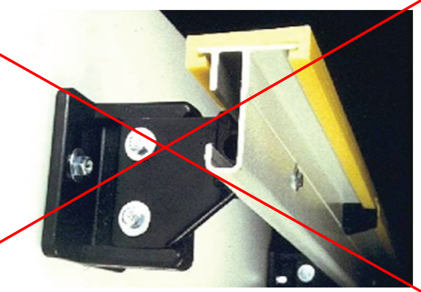
ENVIREX® RETURN TRACK SYSTEMS



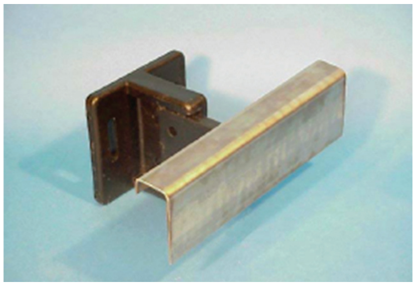
3″ x 3″ x 3/8″ Fiberglass with 3/8″ UHMW-PE Wear Strip

Deflections: 0.25″ @ 90# (10′ bracket spacing)



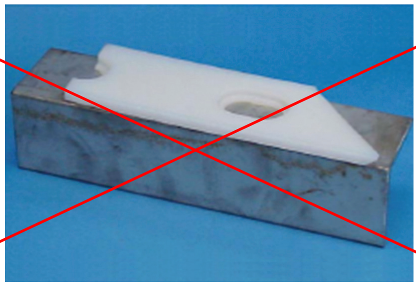
J-Track Fiberglass with UHMW-PE Wear Strip

Deflections: 0.1416″ @ 90# (10′ bracket spacing)



J-Track 316 Stainless Steel - No Wear Strip is Required

Deflections: 0.1416″ @ 90# (10′ bracket spacing)



Stainless Steel 3″ x 3″ x 1/4″ 3/8″ UHMW-PE Wear Strips

Deflections: 0.053″ @ 90# (10′ bracket spacing)

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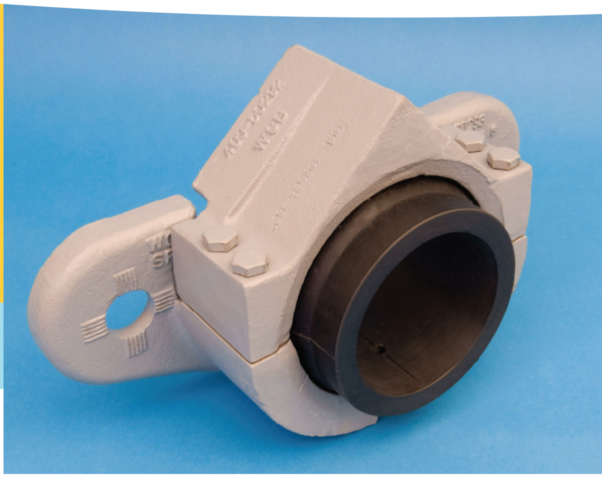

SPLIT WALL BEARING HOUSING WITH POLYURETHANE HUB BALL

Envirex® Split Housing Wall Bearings provide ease of assembly and disassembly with long life polyurethane bearing hub ball.

Split Wall Bearing Features

- Self-aligning allows for irregular concrete wall mounting
- Peak cap housing to sluff off sludge
- Low maintenance polyurethane bearing
- With or without grease options
- 4-bolt disassembly – Type 316 stainless steel
- ANSI/NSF-61 Drinking Water System certified

Polyurethane Hub Ball

- High strength Polyurethane proven successful over 30 years in wastewater and the wastewater industry
- Water lubricated or optional grease lubricated
- Shaft diameter capacity from 1 $^{15}/_{16}$ thru 5 inches (50 mm thru 125 mm)

Split Peak Cap Housing

- Cast steel per ASTM A216, Grade WCB
- Cast steel housing – standard
- Optional – Type 316 stainless steel housing
- 2-bolt anchoring
- Polyurethane friction self-locking washers
- Coated with NSF potable water approved primer paint

Complete installation and after-sales services to help you protect your investment.

- Evoqua experienced field service technicians – the largest group in the industry – can handle a complete upgrade, or do portions of it assisted by your personnel.
- Evoqua can handle the installation of new collectors, as well, working with your contractors or others. Technicians can perform annual inspections, advise on inventory requirements and, of course, be on-site for emergencies.
- Evoqua can upgrade or retrofit any manufacturer's sludge collector with new, non-metallic components. The renovated collector will run more smoothly and require far less maintenance than the original.
- For replacement parts, Evoqua has the most extensive inventory in the business, and can ship from stock immediately when required.

Envirex®
an EVOQUA brand

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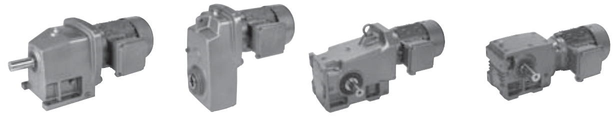
CONSTANT SPEED DRIVES

SIMPLE RELIABLE EFFICIENT

UNICASE™

NORD
DRIVESYSTEMS

NORD Gear



NORD DRIVESYSTEMS

Company Overview

Since 1965, NORD Gear has grown to global proportions on the strength of product performance, superior customer service, and intelligent solutions to a never ending variety of industrial challenges.

All mechanical and electrical components of a drive are available from NORD Gear. Our products cover the full range of drive equipment: helical in-line, Clincher™ shaft-mount, helical-bevel, helical-worm gearboxes, motors and AC drives from 1/6 hp to 250 hp, with torques from 90 lb-in to 900,000 lb-in.

But NORD Gear does far more than manufacture the world's finest drive components. We provide our customers with optimum drive configurations for their specific purposes, providing each and every one of them with truly complete and efficient systems at a price/quality ratio unmatched in today's fast-changing markets.

NORD Gear makes its wide range of products easily available through a global network that provides all customers with prompt delivery and expert support services to consistently exceed customer expectations. We are firmly committed to being totally responsive to the ideas and specifications of every customer, anywhere in the world.

UNICASE™

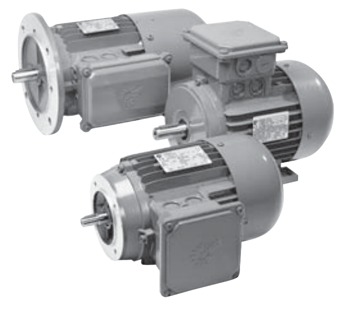
NORD heavy-duty, one-piece housings are precisely machined to exacting standards. Internal reinforcements further increase strength and rigidity. All bearings and seal seats are contained within the casting, eliminating splits or bolt-on carriers that can weaken the housing and allow oil leakage. Bores and mounting faces are machined in one step, producing extremely precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals, and longer life for all components.

Benefits

- Leak-free design
- Quiet operation
- High output torque capabilities
- Extended lubrication life
- Longer gear and bearing life
- Superior dependability/low maintenance/longer life

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-1998 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.



Short, On-Time Delivery

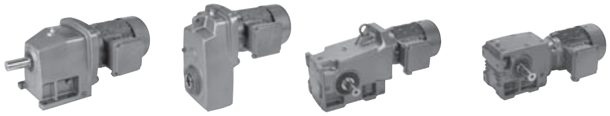
As a NORD customer, you can rest assured that your order will be delivered on time. Because NORD has both decentralized assembly and manufacturing operations and a linked global network, we offer our customers:

- Fast, reliable responses
- Greater product versatility
- Shorter lead times
- Timely shipping
- Rapid delivery

Quality

Quality is assured at NORD assembly and manufacturing facilities, based on ISO 9000 standards — from careful inspection of incoming materials to closely monitored machining operations including gear cutting, turning, hardening & grinding as well as finishing & assembly.

QUALITY ASSURED ISO 9000 GERMANISCHER LLOYD



NORD 911

Trouble? Just call 715-NORD-911 (in Canada, 905-796-3606). Emergency service is available 24 hours a day, 7 days a week. We'll answer your call, ship the parts, or build a unit and have it shipped directly to you to provide what you need, when you need it.

24-HOUR EMERGENCY RESPONSE 911 NORD GEAR CORPORATION (715) NORD-911

Manufacturing

NORD continually invests in research, manufacturing and automation technology. This is to ensure the highest possible quality at affordable prices. NORD invests heavily in our North American facilities as well as our factories around the world. Recent examples include expanding our Waunakee factory and adding numerous new large gear unit assembly cells. In our Glinde, Germany gear factory we added a state-of-the-art Vacuum multi-chamber carburization system.

Global Availability

From Shanghai to Charlotte, and all points between, NORD reaches customers around the world. Deliveries, service, and product support are close at hand, regardless of your location.

Worldwide Standards

NORD products are designed and manufactured based on the latest North American and global standards.

Increased North American Presence

NORD covers North America with over 30 district offices and over 500 distributor branches. NORD operates a manufacturing and assembly facility in Waunakee, WI, Charlotte, NC, Corona, CA, Brampton, ON, and Monterrey, Mexico, resulting in an ever-increasing capacity in the United States and Canada and giving our customers the shortest lead times in the industry.

Energy Efficiency

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Modular Design

NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit your applications.

More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible – assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch shaft extensions – to give you complete freedom to specify a drive solution that's perfect for you.

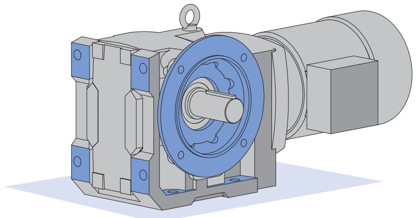
Benefits

- More output speeds
- More mounting arrangements / Greater flexibility
- Fewer gear stages/Lower cost
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.

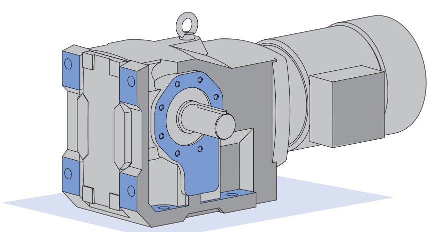
Foot Mounted with B5 Flange (XF)

NORD can supply some foot mounted reducers with a B5 flange as well. These type XF reducers are designed to be foot and not flange mounted. The B5 flange is normally used to mount auxiliary equipment to the speed reducer. If the B5 flange is going to be used to mount the reducer, additional support will normally be required.



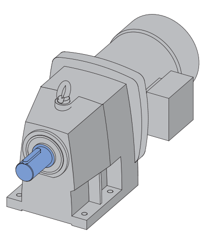
Foot mounted with B14 Face Flange (XZ)

NORD can supply some foot mounted reducers with a B14 face flange as well. These type XZ reducers are designed to be foot and not flange mounted. The B14 face flange is normally used to mount auxiliary equipment to the speed reducer. If the B14 face flange is going to be use to mount the reducer, additional support will normally be required.



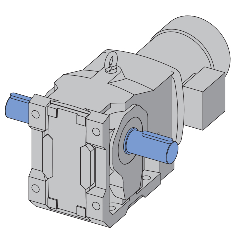
Shaft Options

Solid Shaft (Blank or V)



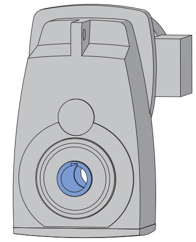
NORD's standard keyed solid shafts include a centered threaded hole. Shafts are available as inch or metric versions. The standard shaft material is 1045 or 4140 or equivalent.

Double Solid Shaft (L)



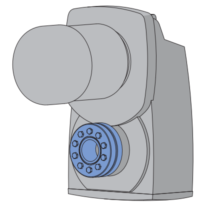
The standard solid shaft end is projected out both sides of the speed reducer. This option is commonly used to transfer torque out of both sides of the reducer or to mount a speed-monitoring device such as an encoder on one of the shaft ends. If you need the keyways to be alligned you must specify with NORD upon ordering

Keyed Hollow Shaft (A)



NORD's standard keyed hollow shafts are made from SAE 1045 high carbon steel. They feature standard keyway dimensions and are available both inch and metric designs. Many NORD reducers offer a variety of hollow shaft diameters.

Shrink Disc (S) (SH)



The shrink disc relies on the proven wedge principle to create a keyless, mechanical interference fit by converting locking screw tension into radial contact pressure on shaft and hub in effect "shrinking" it on to the customer shaft. Shrink discs result in a zero backlash mechanical interference fit that can accommodate high torque unlike other mounting technologies and will never wear or pound out, even for high cycle fluctuating and reversing loads.

Other shrink disc advantages include:

- Elimination of fretting corrosion associated with key connections.
- Generous clearance for easy mounting & dismounting.
- Allow for larger bores sizes compared to keyed hollow shafts.
- For more information see page 72

Heavy Duty Shrink Disc (VS)

NORD heavy duty shrink discs offer increased clamping force and safety factor for severe applications.

Special Shafts & Shaft Materials

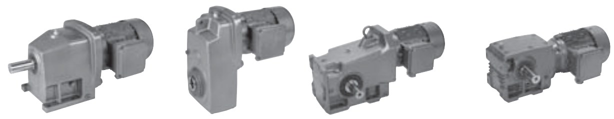
Stainless Steel Output Shaft (SM5)

Output shafts made from stainless steel are available and are frequently used in food, pharmaceutical, and washdown applications. In some cases solid input shafts can also be provided in stainless.

Special Solid Shaft (SWV)

Special solid shaft diameters and lengths can be provided for a nominal price adder. Special features are also available including keyless shafts, cross drilled shafts or special threaded taps. Different shaft materials are also available. NORD has in-house drafting design and machining departments so we can provide special requirements in short lead times. Specify your shaft requirements and NORD will verify the design feasibility.

Gear Unit Options



Special Hollow Shaft (SWA)

Special hollow bore shafts can also be provided. Special hollow bore shafts can be provided with special diameters, multiple keyways, and even special extended hollow shafts that are frequently used with counter rotating drives. Different shaft materials are also available. Specify your shaft requirements and NORD will verify the design feasibility.

Hollow Shaft with Spline (EA)

Hollow shafts with a metric involute spline profile according to DIN 5480 are available for some NORD hollow shaft reducers. These spline shafts are commonly used on crane travel drives. See pages 573 & 671 for details.

Heavy Duty Output Bearings (VL)

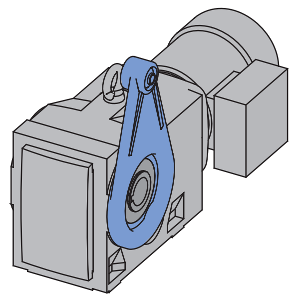
Replacing standard output bearings with heavy-duty versions will increase the external load carrying capacityof the speed reducer. Increased capacity in either or both overhung (radial) or thrust (axial) loading insures that premature bearing failure will not occur due to high stresses in the bearing elements. The increased bearing capacity will also keep the speed reducer as small as possible by not having to select the next larger case size in order to handle the bearing loads. If increased bearing life is desired, larger bearings will reduce the relative stress on the bearings and increased B10 bearing life.

(FKM) Fluoro-rubber Seals (VI)

The NORD standard oil seals are made of Nitrile or rubber and are rated for temperatures up to 125°C or 250°F. If ambient or oil temperatures rise above this level NORD recommends using fluoro-rubber (also called FKM) oil seals. FKM seals are rated from -30°F to 400°F (-35°C to 200°C).

Torque Arm (D)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the reducers B14 flange. The tear drop shaped torque arm has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.

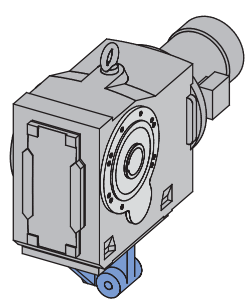


Specify the torque arm location and orientation when ordering

Torque arm location ________
Torque arm orientation ________
See Page 18 for details

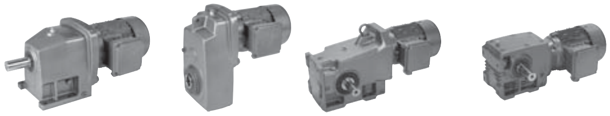
Bottom Mount Torque Arm (K)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the base of the reducer. The torque tab has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.The torque tab is available for bevel units SK 90.1.



Specify the torque tab location when ordering

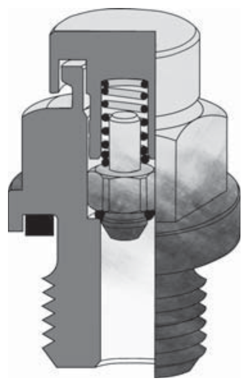
Torque tab location ________
See Page 18 for details ________



Oil Sight Glass (OSG)

The oil sight glass provides a visible oil level indication on the reducer. The sight glass replaces the standard steel fill plug and consists of a sealed clear porthole centered in the middle of a brass plug. The sight glass allows for quick oil level and color inspection.

Autovent™ (DR)



The Autovent™ prevents entry of foreign material, such as water, dust, corrosives, etc… and is perfect for washdown and dusty environments. The Autovent™ is a ball and spring check valve that opens at 2 psi and during operation and closes tightly when the gearbox cools. The Autovent™ is standard on all vented NORD reducers some of the benefits are cleaner gearbox oil, extended lubrication life and longer lasting seals, gears, and bearings.

Open Vent (OV)

An open vent can be optionally supplied on NORD reducers. The open vent allows for air pressure differences between the inner space of the reducer and the atmosphere. This open vent will be closed upon delivery to prevent oil leakage. Before the reducer is put in service the open vent should be activated by removing the sealing plug.

Filtered Vent (FV)

NORD offers a filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

Magnetic Drain Plug (MDP)

Magnetic drain plugs attract and hold ferrous metal particles that may circulate inside the reducer's lubrication system. These potentially abrasive particles may cause excessive wear in the reducer if they remain circulating. An increase of collected material may be a warning sign of future problems.

Special Drain Plugs

NORD oil drain valves are offered to make draining the oil from the gearbox clean and easy. The drain hose needs to be supplied by the customer. The hose fittings are offered in either 90° or straight to accommodate the user.

A brass drain valve is threaded into the existing oil drain port of the gearbox. The spring valve is closed using a rubber o-ring. When the hose fitting is threaded into the drain valve, the spring valve is pushed open and allows oil to drain. When the hose fitting is removed, the drain valve closes. A brass, threaded cap is supplied to cover the drain valve when not in use.

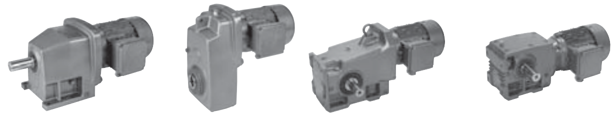
Additional Drain Plug Hole (ADP)

NORD can add an additional drain hole to the reducer housing for a small surcharge if required for special oil plumbing needs.

Long Term Storage (LL)

Speed reducers are frequently put in storage prior to installation for long periods of time and in some cases exposed to the elements. NORD's long term storage option protects the unit from moisture or corrosion by coating all unpainted surfaces with a dry, transparent, durable waxy film. Once installation is necessary this waxy film can be easily removed with a commercial de-greaser or petroleum solvent. If possible the store room should be vented and dry, with room temperatures between 23°F and 104 °F (-5 °C and 40 °C).

Gear Unit Options



NORD DRIVESYSTEMS

Paint Coatings

NORD's standard paint coating is a two component, aliphatic polyurethane finish contaning 316 stainless steel material.This gray stainless steel paint has excellent appearance and outstanding physical properties. It is suitable for both indoor and outdoor applications.

Advantages of NORD's stainless steel two component polyurethane:

- Excellent adhesion to cast iron, aluminum, steel, and plastics
- Excellent corrosion resistance
- Excellent chemical resistance
- Excellent gloss and color retention
- Suitable for indoor and outdoor exposure
- Nonporous and excellent abrasion resistance
- USDA Compliant

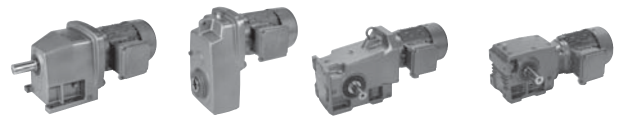
NORD also offers a variety of severe duty paint coatings that provide a high level of protection against water and severe environments both indoors and outdoors. NSD+ (NORD Severe Duty) consists of a primer undercoat and a stainless steel polyurethane topcoat. For the most demanding environments, NORD offers NSD-X3 (NORD Severe Duty triple coated) which consists of a primer undercoat, stainless steel polyurethane coating, and a clear topcoat. Paint coatings are also available in alternate colors as seen in the table below.

Additionally a variety of coating options are available including our Severe Duty coatings:

Finish	Color	Coating	Use
Standard (stainless steel paint)	Stainless steel silver (Gray)	1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color	Black, Blue, Red, Orange	1 x Color top coat (polyurethane)	Indoor or outdoor protected
NSD+			
NORD Severe Duty + NSD+	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
NORD Severe Duty +W NSD+W	White	1 x Primer high solid alkyd system 1 x White top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color NSD+	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color top coat (polyurethane)	Indoor or outdoor moderate environment
NSDX3			
NORD Severe Duty Extreme NSD-X3	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
NORD Severe Duty Extreme NSD-X3W	White	1 x Primer high solid alkyd system 1 x White (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
Alternate color NSD-X3	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment

Special colors and paints possible please contact NORD with your specific requirements.

Lubrication



NORD DRIVESYSTEMS

Lubrication Types

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective “fluid boundary” between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Mounting position not only determines the proper fill-level but may also have some effect on final reducer assembly. If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering. Unless otherwise specified, NORD supplies most all gear units (*) factory-filled with the standard lubrication type and the appropriate amount of lubricating oil.

* Gear units SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 are supplied without oil.

Standard Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	💧❶
	VG220	PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC630	💧❷
	VG220	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	💧
Helical Worm	VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	💧

Optional Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG460	PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC 634	-
	VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	-
	VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil/Cibus SHC220	-
Helical Worm	VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	VG460	FG-PAO	0 to50°C (32 to 122°F)	Mobil/Cibus SHC460	-

Standard Bearing Grease Lubricants

Grease Type/Thickener	NLGI Grade	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Standard (Li-Complex)	NLGI 2	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	💧❶
High Temp (Polyurea)	NLGI 2	-25 to 80°C (-13 to 176°F)	Mobil Polyrex EP 2	💧❷
Food-Grade (AL-Complex)	NLGI 2	-25 to 40°C (-13 to 104°F)	Mobil Grease FM222	💧

💧 Stocked Lubricants

❶ Standard product on serviceable gear units

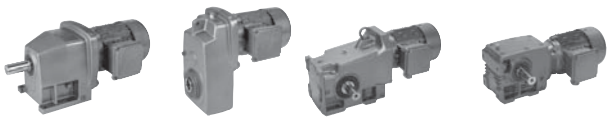
❷ Standard product on maintenance free gear units

Oil Formulation Codes

MIN-EP	Mineral Oil with EP Additive
PAO	Synthetic Polyalphaolefin Oil
PG	Synthetic Polyglycol Oil
FG	Food-Grade Oil
FG-PAO	Food-Grade, Synthetic Polyalphaolefin Oil

Important Notes

- In worm gears avoid using (EP) gear oils that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacture for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility & to obtain recommended cleaning or flushing procedures.
- Do not mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil, or Polyalphaolefin (PAO) oil.
- Please Consult NORD if considering cold-temperature oils below an ISO Viscosity VG100 or lower.



Ventilation

Most gear reducers (except for SK0182NB, SK0282NB and SK1382NB) are equipped with a vent which helps compensate for air pressure differences between the inner space of the gear unit and the atmosphere.

The spring-pressure vent (Autovent™) is commonly supplied and factory-installed. Normally open vents may also be supplied as an option; normally-open vents are closed upon delivery in order to prevent oil leakage during transport. When normally open vents are supplied, the sealing plugs must be removed prior to commissioning the reducer.

Prior to reducer start-up, it is important to check the maintenance manual to verify that the vent is properly located with respect to mounting position.

Mounting Position

The reducer mounting position determines the approximate oil fill-level and the appropriate vent location. In some cases mounting position may dictate possible variation in final reducer assembly.

If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering.

Oil Fill Quantities

Oil fill quantities shown in the catalog or maintenance instructions are approximate amounts. The actual oil volume varies depending upon the gear ratio. Prior to commissioning the reducer, the oil-fill level should be checked using the reducer's oil-level plug. It may be necessary to drain excess oil or add additional oil.

Unless otherwise specified, NORD supplies most all gear units factory-filled with the standard lubrication type per the specified mounting position. Gear units SK10282, SK10382, SK11282, SK11382, and SK12382 are supplied without oil.

Lubrication Replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years.

Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to change the reducer lubricant more often that what is suggested as a typical guideline.

The Importance of Routine Oil Analysis

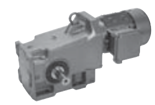
Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends as related to specific equipment, will help establish proper lubrication maintenance and change-out intervals.

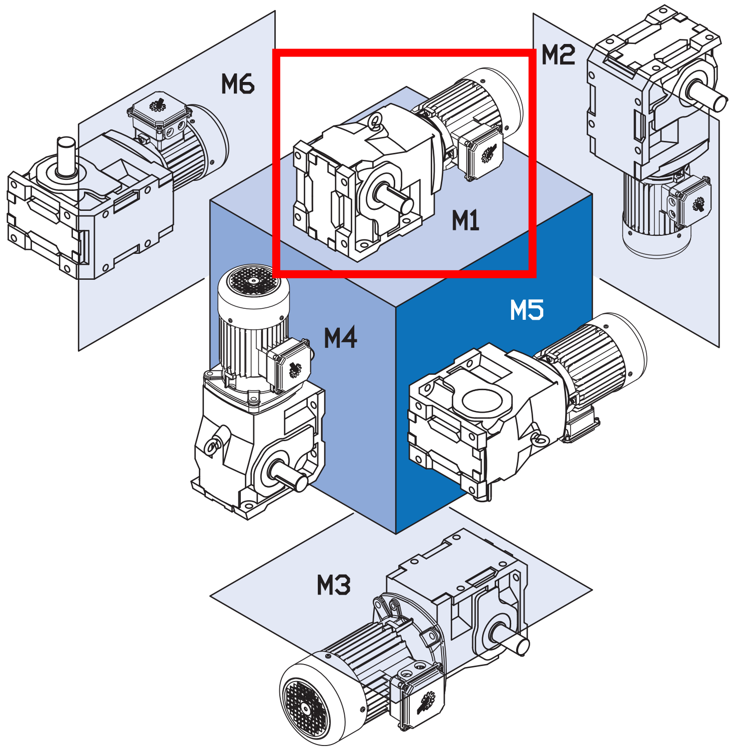
To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NORD suggests replacing the gear oil if oil analysis indicates any of the following:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- Acid number tests indicate a significant level of oxidative break-down of the oil and a critical reduction in performance.

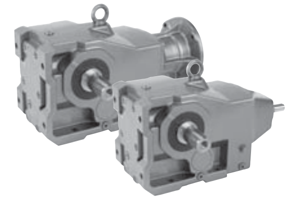
Helical-Bevel Foot Mount Positions & Oil Fill Quantities





Mounting Position	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK92072	0.42	0.40	0.63	0.60	0.53	0.50	0.53	0.50	0.42	0.40	0.42	0.40
SK92172	0.58	0.55	0.95	0.90	1.00	0.95	1.16	1.10	0.79	0.75	0.66	0.62
SK92372	0.95	0.90	1.37	1.30	1.53	1.45	1.69	1.60	1.27	1.20	1.27	1.20
SK92672	1.90	1.80	3.70	3.50	3.38	3.20	3.59	3.40	2.75	2.60	2.75	2.60
SK92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10
SK9012.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9013.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9016.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9017.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9022.1	1.37	1.30	2.75	2.60	3.70	3.50	4.44	4.20	2.11	2.00	2.96	2.80
SK9023.1	2.54	2.40	3.17	3.00	4.02	3.80	5.60	5.30	2.33	2.20	3.28	3.10
SK9032.1	1.80	1.70	5.07	4.80	6.76	6.40	7.08	6.70	4.33	4.10	5.39	5.10
SK9033.1	3.49	3.30	6.98	6.60	7.40	7.00	8.24	7.80	4.55	4.30	5.39	5.10
SK9042.1	4.65	4.40	9.20	8.70	10.6	10.0	10.4	9.80	7.19	6.80	7.93	7.50
SK9043.1	4.86	4.60	10.8	10.2	11.3	10.7	13.5	12.8	5.50	5.20	7.08	6.70
SK9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.6	24.2	12.2	11.5	17.4	16.5
SK9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.1	36.0	19.0	18.0	25.4	24.0
SK9082.1	18.0	17.0	54.4	51.5	66.1	62.5	75.6	71.5	34.9	33.0	49.2	46.5
SK9086.1	30.7	29.0	77.2	73.0	89.8	85.0	108	102	50.7	48.0	65.5	62.0
SK9092.1	38.1	36.0	166	157	180	170	182	172	84.6	80.0	95.1	90.0
SK9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152

SK 9052.1, SK 9053.1
NEMA-C + W
Ratings & Combinations

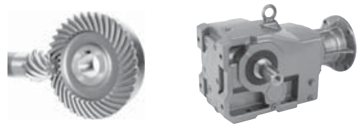



W + NEMA

Model Type	Gear Ratio i_{tot}	Output Speed n_2 1750 rpm [rpm]	Output Torque* $T_{2\ max}$ [lb-in]	Maximum input power◈ Solid input shafts type "W" Input Speed 1750 rpm [hp]	1150 rpm [hp]	875 rpm [hp]	580 rpm [hp]	NEMA C-Face* Available Combinations 56C	140TC	180TC	210TC	250TC	280TC	320TC	360TC
SK 9052.1	8.10	216	23010	30.00	19.80	15.00	9.90					X	X		
	9.40	186	23010	30.00	19.80	15.00	9.90					X	X		
	9.93	176	24780	30.00	19.80	15.00	9.90					X	X		
	10.71	163	25665	30.00	19.80	15.00	9.90					X	X		
	11.88	147	34515	30.00	19.80	15.00	9.90			X	X	X	X		
	13.45	130	38055	30.00	19.80	15.00	9.90			X	X	X	X		
	16.33	107	38055	30.00	19.80	15.00	9.90	X	X	X	X	X	X		
	17.94	98	38055	30.00	19.80	15.00	9.90					X	X		
	19.91	88	38055	30.00	19.80	15.00	9.90			X	X	X	X		
	22.53	78	38055	30.00	19.80	15.00	9.90			X	X	X	X		
	23.33	75	38055	30.00	19.80	15.00	9.90	X	X	X	X	X	X		
	27.35	64	40710	30.00	19.80	15.00	9.90	X	X	X	X	X	X		
	31.28	56	42480	30.00	19.80	15.00	9.90	X	X	X	X	X	X		
	36.21	48	42480	30.00	19.80	15.00	9.90	X	X	X	X	X	X		
	39.72	44	42480	29.66	19.57	14.83	9.79			X	X	X	X*		
	44.96	39	42480	26.29	17.35	13.14	8.67			X	X	X	X*		
	54.56	32	42480	21.57	14.24	10.78	7.12	X	X	X	X	X	X*		
	62.42	28	42480	18.87	12.46	9.44	6.23	X	X	X	X	X*	X*		
	72.24	24	42480	16.18	10.68	8.09	5.34	X	X	X	X	X*	X*		
	88.17	20	42480	13.48	8.90	6.74	4.45	X	X	X	X	X*			
	102.40	17	42480	11.46	7.56	5.73	3.78	X	X	X	X				
	120.03	15	42480	10.11	6.67	5.06	3.34	X	X	X	X*				
	145.16	12	31860	6.07	4.00	3.03	2.00	X	X	X					
	169.24	10	42480	6.74	4.45	3.37	2.22			X	X*				
	198.38	8.8	42480	5.93	3.91	2.97	1.96			X	X*				
	247.06	7.1	42480	4.79	3.16	2.39	1.58	X	X	X*					
	289.61	6.0	42480	4.04	2.67	2.02	1.33	X	X	X*					
SK 9053.1	164.99	11	42480	5.00	3.30	2.50	1.65	X	X	X	X*				
	229.07	7.6	42480	5.00	3.30	2.50	1.65	X	X	X	X*				
	265.11	6.6	42480	4.45	2.94	2.22	1.47	X	X	X*	X*				
	348.91	5.0	42480	3.37	2.22	1.69	1.11	X	X	X*					
	458.57	3.8	42480	2.56	1.69	1.28	0.85	X	X						
	579.95	3.0	42480	2.02	1.33	1.01	0.67	X	X*						
	703.83	2.5	35400	1.40	0.93	0.70	0.46	X	X*						
	931.87	1.9	42480	1.28	0.85	0.64	0.42	X	X*						
	1062.85	1.6	42480	1.08	0.71	0.54	0.36	X	X*	X*	X*				
	1398.80	1.3	42480	0.88	0.58	0.44	0.29	X*	X*	X*					
	1872.50	0.93	42480	0.63	0.41	0.31	0.21	X*	X*						
	2023.49	0.86	42480	0.58	0.38	0.29	0.19	X*	X*						
	2953.98	0.59	42480	0.40	0.26	0.20	0.13	X*	X*						
	3735.92	0.47	42480	0.32	0.21	0.16	0.10	X*	X*						

* Caution - The motor power may exceed the gear unit's mechanical torque capacity
◈ The mechanical power limit of the solid input shaft type "W" may limit the reducer rating.
All ratings are mechanical. See page 14 for thermal considerations.

lb	W	56C	140TC	180TC	210TC	250TC	280TC
SK 9052.1	441	430	430	445	476	498	498
SK 9053.1	459	463	463	472	-	-	-

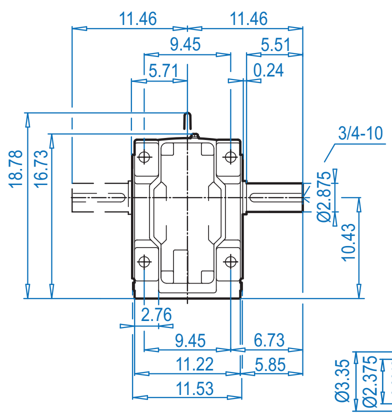


NORD DRIVESYSTEMS

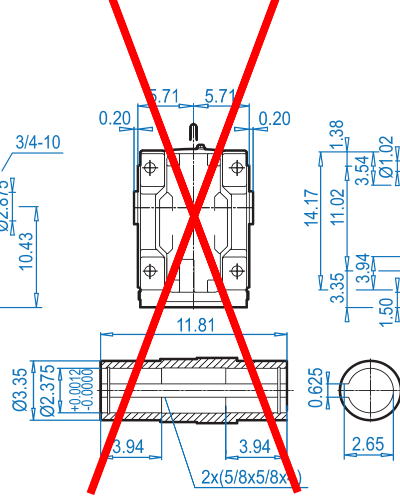
DIMENSIONS

ALTERNATE SHAFTS SEE PAGES 566 - 573

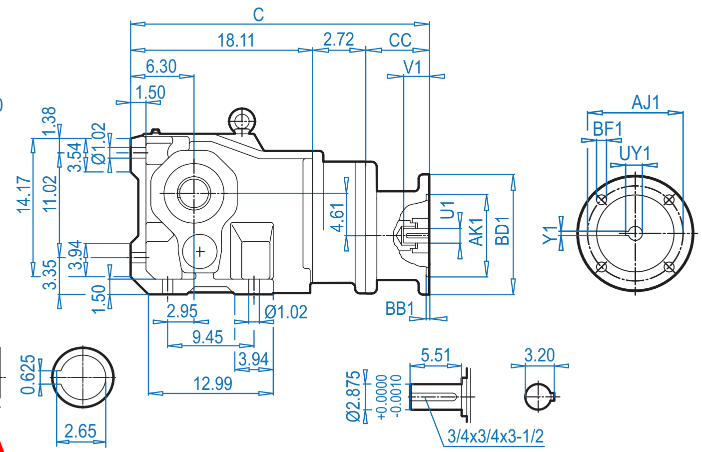
SK 9053.1



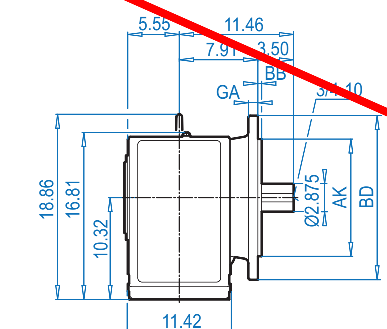
SK 9053.1AX



NEMA Input



SK 9053.1VF



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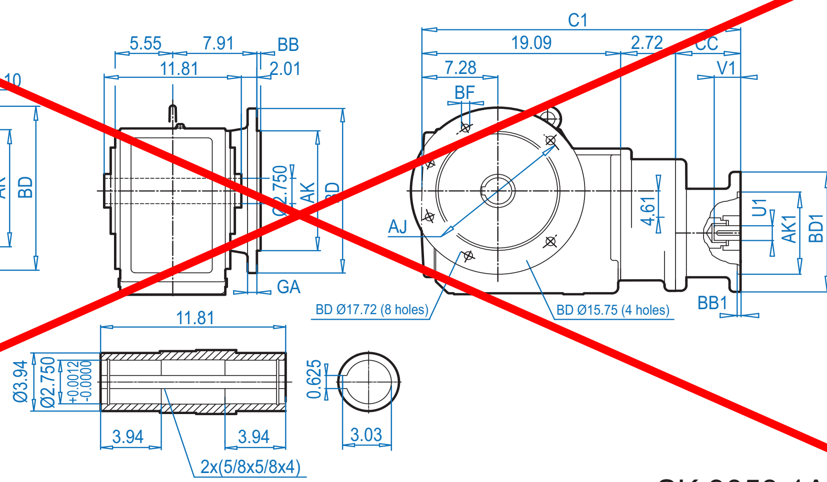
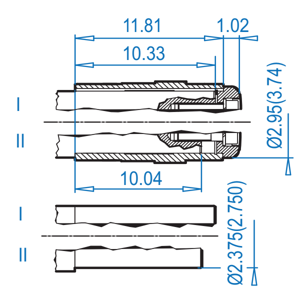


SK 9053.1AXB(AFB) 574



Mounting flange

BD (mm)	AJ	AK	BB	BF	GA
15.75 (400)	13.78	11.811 + 0.0000 - 0.0014	0.20	0.69	0.79
17.72 (450)	15.75	13.780 + 0.0000 - 0.0014	0.20	0.69	0.87

NEMA Dimensions

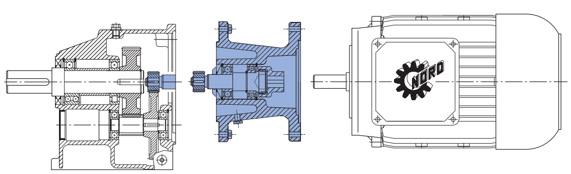
Type	AJ1	AK1	BB1	BD1	BF1	U1	V1	UY1	Y1	C	C1	CC
56C	5.88	4.500	0.18	6.54	0.43	0.625	2.06	0.71	0.188	25.43	26.41	4.60
140TC	5.88	4.500	0.18	6.54	0.43	0.875	2.12	0.96	0.188	25.43	26.41	4.60
180 TC	7.25	8.500	0.23	9.17	0.59	1.125	2.62	1.24	0.250	27.43	28.41	6.60

NEMA C-Face Motor Adapter

NEMA C-face motor adapters allow for easy installation and removal of industry standard C-face motors. NEMA C-face motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer. Gear units with NEMA C-face adapters are commonly used where applications require specialized motors or the user wants to easily find a replacement motor if failure occurs. NORD also offers high performance NEMA C-face motors and brakemotors, that can be factory installed to the motor adapter.

NORD motor adapters deliver nearly 100% of the torque generated by the motor and can be used from -22°F (-30°C) to 212°F (100°C). Most motor adapters have specially sealed bearings that are lubricated for life. However, some larger adapters are supplied with an automatic lubricator, which provides time released grease to the outboard adapter bearing. The automatic lubricator needs replacement after a specific service interval, see page 675 for more details.

The maximum input power of a gear unit with a NEMA C-face adapter is generally limited by the power rating of the standard NEMA C-face motor size. The power limit is indicated in the ratings table for a standard 4-pole 1750 rpm motor. In some cases the gearbox limit ($T2_{max}$) will be the limiting capacity. Both the NEMA adapter limit and the gearbox torque limit must be considered. If the speeds required exceed those included in the performance and speed reduction tables please contact NORD.



IEC Motor Adapter (example SK32 – IEC63)

IEC motor adapters allow for easy installation and removal of industry standard IEC motors according to DIN 42677. The IEC adapter is very similar to the NEMA C-face adapter in construction. The maximum input power is generally limited by the IEC motor size. For ratings and dimensions, please consult NORDS's metric catalogs.

Vertical Motor Adapter Applications

Gear units with motors frame sizes 250TC (IEC160) and larger, in a vertical up motor mounting position, NORD recommends using an integral gearmotor instead of a NEMA or IEC input adapter. If your application requires this mounting position and a NEMA or IEC input, please consult NORD. In vertical down motor mounted applications it is recommended to shorten the maintenance interval.

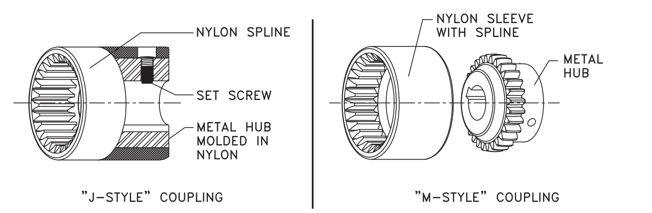
Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending on the size of the C-face input, NORD provides either a gear or jaw type coupling.

Gear Couplings

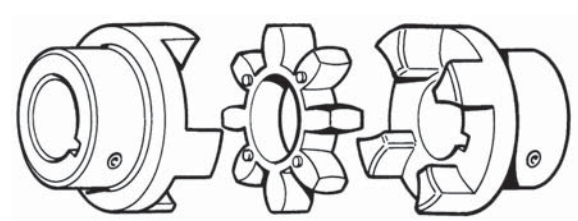
Gear couplings are used with 56C to 280TC adapters and provide a compact space saving design. C-face adapter input shafts have a machined male spline that meshes with a molded nylon spline on the coupling. This specially designed molded nylon sleeve that exhibits high torsional stiffness, resulting in minimum fit-up backlash and reduced internal frictional losses. Gear couplings lightweight design yields low inertia and use blind assembly and slip together components to make inspection easy without disassembly.

NORD incorporates two styles of gear couplings, the "J" and "M" styles. The "J" style is one-piece couplings consisting of a nylon sleeve and metal hub that are fused together. The "M" style is a two-piece coupling consisting of a separate nylon sleeve and metal hub.



Jaw Couplings

Jaw couplings are used with 320TC and larger adapters. The cast iron jaw type couplings have a urethane "spider" that provides smooth transmission of the motor torque and has excellent shock and vibration dampening characteristics. A set screw on the coupling prohibits axial movement along the motor shaft.

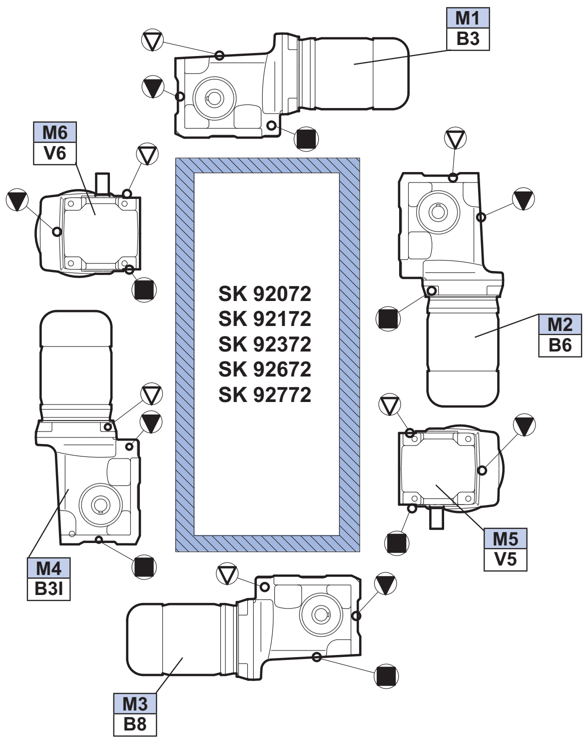


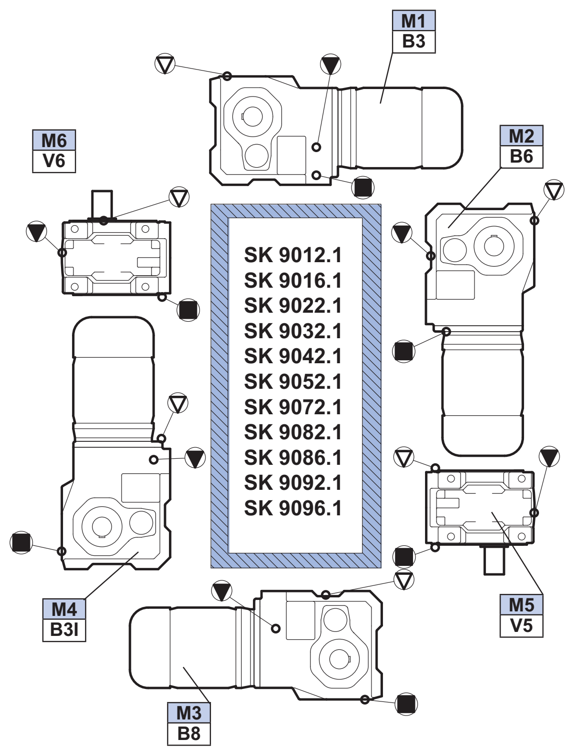
NEMA Motor Adapter Details

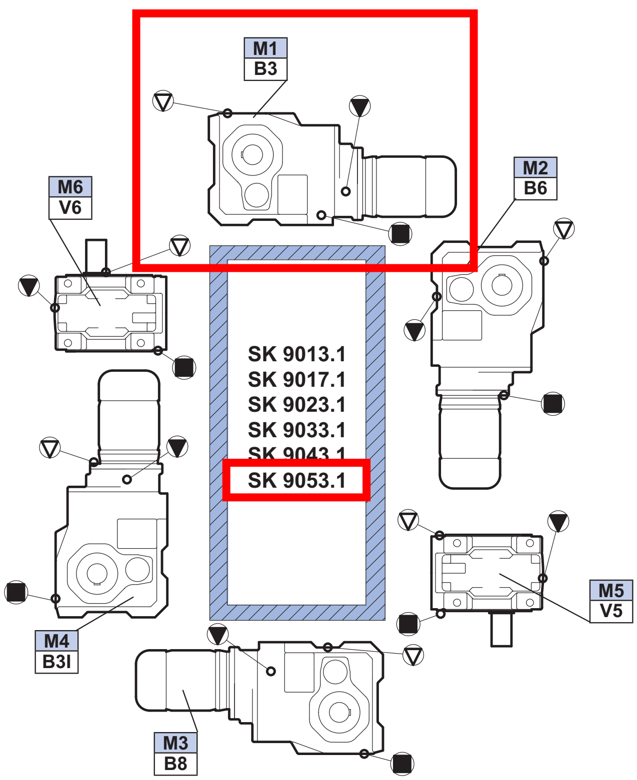
NEMA C-face Motor Frame Size	NEMA Adapter Nomenclature	4 pole Motor HP	Max Motor Weight [lb]	Coupling Descrip-tion	Coupling Bore (inches)	Maximum Cou-pling Torque Capacity (in-lb)	Safety Factor
56 C	- 56C	≤ 1.0	66	J14	0.625	177	3.3 min
56 C	- 56C	≤ 1.5	66	J24	0.875	354	6.6 min
143 TC	- 140TC	≤ 1.5	88				6.6 min
145 TC	- 140TC	≤ 2	110				4.9 min
145 TC	- 140TC	3	110				3.3 min
182 TC	- 180TC	3	130	J28	1.125	797	7.4 min
184 TC	- 180TC	5	175				4.4 min
182 TC	- 180TC	3	130	M38	1.125	1416	13.1 min
184 TC	- 180TC	5	175				7.9 min
213 TC	- 210TC	7.5	220		1.375		5.2 min
215 TC	- 210TC	10	220				4.0 min
254 TC	- 250TC	15	450	M42	1.625	1770	3.3 min
256 TC	- 250TC	20	450				2.5 min
284 TC	- 280TC	25	550	M48	1.875	2478	2.8 min
286 TC	- 280TC	30	550				2.3 min
324 TC	- 320TC	40	770	R65	2.125	11,060	8.0 min
326 TC	- 320TC	50	1100				6.4 min
364 TC	- 360TC	60	1550	R90	2.375	42,480	19.9 min
365 TC	- 360TC	75	1550				16.1 min
404 TSC	- 400TSC	100	2205		2.875		12.1 min

IEC Motor Adapter Details

IEC Motor B5 4 pole	IEC Adapter Nomenclature	HP / kW	Max Weight Limit [lb]	Coupling Descrip-tion	Coupling Bore (mm)	Maximum Cou-pling Torque Capacity (Nm)	Safety Factor
63 S/4	- IEC 63	0.16 / 0.12	56	J14	11	20	23.2 min
63 L/4	- IEC 63	0.25 / 0.18	56				15.8 min
71 S/4	- IEC 71	0.33 / 0.25	67		14		11.5 min
71 L/4	- IEC 71	0.50 / 0.37	67				7.8 min
80 S/4	- IEC 80	0.75 / 0.55	89	J24	19	40	10.4 min
80 L/4	- IEC 80	1.00 / 0.75	89				7.6 min
90 S/4	- IEC 90	1.5 / 1.1	111		24		5.3 min
90 L/4	- IEC 90	2.0 / 1.5	111				3.8 min
100 L/4	- IEC 100	3.0 / 2.2	133	J28	28	90	6.1 min
100 L/40	- IEC 100	5.0 / 3.7	133				4.4 min
112 M/4	- IEC 112	5.3 / 4.0	177				3.4 min
132 S/4	- IEC 132	7.5 / 5.5	221	M38	38	160	4.3 min
132 M/4	- IEC 132	10 / 7.5	221				3.2 min
160 M/4	- IEC 160	15 / 11	441	M42	42	200	2.2 min
160 L/4	- IEC 160	20 / 15	441				1.6 min
180 M/4	- IEC 180	25 / 18.5	552	M48	48	280	2.3 min
180 L/4	- IEC 180	30 / 22	552				1.9 min
200 L/4	- IEC 200	40 / 30	772	R65	55	1250	6.3 min
225 S/4	- IEC 225	50 / 37.5	1103		60		5.2 min
225 M/4	- IEC 225	60 / 45	1103				4.2 min
250 M/4	- IEC 250	75 / 55	1544	R90	70	4800	13.5 min
280 S/4	- IEC 280	100 / 75	1544		80		9.9 min
280 M/4	- IEC 280	125 / 90	2205				8.2 min
315 S/4	- IEC 315	150 / 110	3307		85		6.7 min
315 M/4	- IEC 315	175 / 132	3307				5.6 min
315 L/4	- IEC 315	250 / 200	3307				3.7 min







▽ = Vent ▼ = Oil Level ■ = Oil Drain

SERVICE

DRIVESYSTEMS www.nord.com

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Phone: 608.849.0140

CANADA
Brampton, ON (Toronto)
Phone: 905.796.3606

1002000001/01.11

10. Gear Reducer, Longitudinal Dual Output Drives (Fore Bay) - Nord, SK 9043.1-56C

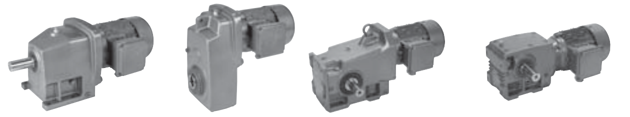
CONSTANT SPEED DRIVES

SIMPLE RELIABLE EFFICIENT

UNICASE™

NORD DRIVESYSTEMS

NORD Gear



NORD DRIVESYSTEMS

Company Overview

Since 1965, NORD Gear has grown to global proportions on the strength of product performance, superior customer service, and intelligent solutions to a never ending variety of industrial challenges.

All mechanical and electrical components of a drive are available from NORD Gear. Our products cover the full range of drive equipment: helical in-line, Clincher™ shaft-mount, helical-bevel, helical-worm gearboxes, motors and AC drives from 1/6 hp to 250 hp, with torques from 90 lb-in to 900,000 lb-in.

But NORD Gear does far more than manufacture the world's finest drive components. We provide our customers with optimum drive configurations for their specific purposes, providing each and every one of them with truly complete and efficient systems at a price/quality ratio unmatched in today's fast-changing markets.

NORD Gear makes its wide range of products easily available through a global network that provides all customers with prompt delivery and expert support services to consistently exceed customer expectations. We are firmly committed to being totally responsive to the ideas and specifications of every customer, anywhere in the world.

UNICASE™

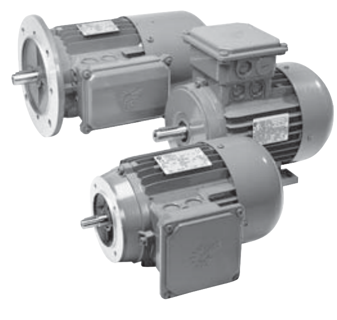
NORD heavy-duty, one-piece housings are precisely machined to exacting standards. Internal reinforcements further increase strength and rigidity. All bearings and seal seats are contained within the casting, eliminating splits or bolt-on carriers that can weaken the housing and allow oil leakage. Bores and mounting faces are machined in one step, producing extremely precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals, and longer life for all components.

Benefits

- Leak-free design
- Quiet operation
- High output torque capabilities
- Extended lubrication life
- Longer gear and bearing life
- Superior dependability/low maintenance/longer life

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-1998 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.



Short, On-Time Delivery

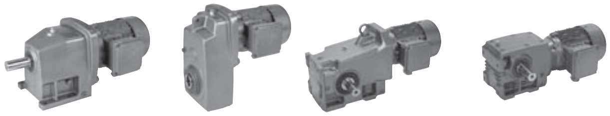
As a NORD customer, you can rest assured that your order will be delivered on time. Because NORD has both decentralized assembly and manufacturing operations and a linked global network, we offer our customers:

- Fast, reliable responses
- Greater product versatility
- Shorter lead times
- Timely shipping
- Rapid delivery

Quality

Quality is assured at NORD assembly and manufacturing facilities, based on ISO 9000 standards — from careful inspection of incoming materials to closely monitored machining operations including gear cutting, turning, hardening & grinding as well as finishing & assembly.

QUALITY ASSURED ISO 9000 GERMANISCHER LLOYD



NORD 911

Trouble? Just call 715-NORD-911 (in Canada, 905-796-3606). Emergency service is available 24 hours a day, 7 days a week. We'll answer your call, ship the parts, or build a unit and have it shipped directly to you to provide what you need, when you need it.

24-HOUR EMERGENCY RESPONSE
911
NORD GEAR CORPORATION
(715) NORD-911

Manufacturing

NORD continually invests in research, manufacturing and automation technology. This is to ensure the highest possible quality at affordable prices. NORD invests heavily in our North American facilities as well as our factories around the world. Recent examples include expanding our Waunakee factory and adding numerous new large gear unit assembly cells. In our Glinde, Germany gear factory we added a state-of-the-art Vacuum multi-chamber carburization system.

Global Availability

From Shanghai to Charlotte, and all points between, NORD reaches customers around the world. Deliveries, service, and product support are close at hand, regardless of your location.

Worldwide Standards

NORD products are designed and manufactured based on the latest North American and global standards.

Increased North American Presence

NORD covers North America with over 30 district offices and over 500 distributor branches. NORD operates a manufacturing and assembly facility in Waunakee, WI, Charlotte, NC, Corona, CA, Brampton, ON, and Monterrey, Mexico, resulting in an ever-increasing capacity in the United States and Canada and giving our customers the shortest lead times in the industry.

Energy Efficiency

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Modular Design

NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit your applications.

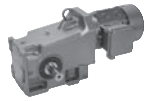
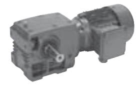
More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible – assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch shaft extensions – to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

- More output speeds
- More mounting arrangements / Greater flexibility
- Fewer gear stages/Lower cost
- Metric and inch products

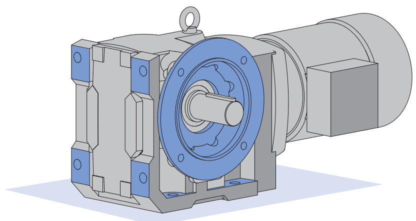
NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.



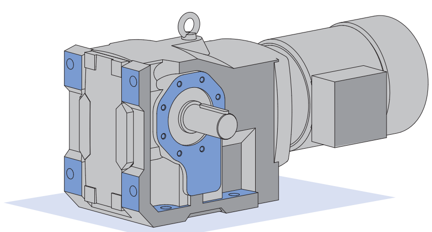
Foot Mounted with B5 Flange (XF)

NORD can supply some foot mounted reducers with a B5 flange as well. These type XF reducers are designed to be foot and not flange mounted. The B5 flange is normally used to mount auxiliary equipment to the speed reducer. If the B5 flange is going to be used to mount the reducer, additional support will normally be required.



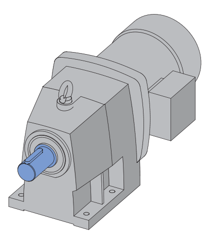
Foot mounted with B14 Face Flange (XZ)

NORD can supply some foot mounted reducers with a B14 face flange as well. These type XZ reducers are designed to be foot and not flange mounted. The B14 face flange is normally used to mount auxiliary equipment to the speed reducer. If the B14 face flange is going to be use to mount the reducer, additional support will normally be required.



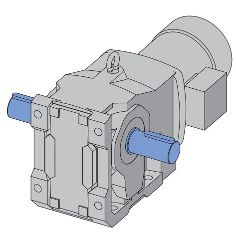
Shaft Options

Solid Shaft (Blank or V)



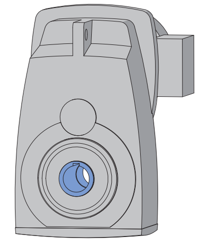
NORD's standard keyed solid shafts include a centered threaded hole. Shafts are available as inch or metric versions. The standard shaft material is 1045 or 4140 or equivalent.

Double Solid Shaft (L)



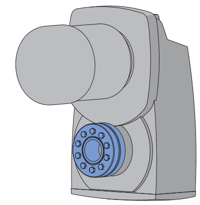
The standard solid shaft end is projected out both sides of the speed reducer. This option is commonly used to transfer torque out of both sides of the reducer or to mount a speed-monitoring device such as an encoder on one of the shaft ends. If you need the keyways to be alligned you must specify with NORD upon ordering

Keyed Hollow Shaft (A)



NORD's standard keyed hollow shafts are made from SAE 1045 high carbon steel. They feature standard keyway dimensions and are available both inch and metric designs. Many NORD reducers offer a variety of hollow shaft diameters.

Shrink Disc (S) (SH)



The shrink disc relies on the proven wedge principle to create a keyless, mechanical interference fit by converting locking screw tension into radial contact pressure on shaft and hub in effect "shrinking" it on to the customer shaft. Shrink discs result in a zero backlash mechanical interference fit that can accommodate high torque unlike other mounting technologies and will never wear or pound out, even for high cycle fluctuating and reversing loads.

Other shrink disc advantages include:

- Elimination of fretting corrosion associated with key connections.
- Generous clearance for easy mounting & dismounting.
- Allow for larger bores sizes compared to keyed hollow shafts.
- For more information see page 72

Heavy Duty Shrink Disc (VS)

NORD heavy duty shrink discs offer increased clamping force and safety factor for severe applications.

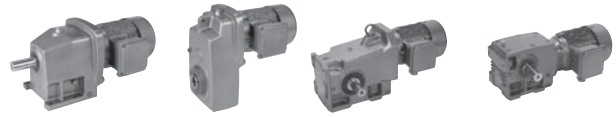
Special Shafts & Shaft Materials

Stainless Steel Output Shaft (SM5)

Output shafts made from stainless steel are available and are frequently used in food, pharmaceutical, and washdown applications. In some cases solid input shafts can also be provided in stainless.

Special Solid Shaft (SWV)

Special solid shaft diameters and lengths can be provided for a nominal price adder. Special features are also available including keyless shafts, cross drilled shafts or special threaded taps. Different shaft materials are also available. NORD has in-house drafting design and machining departments so we can provide special requirements in short lead times. Specify your shaft requirements and NORD will verify the design feasibility.



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Special Hollow Shaft (SWA)

Special hollow bore shafts can also be provided. Special hollow bore shafts can be provided with special diameters, multiple keyways, and even special extended hollow shafts that are frequently used with counter rotating drives. Different shaft materials are also available. Specify your shaft requirements and NORD will verify the design feasibility.

Hollow Shaft with Spline (EA)

Hollow shafts with a metric involute spline profile according to DIN 5480 are available for some NORD hollow shaft reducers. These spline shafts are commonly used on crane travel drives. See pages 573 & 671 for details.

Heavy Duty Output Bearings (VL)

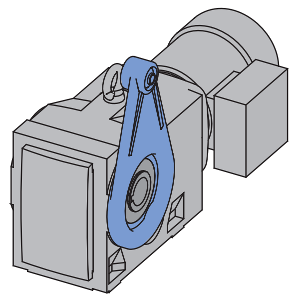
Replacing standard output bearings with heavy-duty versions will increase the external load carrying capacityof the speed reducer. Increased capacity in either or both overhung (radial) or thrust (axial) loading insures that premature bearing failure will not occur due to high stresses in the bearing elements. The increased bearing capacity will also keep the speed reducer as small as possible by not having to select the next larger case size in order to handle the bearing loads. If increased bearing life is desired, larger bearings will reduce the relative stress on the bearings and increased B10 bearing life.

(FKM) Fluoro-rubber Seals (VI)

The NORD standard oil seals are made of Nitrile or rubber and are rated for temperatures up to 125°C or 250°F. If ambient or oil temperatures rise above this level NORD recommends using fluoro-rubber (also called FKM) oil seals. FKM seals are rated from -30°F to 400°F (-35°C to 200°C).

Torque Arm (D)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the reducers B14 flange. The tear drop shaped torque arm has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.

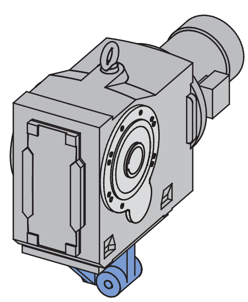


Specify the torque arm location and orientation when ordering

Torque arm location______________
Torque arm orientation______________
See Page 18 for details

Bottom Mount Torque Arm (K)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the base of the reducer. The torque tab has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.The torque tab is available for bevel units SK 90.1.



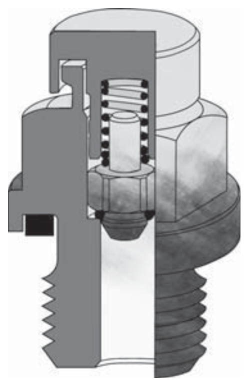
Specify the torque tab location when ordering

Torque tab location______________
See Page 18 for details______________

Oil Sight Glass (OSG)

The oil sight glass provides a visible oil level indication on the reducer. The sight glass replaces the standard steel fill plug and consists of a sealed clear porthole centered in the middle of a brass plug. The sight glass allows for quick oil level and color inspection.

Autovent™ (DR)



The Autovent™ prevents entry of foreign material, such as water, dust, corrosives, etc… and is perfect for washdown and dusty environments. The Autovent™ is a ball and spring check valve that opens at 2 psi and during operation and closes tightly when the gearbox cools. The Autovent™ is standard on all vented NORD reducers some of the benefits are cleaner gearbox oil, extended lubrication life and longer lasting seals, gears, and bearings.

Open Vent (OV)

An open vent can be optionally supplied on NORD reducers. The open vent allows for air pressure differences between the inner space of the reducer and the atmosphere. This open vent will be closed upon delivery to prevent oil leakage. Before the reducer is put in service the open vent should be activated by removing the sealing plug.

Filtered Vent (FV)

NORD offers a filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

Magnetic Drain Plug (MDP)

Magnetic drain plugs attract and hold ferrous metal particles that may circulate inside the reducer's lubrication system. These potentially abrasive particles may cause excessive wear in the reducer if they remain circulating. An increase of collected material may be a warning sign of future problems.

Special Drain Plugs

NORD oil drain valves are offered to make draining the oil from the gearbox clean and easy. The drain hose needs to be supplied by the customer. The hose fittings are offered in either 90° or straight to accommodate the user.

A brass drain valve is threaded into the existing oil drain port of the gearbox. The spring valve is closed using a rubber o-ring. When the hose fitting is threaded into the drain valve, the spring valve is pushed open and allows oil to drain. When the hose fitting is removed, the drain valve closes. A brass, threaded cap is supplied to cover the drain valve when not in use.

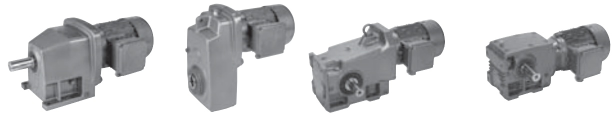
Additional Drain Plug Hole (ADP)

NORD can add an additional drain hole to the reducer housing for a small surcharge if required for special oil plumbing needs.

Long Term Storage (LL)

Speed reducers are frequently put in storage prior to installation for long periods of time and in some cases exposed to the elements. NORD's long term storage option protects the unit from moisture or corrosion by coating all unpainted surfaces with a dry, transparent, durable waxy film. Once installation is necessary this waxy film can be easily removed with a commercial de-greaser or petroleum solvent. If possible the store room should be vented and dry, with room temperatures between 23°F and 104 °F (-5 °C and 40 °C).

Gear Unit Options



DRIVESYSTEMS

Paint Coatings

NORD's standard paint coating is a two component, aliphatic polyurethane finish contaning 316 stainless steel material.This gray stainless steel paint has excellent appearance and outstanding physical properties. It is suitable for both indoor and outdoor applications.

Advantages of NORD's stainless steel two component polyurethane:

- Excellent adhesion to cast iron, aluminum, steel, and plastics
- Excellent corrosion resistance
- Excellent chemical resistance
- Excellent gloss and color retention
- Suitable for indoor and outdoor exposure
- Nonporous and excellent abrasion resistance
- USDA Compliant

NORD also offers a variety of severe duty paint coatings that provide a high level of protection against water and severe environments both indoors and outdoors. NSD+ (NORD Severe Duty) consists of a primer undercoat and a stainless steel polyurethane topcoat. For the most demanding environments, NORD offers NSD-X3 (NORD Severe Duty triple coated) which consists of a primer undercoat, stainless steel polyurethane coating, and a clear topcoat. Paint coatings are also available in alternate colors as seen in the table below.

Additionally a variety of coating options are available including our Severe Duty coatings:

Finish	Color	Coating	Use
Standard (stainless steel paint)	Stainless steel silver (Gray)	1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color	Black, Blue, Red, Orange	1 x Color top coat (polyurethane)	Indoor or outdoor protected

NSD+

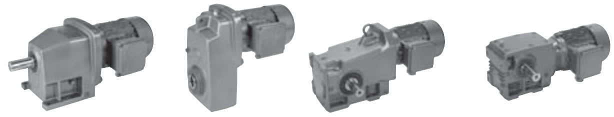
NORD Severe Duty + NSD+	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
NORD Severe Duty +W NSD+W	White	1 x Primer high solid alkyd system 1 x White top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color NSD+	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color top coat (polyurethane)	Indoor or outdoor moderate environment

NSD X3

NORD Severe Duty Extreme NSD-X3	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
NORD Severe Duty Extreme NSD-X3W	White	1 x Primer high solid alkyd system 1 x White (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
Alternate color NSD-X3	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment

Special colors and paints possible please contact NORD with your specific requirements.

Lubrication



NORD DRIVESYSTEMS

Lubrication Types

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Mounting position not only determines the proper fill-level but may also have some effect on final reducer assembly. If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering. Unless otherwise specified, NORD supplies most all gear units (*) factory-filled with the standard lubrication type and the appropriate amount of lubricating oil.

* Gear units SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 are supplied without oil.

Standard Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	🌢❶
	VG220	PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC630	🌢❷
	VG220	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	🌢
Helical Worm	VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	🌢

Optional Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG460	PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC 634	-
	VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	-
	VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil/Cibus SHC220	-
Helical Worm	VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	VG460	FG-PAO	0 to50°C (32 to 122°F)	Mobil/Cibus SHC460	-

Standard Bearing Grease Lubricants

Grease Type/Thickener	NLGI Grade	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Standard (Li-Complex)	NLGI 2	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	🌢❶
High Temp (Polyurea)	NLGI 2	-25 to 80°C (-13 to 176°F)	Mobil Polyrex EP 2	🌢❷
Food-Grade (AL-Complex)	NLGI 2	-25 to 40°C (-13 to 104°F)	Mobil Grease FM222	🌢

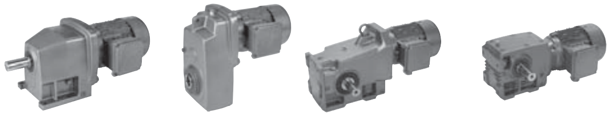
🌢 Stocked Lubricants
❶ Standard product on serviceable gear units
❷ Standard product on maintenance free gear units

Oil Formulation Codes

MIN-EP	Mineral Oil with EP Additive
PAO	Synthetic Polyalphaolefin Oil
PG	Synthetic Polyglycol Oil
FG	Food-Grade Oil
FG-PAO	Food-Grade, Synthetic Polyalphaolefin Oil

Important Notes

- In worm gears avoid using (EP) gear oils that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacture for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility & to obtain recommended cleaning or flushing procedures.
- Do not mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil, or Polyalphaolefin (PAO) oil.
- Please Consult NORD if considering cold-temperature oils below an ISO Viscosity VG100 or lower.



Ventilation

Most gear reducers (except for SK0182NB, SK0282NB and SK1382NB) are equipped with a vent which helps compensate for air pressure differences between the inner space of the gear unit and the atmosphere.

The spring-pressure vent (Autovent™) is commonly supplied and factory-installed. Normally open vents may also be supplied as an option; normally-open vents are closed upon delivery in order to prevent oil leakage during transport. When normally open vents are supplied, the sealing plugs must be removed prior to commissioning the reducer.

Prior to reducer start-up, it is important to check the maintenance manual to verify that the vent is properly located with respect to mounting position.

Mounting Position

The reducer mounting position determines the approximate oil fill-level and the appropriate vent location. In some cases mounting position may dictate possible variation in final reducer assembly.

If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering.

Oil Fill Quantities

Oil fill quantities shown in the catalog or maintenance instructions are approximate amounts. The actual oil volume varies depending upon the gear ratio. Prior to commissioning the reducer, the oil-fill level should be checked using the reducer's oil-level plug. It may be necessary to drain excess oil or add additional oil.

Unless otherwise specified, NORD supplies most all gear units factory-filled with the standard lubrication type per the specified mounting position. Gear units SK10282, SK10382, SK11282, SK11382, and SK12382 are supplied without oil.

Lubrication Replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years.

Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to change the reducer lubricant more often that what is suggested as a typical guideline.

The Importance of Routine Oil Analysis

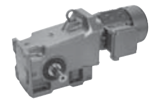
Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends as related to specific equipment, will help establish proper lubrication maintenance and change-out intervals.

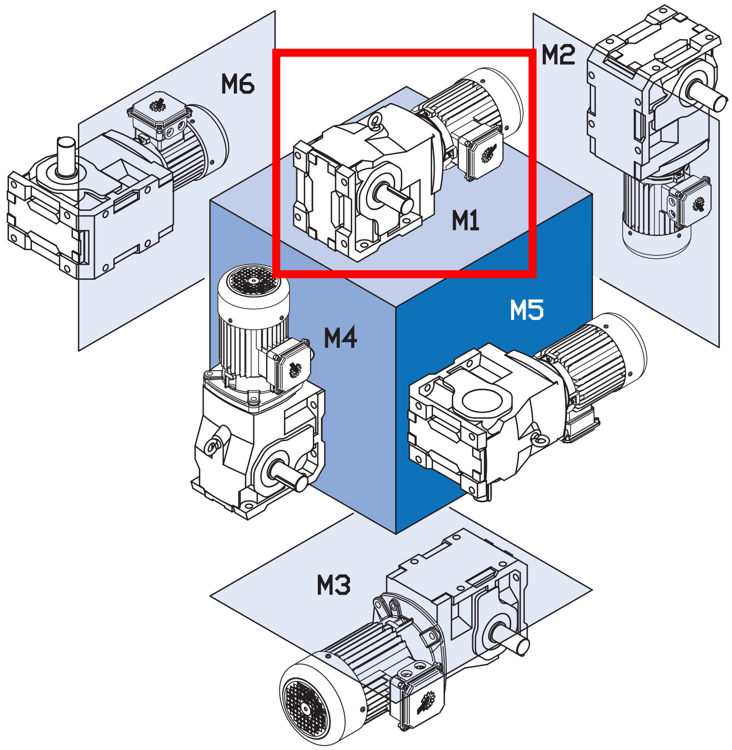
To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NORD suggests replacing the gear oil if oil analysis indicates any of the following:

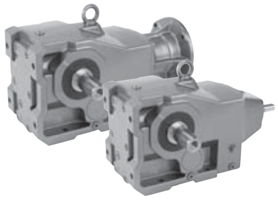
- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- Acid number tests indicate a significant level of oxidative break-down of the oil and a critical reduction in performance.

Helical-Bevel Foot Mount Positions & Oil Fill Quantities





Mounting Position	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK92072	0.42	0.40	0.63	0.60	0.53	0.50	0.53	0.50	0.42	0.40	0.42	0.40
SK92172	0.58	0.55	0.95	0.90	1.00	0.95	1.16	1.10	0.79	0.75	0.66	0.62
SK92372	0.95	0.90	1.37	1.30	1.53	1.45	1.69	1.60	1.27	1.20	1.27	1.20
SK92672	1.90	1.80	3.70	3.50	3.38	3.20	3.59	3.40	2.75	2.60	2.75	2.60
SK92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10
SK9012.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9013.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9016.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9017.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9022.1	1.37	1.30	2.75	2.60	3.70	3.50	4.44	4.20	2.11	2.00	2.96	2.80
SK9023.1	2.54	2.40	3.17	3.00	4.02	3.80	5.60	5.30	2.33	2.20	3.28	3.10
SK9032.1	1.80	1.70	5.07	4.80	6.76	6.40	7.08	6.70	4.33	4.10	5.39	5.10
SK9033.1	3.49	3.30	6.98	6.60	7.40	7.00	8.24	7.80	4.55	4.30	5.39	5.10
SK9042.1	4.65	4.40	9.20	8.70	10.6	10.0	10.4	9.80	7.19	6.80	7.93	7.50
SK9043.1	4.86	4.60	10.8	10.2	11.3	10.7	13.5	12.8	5.50	5.20	7.08	6.70
SK9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.6	24.2	12.2	11.5	17.4	16.5
SK9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.1	36.0	19.0	18.0	25.4	24.0
SK9082.1	18.0	17.0	54.4	51.5	66.1	62.5	75.6	71.5	34.9	33.0	49.2	46.5
SK9086.1	30.7	29.0	77.2	73.0	89.8	85.0	108	102	50.7	48.0	65.5	62.0
SK9092.1	38.1	36.0	166	157	180	170	182	172	84.6	80.0	95.1	90.0
SK9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152



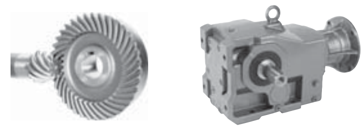

SK 9042.1, SK 9043.1 NEMA-C + W Ratings & Combinations

Model Type	Gear Ratio i_{tot}	Output Speed n_2 1750 rpm [rpm]	Output Torque* $T_{2\ max}$ [lb-in]	Maximum input power◈ Solid input shafts type "W" Input Speed 1750 rpm [hp]	1150 rpm [hp]	875 rpm [hp]	580 rpm [hp]	NEMA C-Face* Available Combinations 56C	140TC	180TC	210TC	250TC	280TC	320TC	360TC
SK 9042.1	8.83	198	12390	20.00	13.20	10.00	6.60			X	X	X			
	9.39	186	13275	20.00	13.20	10.00	6.60			X	X	X	X*		
	10.21	171	13275	20.00	13.20	10.00	6.60			X	X	X			
	11.40	154	13275	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	13.40	131	17700	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	15.66	112	17700	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	18.20	96	21683	20.00	13.20	10.00	6.60			X	X	X			
	20.32	86	23010	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	23.89	73	23895	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	27.91	63	24780	20.00	13.20	10.00	6.60	X	X	X	X	X	X*		
	31.70	55	11336	9.89	6.53	4.96	3.29	X	X	X	X				
	34.39	51	24780	20.00	13.20	10.00	6.60	X	X	X	X	X*			
	40.54	43	24780	16.91	11.16	8.45	5.58	X	X	X	X	X*	X*		
	47.67	37	24780	14.55	9.60	7.27	4.80	X	X	X	X	X*	X*		
	55.69	31	24780	12.19	8.04	6.09	4.02	X	X	X	X	X*	X*		
	63.25	28	24780	11.01	7.27	5.50	3.63	X	X	X	X				
	68.61	26	24780	10.22	6.75	5.11	3.37	X	X	X	X	X*			
	76.18	23	24780	9.04	5.97	4.52	2.98	X	X	X	X*				
	86.43	20	24780	7.86	5.19	3.93	2.59	X	X	X	X*				
	95.56	18	24780	7.08	4.67	3.54	2.34	X	X	X	X*				
	117.79	15	21240	5.06	3.34	2.53	1.67	X	X	X*					
	132.79	13	24780	5.11	3.37	2.56	1.69			X	X*				
	159.94	11	24780	4.32	2.85	2.16	1.43			X*	X*				
	165.24	11	13275	2.32	1.53	1.16	0.76	X	X						
	195.12	9.0	24780	3.54	2.34	1.77	1.17	X	X	X*					
	235.01	7.4	24780	2.91	1.92	1.45	0.96	X	X	X*					
	273.73	6.4	24780	2.52	1.66	1.26	0.83	X	X						
	329.69	5.3	24780	2.08	1.38	1.04	0.69	X	X						
SK 9043.1	172.08	10	24780	3.00	1.98	1.50	0.99	X	X	X*					
	204.38	8.6	24780	3.00	1.98	1.50	0.99	X	X	X*					
	279.60	6.3	24780	2.48	1.63	1.24	0.82	X	X	X*					
	350.72	5.0	24780	1.97	1.30	0.98	0.65	X	X*	X*					
	404.82	4.3	24780	1.69	1.12	0.85	0.56	X	X*	X*					
	568.04	3.1	24780	1.22	0.80	0.61	0.40	X	X*						
	645.18	2.7	24780	1.06	0.70	0.53	0.35	X	X*						
	881.60	2.0	24780	0.79	0.52	0.39	0.26	X*	X*						
	1113.24	1.6	24780	0.63	0.42	0.31	0.21	X*	X*						
	1517.17	1.2	24780	0.47	0.31	0.24	0.16	X*	X*						
	2128.35	0.82	24780	0.32	0.21	0.16	0.11	X*	X*						
	2397.14	0.73	24780	0.29	0.19	0.14	0.09	X*	X*						
	3026.98	0.58	24780	0.23	0.15	0.11	0.08	X*	X*						
	3362.82	0.52	24780	0.20	0.13	0.10	0.07	X*	X*						
	4246.38	0.41	24780	0.16	0.11	0.08	0.05	X*	X*						

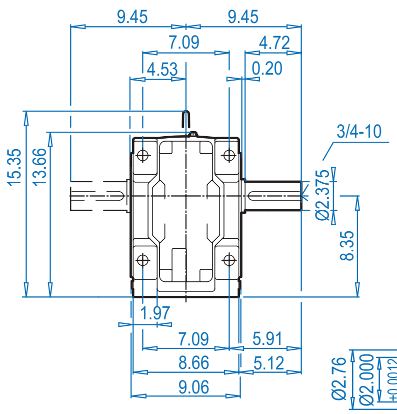
W + NEMA

* Caution - The motor power may exceed the gear unit's mechanical torque capacity
◈ The mechanical power limit of the solid input shaft type "W" may limit the reducer rating.
All ratings are mechanical. See page 14 for thermal considerations.

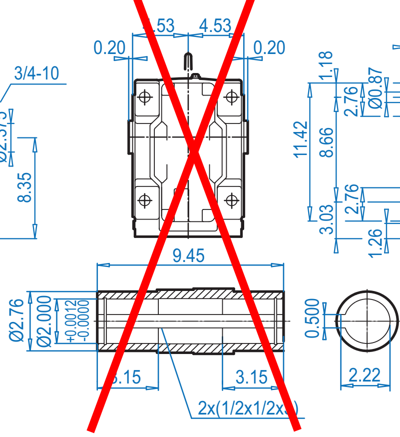
lb	W	56C	140TC	180TC	210TC	250TC
SK 9042.1	276	265	265	280	311	333
SK 9043.1	287	291	291	300	-	-



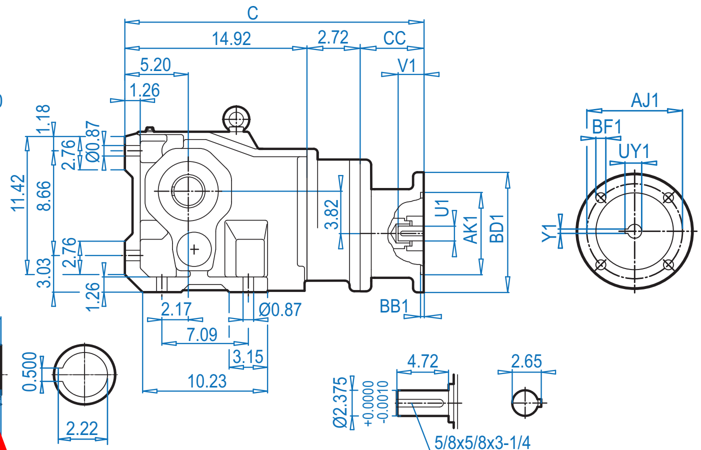
SK 9043.1



SK 9043.1AX



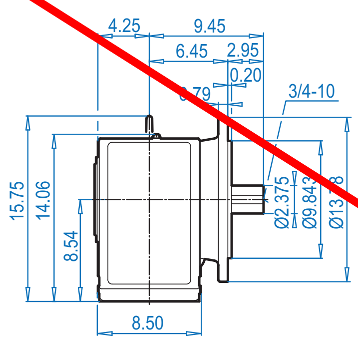
NEMA Input



DIMENSIONS

Dimensions in Inches

SK 9043.1VF



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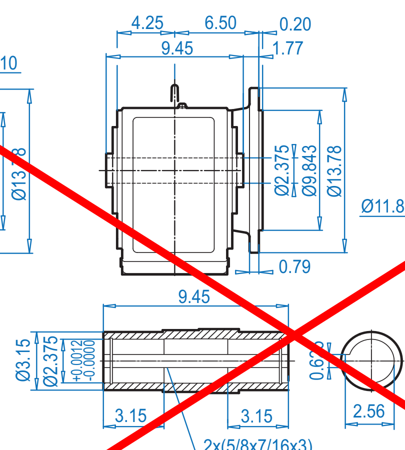
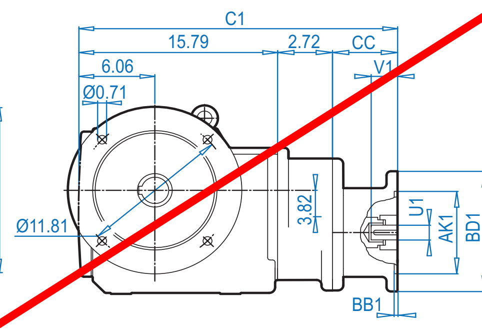
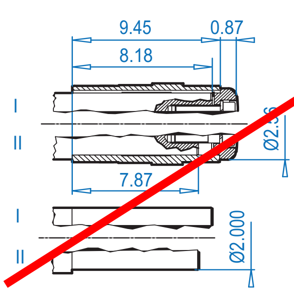


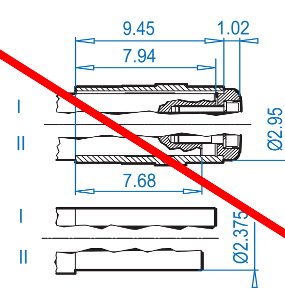


ALTERNATE SHAFTS SEE PAGES 566 - 573

SK 9043.1AXB 574



SK 9043.1AFB 574



NEMA Dimensions

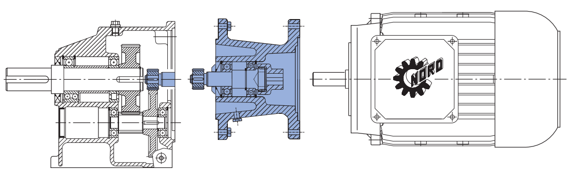
Type	AJ1	AK1	BB1	BD1	BF1	U1	V1	UY1	Y1	C	C1	CC
56C	5.88	4.500	0.18	6.54	0.43	0.625	2.06	0.71	0.188	22.24	23.11	460
140TC	5.88	4.500	0.18	6.54	0.43	0.875	2.12	0.96	0.188	22.24	23.11	4.60
180 TC	7.25	8.500	0.23	9.17	0.59	1.125	2.62	1.24	0.250	24.24	25.11	6.60

NEMA C-Face Motor Adapter

NEMA C-face motor adapters allow for easy installation and removal of industry standard C-face motors. NEMA C-face motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer. Gear units with NEMA C-face adapters are commonly used where applications require specialized motors or the user wants to easily find a replacement motor if failure occurs. NORD also offers high performance NEMA C-face motors and brakemotors, that can be factory installed to the motor adapter.

NORD motor adapters deliver nearly 100% of the torque generated by the motor and can be used from -22ºF (-30ºC) to 212ºF (100ºC). Most motor adapters have specially sealed bearings that are lubricated for life. However, some larger adapters are supplied with an automatic lubricator, which provides time released grease to the outboard adapter bearing. The automatic lubricator needs replacement after a specific service interval, see page 675 for more details.

The maximum input power of a gear unit with a NEMA C-face adapter is generally limited by the power rating of the standard NEMA C-face motor size. The power limit is indicated in the ratings table for a standard 4-pole 1750 rpm motor. In some cases the gearbox limit ($T2_{max}$) will be the limiting capacity. Both the NEMA adapter limit and the gearbox torque limit must be considered. If the speeds required exceed those included in the performance and speed reduction tables please contact NORD.



IEC Motor Adapter (example SK32 – IEC63)

IEC motor adapters allow for easy installation and removal of industry standard IEC motors according to DIN 42677. The IEC adapter is very similar to the NEMA C-face adapter in construction. The maximum input power is generally limited by the IEC motor size. For ratings and dimensions, please consult NORDS's metric catalogs.

Vertical Motor Adapter Applications

Gear units with motors frame sizes 250TC (IEC160) and larger, in a vertical up motor mounting position, NORD recommends using an integral gearmotor instead of a NEMA or IEC input adapter. If your application requires this mounting position and a NEMA or IEC input, please consult NORD. In vertical down motor mounted applications it is recommended to shorten the maintenance interval.

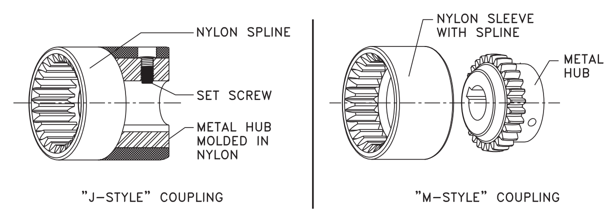
Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending on the size of the C-face input, NORD provides either a gear or jaw type coupling.

Gear Couplings

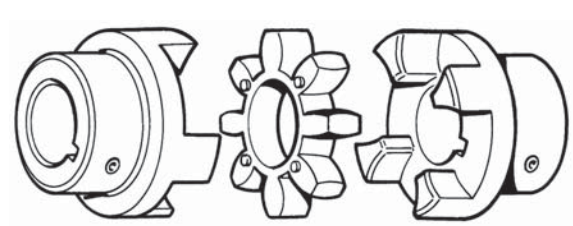
Gear couplings are used with 56C to 280TC adapters and provide a compact space saving design. C-face adapter input shafts have a machined male spline that meshes with a molded nylon spline on the coupling. This specially designed molded nylon sleeve that exhibits high torsional stiffness, resulting in minimum fit-up backlash and reduced internal frictional losses. Gear couplings lightweight design yields low inertia and use blind assembly and slip together components to make inspection easy without disassembly.

NORD incorporates two styles of gear couplings, the "J" and "M" styles. The "J" style is one-piece couplings consisting of a nylon sleeve and metal hub that are fused together. The "M" style is a two-piece coupling consisting of a separate nylon sleeve and metal hub.



Jaw Couplings

Jaw couplings are used with 320TC and larger adapters. The cast iron jaw type couplings have a urethane "spider" that provides smooth transmission of the motor torque and has excellent shock and vibration dampening characteristics. A set screw on the coupling prohibits axial movement along the motor shaft.



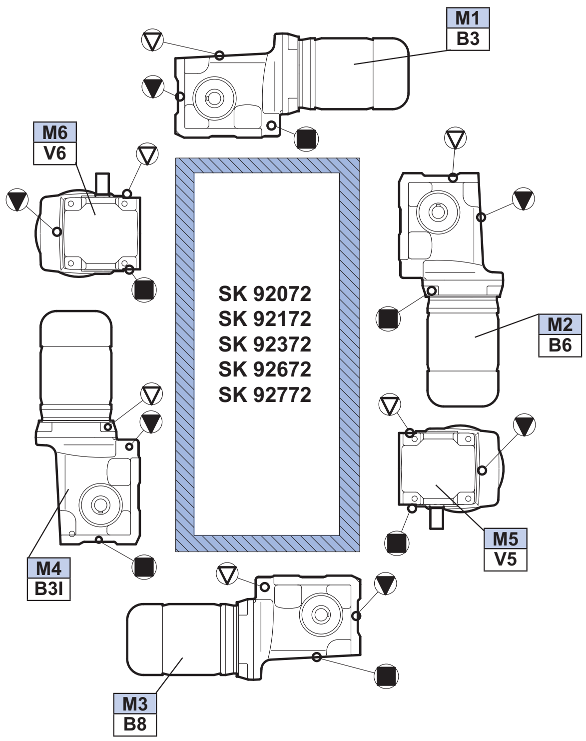
NEMA Motor Adapter Details

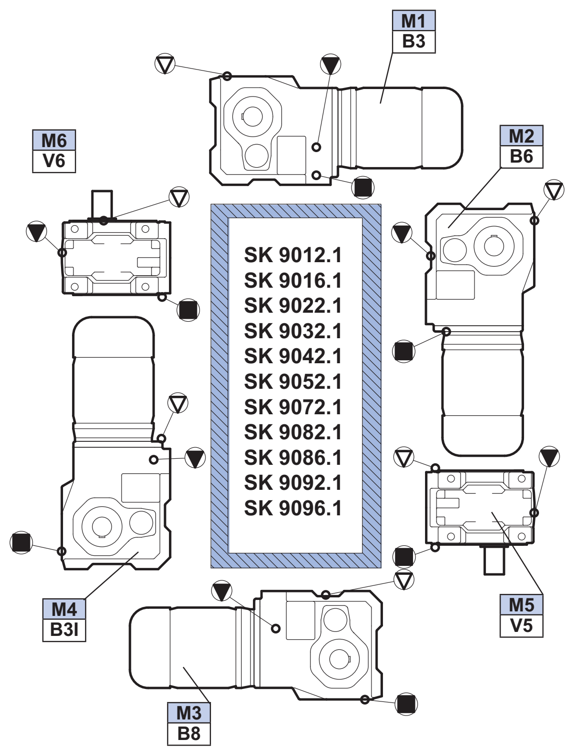
NEMA C-face Motor Frame Size	NEMA Adapter Nomenclature	4 pole Motor HP	Max Motor Weight [lb]	Coupling Descrip-tion	Coupling Bore (inches)	Maximum Cou-pling Torque Capacity (in-lb)	Safety Factor
56 C	- 56C	≤ 1.0	66	J14	0.625	177	3.3 min
56 C	- 56C	≤ 1.5	66	J24	0.875	354	6.6 min
143 TC	- 140TC	≤ 1.5	88				6.6 min
145 TC	- 140TC	≤ 2	110				4.9 min
145 TC	- 140TC	3	110				3.3 min
182 TC	- 180TC	3	130	J28	1.125	797	7.4 min
184 TC	- 180TC	5	175				4.4 min
182 TC	- 180TC	3	130	M38	1.125	1416	13.1 min
184 TC	- 180TC	5	175				7.9 min
213 TC	- 210TC	7.5	220		1.375		5.2 min
215 TC	- 210TC	10	220				4.0 min
254 TC	- 250TC	15	450	M42	1.625	1770	3.3 min
256 TC	- 250TC	20	450				2.5 min
284 TC	- 280TC	25	550	M48	1.875	2478	2.8 min
286 TC	- 280TC	30	550				2.3 min
324 TC	- 320TC	40	770	R65	2.125	11,060	8.0 min
326 TC	- 320TC	50	1100				6.4 min
364 TC	- 360TC	60	1550	R90	2.375	42,480	19.9 min
365 TC	- 360TC	75	1550				16.1 min
404 TSC	- 400TSC	100	2205		2.875		12.1 min

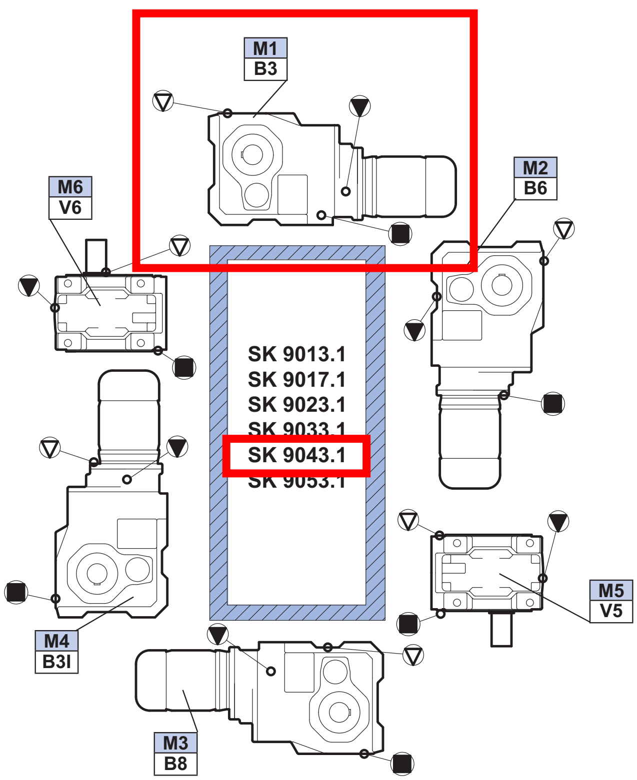
IEC Motor Adapter Details

IEC Motor B5 4 pole	IEC Adapter Nomenclature	HP / kW	Max Weight Limit [lb]	Coupling Descrip-tion	Coupling Bore (mm)	Maximum Cou-pling Torque Capacity (Nm)	Safety Factor
63 S/4	- IEC 63	0.16 / 0.12	56	J14	11	20	23.2 min
63 L/4	- IEC 63	0.25 / 0.18	56				15.8 min
71 S/4	- IEC 71	0.33 / 0.25	67		14		11.5 min
71 L/4	- IEC 71	0.50 / 0.37	67				7.8 min
80 S/4	- IEC 80	0.75 / 0.55	89	J24	19	40	10.4 min
80 L/4	- IEC 80	1.00 / 0.75	89				7.6 min
90 S/4	- IEC 90	1.5 / 1.1	111		24		5.3 min
90 L/4	- IEC 90	2.0 / 1.5	111				3.8 min
100 L/4	- IEC 100	3.0 / 2.2	133	J28	28	90	6.1 min
100 L/40	- IEC 100	5.0 / 3.7	133				4.4 min
112 M/4	- IEC 112	5.3 / 4.0	177				3.4 min
132 S/4	- IEC 132	7.5 / 5.5	221	M38	38	160	4.3 min
132 M/4	- IEC 132	10 / 7.5	221				3.2 min
160 M/4	- IEC 160	15 / 11	441	M42	42	200	2.2 min
160 L/4	- IEC 160	20 / 15	441				1.6 min
180 M/4	- IEC 180	25 / 18.5	552	M48	48	280	2.3 min
180 L/4	- IEC 180	30 / 22	552				1.9 min
200 L/4	- IEC 200	40 / 30	772	R65	55	1250	6.3 min
225 S/4	- IEC 225	50 / 37.5	1103		60		5.2 min
225 M/4	- IEC 225	60 / 45	1103				4.2 min
250 M/4	- IEC 250	75 / 55	1544	R90	70	4800	13.5 min
280 S/4	- IEC 280	100 / 75	1544		80		9.9 min
280 M/4	- IEC 280	125 / 90	2205				8.2 min
315 S/4	- IEC 315	150 / 110	3307		85		6.7 min
315 M/4	- IEC 315	175 / 132	3307				5.6 min
315 L/4	- IEC 315	250 / 200	3307				3.7 min

INPUT SECTION







▽ = Vent ▼ = Oil Level ■ = Oil Drain

DRIVESYSTEMS **www.nord.com**

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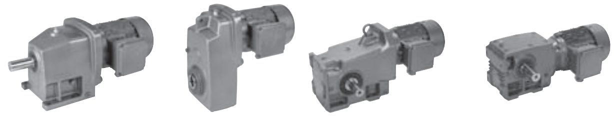
CONSTANT SPEED DRIVES

SIMPLE RELIABLE EFFICIENT

UNICASE™

NORD DRIVESYSTEMS

NORD Gear



DRIVESYSTEMS

Company Overview

Since 1965, NORD Gear has grown to global proportions on the strength of product performance, superior customer service, and intelligent solutions to a never ending variety of industrial challenges.

All mechanical and electrical components of a drive are available from NORD Gear. Our products cover the full range of drive equipment: helical in-line, Clincher™ shaft-mount, helical-bevel, helical-worm gearboxes, motors and AC drives from 1/6 hp to 250 hp, with torques from 90 lb-in to 900,000 lb-in.

But NORD Gear does far more than manufacture the world's finest drive components. We provide our customers with optimum drive configurations for their specific purposes, providing each and every one of them with truly complete and efficient systems at a price/quality ratio unmatched in today's fast-changing markets.

NORD Gear makes its wide range of products easily available through a global network that provides all customers with prompt delivery and expert support services to consistently exceed customer expectations. We are firmly committed to being totally responsive to the ideas and specifications of every customer, anywhere in the world.

UNICASE™

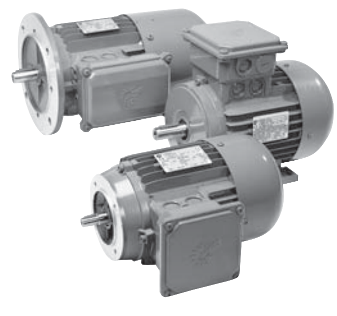
NORD heavy-duty, one-piece housings are precisely machined to exacting standards. Internal reinforcements further increase strength and rigidity. All bearings and seal seats are contained within the casting, eliminating splits or bolt-on carriers that can weaken the housing and allow oil leakage. Bores and mounting faces are machined in one step, producing extremely precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals, and longer life for all components.

Benefits

- Leak-free design
- Quiet operation
- High output torque capabilities
- Extended lubrication life
- Longer gear and bearing life
- Superior dependability/low maintenance/longer life

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-1998 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.



Short, On-Time Delivery

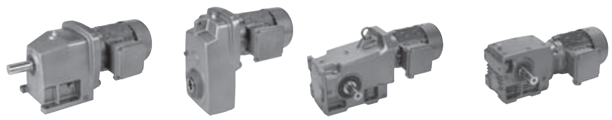
As a NORD customer, you can rest assured that your order will be delivered on time. Because NORD has both decentralized assembly and manufacturing operations and a linked global network, we offer our customers:

- Fast, reliable responses
- Greater product versatility
- Shorter lead times
- Timely shipping
- Rapid delivery

Quality

Quality is assured at NORD assembly and manufacturing facilities, based on ISO 9000 standards — from careful inspection of incoming materials to closely monitored machining operations including gear cutting, turning, hardening & grinding as well as finishing & assembly.

QUALITY ASSURED ISO 9000 GERMANISCHER LLOYD



NORD 911

Trouble? Just call 715-NORD-911 (in Canada, 905-796-3606). Emergency service is available 24 hours a day, 7 days a week. We'll answer your call, ship the parts, or build a unit and have it shipped directly to you to provide what you need, when you need it.

Manufacturing

NORD continually invests in research, manufacturing and automation technology. This is to ensure the highest possible quality at affordable prices. NORD invests heavily in our North American facilities as well as our factories around the world. Recent examples include expanding our Waunakee factory and adding numerous new large gear unit assembly cells. In our Glinde, Germany gear factory we added a state-of-the-art Vacuum multi-chamber carburization system.

Global Availability

From Shanghai to Charlotte, and all points between, NORD reaches customers around the world. Deliveries, service, and product support are close at hand, regardless of your location.

Worldwide Standards

NORD products are designed and manufactured based on the latest North American and global standards.

Increased North American Presence

NORD covers North America with over 30 district offices and over 500 distributor branches. NORD operates a manufacturing and assembly facility in Waunakee, WI, Charlotte, NC, Corona, CA, Brampton, ON, and Monterrey, Mexico, resulting in an ever-increasing capacity in the United States and Canada and giving our customers the shortest lead times in the industry.

Energy Efficiency

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Modular Design

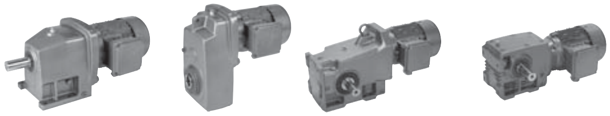
NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit your applications.

More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible – assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch shaft extensions – to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

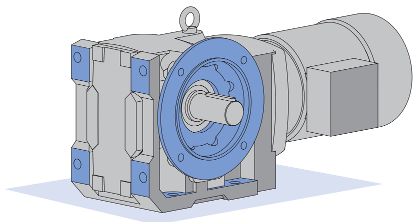
- More output speeds
- More mounting arrangements / Greater flexibility
- Fewer gear stages/Lower cost
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.



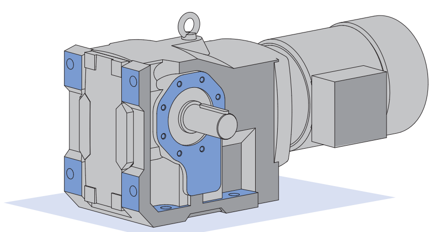
Foot Mounted with B5 Flange (XF)

NORD can supply some foot mounted reducers with a B5 flange as well. These type XF reducers are designed to be foot and not flange mounted. The B5 flange is normally used to mount auxiliary equipment to the speed reducer. If the B5 flange is going to be used to mount the reducer, additional support will normally be required.



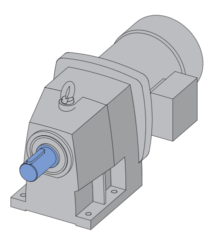
Foot mounted with B14 Face Flange (XZ)

NORD can supply some foot mounted reducers with a B14 face flange as well. These type XZ reducers are designed to be foot and not flange mounted. The B14 face flange is normally used to mount auxiliary equipment to the speed reducer. If the B14 face flange is going to be use to mount the reducer, additional support will normally be required.



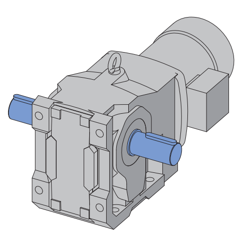
Shaft Options

Solid Shaft (Blank or V)



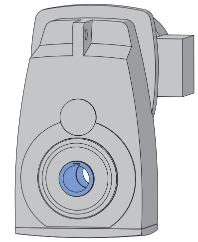
NORD's standard keyed solid shafts include a centered threaded hole. Shafts are available as inch or metric versions. The standard shaft material is 1045 or 4140 or equivalent.

Double Solid Shaft (L)



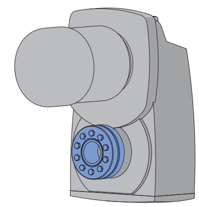
The standard solid shaft end is projected out both sides of the speed reducer. This option is commonly used to transfer torque out of both sides of the reducer or to mount a speed-monitoring device such as an encoder on one of the shaft ends. If you need the keyways to be alligned you must specify with NORD upon ordering

Keyed Hollow Shaft (A)



NORD's standard keyed hollow shafts are made from SAE 1045 high carbon steel. They feature standard keyway dimensions and are available both inch and metric designs. Many NORD reducers offer a variety of hollow shaft diameters.

Shrink Disc (S) (SH)



The shrink disc relies on the proven wedge principle to create a keyless, mechanical interference fit by converting locking screw tension into radial contact pressure on shaft and hub in effect "shrinking" it on to the customer shaft. Shrink discs result in a zero backlash mechanical interference fit that can accommodate high torque unlike other mounting technologies and will never wear or pound out, even for high cycle fluctuating and reversing loads.

Other shrink disc advantages include:

- Elimination of fretting corrosion associated with key connections.
- Generous clearance for easy mounting & dismounting.
- Allow for larger bores sizes compared to keyed hollow shafts.
- For more information see page 72

Heavy Duty Shrink Disc (VS)

NORD heavy duty shrink discs offer increased clamping force and safety factor for severe applications.

Special Shafts & Shaft Materials

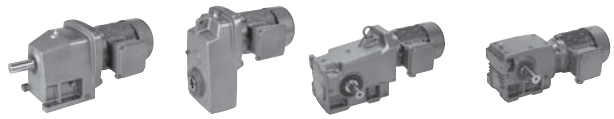
Stainless Steel Output Shaft (SM5)

Output shafts made from stainless steel are available and are frequently used in food, pharmaceutical, and washdown applications. In some cases solid input shafts can also be provided in stainless.

Special Solid Shaft (SWV)

Special solid shaft diameters and lengths can be provided for a nominal price adder. Special features are also available including keyless shafts, cross drilled shafts or special threaded taps. Different shaft materials are also available. NORD has in-house drafting design and machining departments so we can provide special requirements in short lead times. Specify your shaft requirements and NORD will verify the design feasibility.

Gear Unit Options



Special Hollow Shaft (SWA)

Special hollow bore shafts can also be provided. Special hollow bore shafts can be provided with special diameters, multiple keyways, and even special extended hollow shafts that are frequently used with counter rotating drives. Different shaft materials are also available. Specify your shaft requirements and NORD will verify the design feasibility.

Hollow Shaft with Spline (EA)

Hollow shafts with a metric involute spline profile according to DIN 5480 are available for some NORD hollow shaft reducers. These spline shafts are commonly used on crane travel drives. See pages 573 & 671 for details.

Heavy Duty Output Bearings (VL)

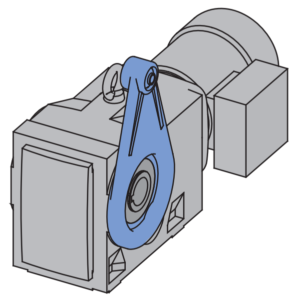
Replacing standard output bearings with heavy-duty versions will increase the external load carrying capacityof the speed reducer. Increased capacity in either or both overhung (radial) or thrust (axial) loading insures that premature bearing failure will not occur due to high stresses in the bearing elements. The increased bearing capacity will also keep the speed reducer as small as possible by not having to select the next larger case size in order to handle the bearing loads. If increased bearing life is desired, larger bearings will reduce the relative stress on the bearings and increased B10 bearing life.

(FKM) Fluoro-rubber Seals (VI)

The NORD standard oil seals are made of Nitrile or rubber and are rated for temperatures up to 125°C or 250°F. If ambient or oil temperatures rise above this level NORD recommends using fluoro-rubber (also called FKM) oil seals. FKM seals are rated from -30°F to 400°F (-35°C to 200°C).

Torque Arm (D)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the reducers B14 flange. The tear drop shaped torque arm has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.

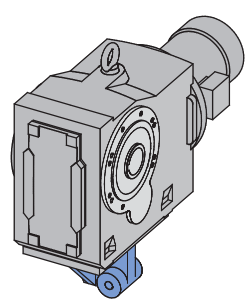


Specify the torque arm location and orientation when ordering

Torque arm location ______
Torque arm orientation ______
See Page 18 for details

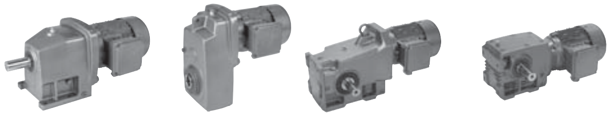
Bottom Mount Torque Arm (K)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the base of the reducer. The torque tab has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.The torque tab is available for bevel units SK 90.1.



Specify the torque tab location when ordering

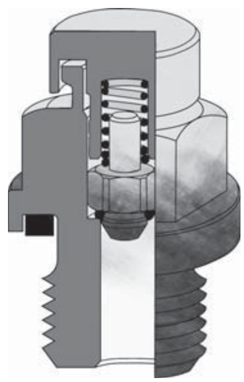
Torque tab location ______
See Page 18 for details ______



Oil Sight Glass (OSG)

The oil sight glass provides a visible oil level indication on the reducer. The sight glass replaces the standard steel fill plug and consists of a sealed clear porthole centered in the middle of a brass plug. The sight glass allows for quick oil level and color inspection.

Autovent™ (DR)



The Autovent™ prevents entry of foreign material, such as water, dust, corrosives, etc… and is perfect for washdown and dusty environments. The Autovent™ is a ball and spring check valve that opens at 2 psi and during operation and closes tightly when the gearbox cools. The Autovent™ is standard on all vented NORD reducers some of the benefits are cleaner gearbox oil, extended lubrication life and longer lasting seals, gears, and bearings.

Open Vent (OV)

An open vent can be optionally supplied on NORD reducers. The open vent allows for air pressure differences between the inner space of the reducer and the atmosphere. This open vent will be closed upon delivery to prevent oil leakage. Before the reducer is put in service the open vent should be activated by removing the sealing plug.

Filtered Vent (FV)

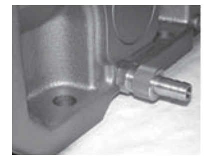
NORD offers a filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

Magnetic Drain Plug (MDP)

Magnetic drain plugs attract and hold ferrous metal particles that may circulate inside the reducer's lubrication system. These potentially abrasive particles may cause excessive wear in the reducer if they remain circulating. An increase of collected material may be a warning sign of future problems.

Special Drain Plugs

NORD oil drain valves are offered to make draining the oil from the gearbox clean and easy. The drain hose needs to be supplied by the customer. The hose fittings are offered in either 90° or straight to accommodate the user.



A brass drain valve is threaded into the existing oil drain port of the gearbox. The spring valve is closed using a rubber o-ring. When the hose fitting is threaded into the drain valve, the spring valve is pushed open and allows oil to drain. When the hose fitting is removed, the drain valve closes. A brass, threaded cap is supplied to cover the drain valve when not in use.

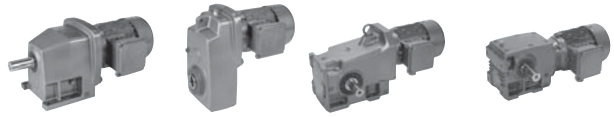
Additional Drain Plug Hole (ADP)

NORD can add an additional drain hole to the reducer housing for a small surcharge if required for special oil plumbing needs.

Long Term Storage (LL)

Speed reducers are frequently put in storage prior to installation for long periods of time and in some cases exposed to the elements. NORD's long term storage option protects the unit from moisture or corrosion by coating all unpainted surfaces with a dry, transparent, durable waxy film. Once installation is necessary this waxy film can be easily removed with a commercial de-greaser or petroleum solvent. If possible the store room should be vented and dry, with room temperatures between 23°F and 104 °F (-5 °C and 40 °C).

Gear Unit Options



Paint Coatings

NORD's standard paint coating is a two component, aliphatic polyurethane finish contaning 316 stainless steel material.This gray stainless steel paint has excellent appearance and outstanding physical properties. It is suitable for both indoor and outdoor applications.

Advantages of NORD's stainless steel two component polyurethane:

- Excellent adhesion to cast iron, aluminum, steel, and plastics
- Excellent corrosion resistance
- Excellent chemical resistance
- Excellent gloss and color retention
- Suitable for indoor and outdoor exposure
- Nonporous and excellent abrasion resistance
- USDA Compliant

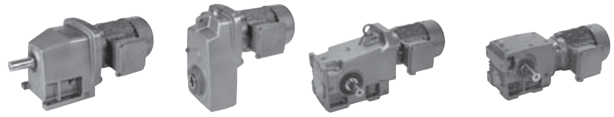
NORD also offers a variety of severe duty paint coatings that provide a high level of protection against water and severe environments both indoors and outdoors. NSD+ (NORD Severe Duty) consists of a primer undercoat and a stainless steel polyurethane topcoat. For the most demanding environments, NORD offers NSD-X3 (NORD Severe Duty triple coated) which consists of a primer undercoat, stainless steel polyurethane coating, and a clear topcoat. Paint coatings are also available in alternate colors as seen in the table below.

Additionally a variety of coating options are available including our Severe Duty coatings:

Finish	Color	Coating	Use
Standard (stainless steel paint)	Stainless steel silver (Gray)	1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color	Black, Blue, Red, Orange	1 x Color top coat (polyurethane)	Indoor or outdoor protected
NORD Severe Duty + NSD+	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
NORD Severe Duty +W NSD+W	White	1 x Primer high solid alkyd system 1 x White top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color NSD+	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color top coat (polyurethane)	Indoor or outdoor moderate environment
NORD Severe Duty Extreme NSD-X3	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
NORD Severe Duty Extreme NSD-X3W	White	1 x Primer high solid alkyd system 1 x White (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
Alternate color NSD-X3	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment

Special colors and paints possible please contact NORD with your specific requirements.

Lubrication



NORD DRIVESYSTEMS

Lubrication Types

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Mounting position not only determines the proper fill-level but may also have some effect on final reducer assembly. If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering. Unless otherwise specified, NORD supplies most all gear units (*) factory-filled with the standard lubrication type and the appropriate amount of lubricating oil.

* Gear units SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 are supplied without oil.

Standard Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	🌢❶
	VG220	PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC630	🌢❷
	VG220	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	🌢
Helical Worm	VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	🌢

Optional Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG460	PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC 634	-
	VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	-
	VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil/Cibus SHC220	-
Helical Worm	VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	VG460	FG-PAO	0 to50°C (32 to 122°F)	Mobil/Cibus SHC460	-

Standard Bearing Grease Lubricants

Grease Type/Thickener	NLGI Grade	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Standard (Li-Complex)	NLGI 2	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	🌢❶
High Temp (Polyurea)	NLGI 2	-25 to 80°C (-13 to 176°F)	Mobil Polyrex EP 2	🌢❷
Food-Grade (AL-Complex)	NLGI 2	-25 to 40°C (-13 to 104°F)	Mobil Grease FM222	🌢

🌢 Stocked Lubricants

❶ Standard product on serviceable gear units

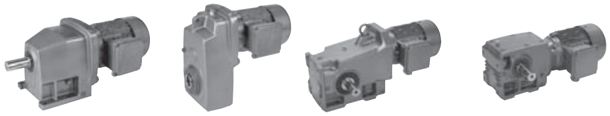
❷ Standard product on maintenance free gear units

Oil Formulation Codes

MIN-EP	Mineral Oil with EP Additive
PAO	Synthetic Polyalphaolefin Oil
PG	Synthetic Polyglycol Oil
FG	Food-Grade Oil
FG-PAO	Food-Grade, Synthetic Polyalphaolefin Oil

Important Notes

- In worm gears avoid using (EP) gear oils that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacture for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility & to obtain recommended cleaning or flushing procedures.
- Do not mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil, or Polyalphaolefin (PAO) oil.
- Please Consult NORD if considering cold-temperature oils below an ISO Viscosity VG100 or lower.



Lubrication

Ventilation

Most gear reducers (except for SK0182NB, SK0282NB and SK1382NB) are equipped with a vent which helps compensate for air pressure differences between the inner space of the gear unit and the atmosphere.

The spring-pressure vent (Autovent™) is commonly supplied and factory-installed. Normally open vents may also be supplied as an option; normally-open vents are closed upon delivery in order to prevent oil leakage during transport. When normally open vents are supplied, the sealing plugs must be removed prior to commissioning the reducer.

Prior to reducer start-up, it is important to check the maintenance manual to verify that the vent is properly located with respect to mounting position.

Mounting Position

The reducer mounting position determines the approximate oil fill-level and the appropriate vent location. In some cases mounting position may dictate possible variation in final reducer assembly.

If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering.

Oil Fill Quantities

Oil fill quantities shown in the catalog or maintenance instructions are approximate amounts. The actual oil volume varies depending upon the gear ratio. Prior to commissioning the reducer, the oil-fill level should be checked using the reducer's oil-level plug. It may be necessary to drain excess oil or add additional oil.

Unless otherwise specified, NORD supplies most all gear units factory-filled with the standard lubrication type per the specified mounting position. Gear units SK10282, SK10382, SK11282, SK11382, and SK12382 are supplied without oil.

Lubrication Replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years.

Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to change the reducer lubricant more often that what is suggested as a typical guideline.

The Importance of Routine Oil Analysis

Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends as related to specific equipment, will help establish proper lubrication maintenance and change-out intervals.

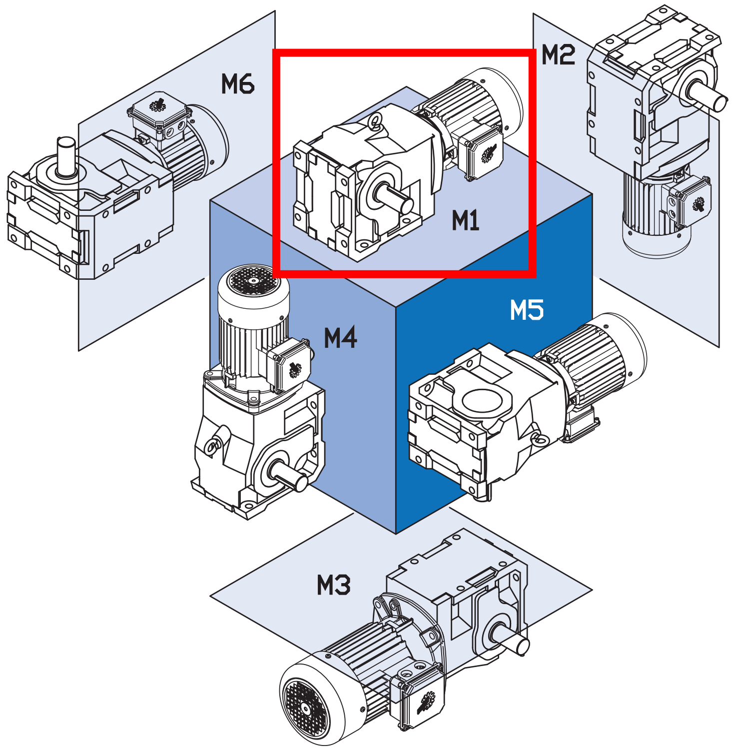
To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

NORD suggests replacing the gear oil if oil analysis indicates any of the following:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- Acid number tests indicate a significant level of oxidative break-down of the oil and a critical reduction in performance.

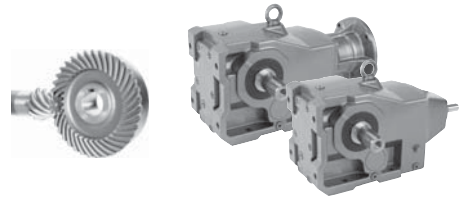
Helical-Bevel Foot Mount Positions & Oil Fill Quantities

NORD DRIVESYSTEMS



Mounting Position	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK92072	0.42	0.40	0.63	0.60	0.53	0.50	0.53	0.50	0.42	0.40	0.42	0.40
SK92172	0.58	0.55	0.95	0.90	1.00	0.95	1.16	1.10	0.79	0.75	0.66	0.62
SK92372	0.95	0.90	1.37	1.30	1.53	1.45	1.69	1.60	1.27	1.20	1.27	1.20
SK92672	1.90	1.80	3.70	3.50	3.38	3.20	3.59	3.40	2.75	2.60	2.75	2.60
SK92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10
SK9012.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9013.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9016.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9017.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9022.1	1.37	1.30	2.75	2.60	3.70	3.50	4.44	4.20	2.11	2.00	2.96	2.80
SK9023.1	2.54	2.40	3.17	3.00	4.02	3.80	5.60	5.30	2.33	2.20	3.28	3.10
SK9032.1	1.80	1.70	5.07	4.80	6.76	6.40	7.08	6.70	4.33	4.10	5.39	5.10
SK9033.1	3.49	3.30	6.98	6.60	7.40	7.00	8.24	7.80	4.55	4.30	5.39	5.10
SK9042.1	4.65	4.40	9.20	8.70	10.6	10.0	10.4	9.80	7.19	6.80	7.93	7.50
SK9043.1	4.86	4.60	10.8	10.2	11.3	10.7	13.5	12.8	5.50	5.20	7.08	6.70
SK9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.6	24.2	12.2	11.5	17.4	16.5
SK9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.1	36.0	19.0	18.0	25.4	24.0
SK9082.1	18.0	17.0	54.4	51.5	66.1	62.5	75.6	71.5	34.9	33.0	49.2	46.5
SK9086.1	30.7	29.0	77.2	73.0	89.8	85.0	108	102	50.7	48.0	65.5	62.0
SK9092.1	38.1	36.0	166	157	180	170	182	172	84.6	80.0	95.1	90.0
SK9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152

SK 9032.1, SK 9033.1
NEMA-C + W
Ratings & Combinations

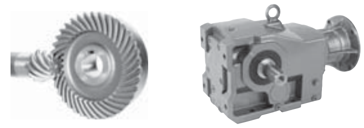


NORD DRIVESYSTEMS

Model Type	Gear Ratio i_{tot}	Output Speed n_2 1750 rpm [rpm]	Output Torque* $T_{2\,max}$ [lb-in]	Maximum input power◈ Solid input shafts type "W" Input Speed 1750 rpm [hp]	1150 rpm [hp]	875 rpm [hp]	580 rpm [hp]	NEMA C-Face* Available Combinations 56C	140TC	180TC	210TC	250TC	280TC	320TC	360TC
SK 9032.1	8.48	206	7788	10.00	6.60	5.00	3.30	X	X	X	X				
	10.73	163	7965	10.00	6.60	5.00	3.30	X	X	X	X				
	12.68	138	8850	10.00	6.60	5.00	3.30	X	X	X	X				
	13.49	130	11948	10.00	6.60	5.00	3.30	X	X	X	X				
	16.04	109	12390	10.00	6.60	5.00	3.30	X	X	X	X				
	17.08	102	12833	10.00	6.60	5.00	3.30	X	X	X	X				
	20.23	87	13275	10.00	6.60	5.00	3.30	X	X	X	X				
	23.91	73	13718	10.00	6.60	5.00	3.30	X	X	X	X				
	25.03	70	13275	10.00	6.60	5.00	3.30	X	X	X	X				
	29.66	59	13275	10.00	6.60	5.00	3.30	X	X	X	X				
	35.61	49	13718	10.00	6.60	5.00	3.30	X	X	X	X				
	38.05	46	13718	10.00	6.60	5.00	3.30	X	X	X	X*				
	40.36	43	13718	9.36	6.18	4.68	3.09	X	X	X	X*				
	47.70	37	13718	8.05	5.32	4.03	2.66	X	X	X	X*				
	49.94	35	13718	7.62	5.03	3.81	2.51	X	X	X	X*				
	59.17	30	13718	6.53	4.31	3.26	2.15	X	X	X	X*				
	64.08	27	13718	5.88	3.88	2.94	1.94	X	X	X	X*				
	75.91	23	13718	5.01	3.30	2.50	1.65	X	X	X*	X*				
	84.17	21	13718	4.57	3.02	2.29	1.51	X	X	X*	X*				
	93.50	19	13718	4.14	2.73	2.07	1.36	X	X	X*					
	110.77	16	13718	3.48	2.30	1.74	1.15	X	X	X*					
	117.70	15	13718	3.26	2.15	1.63	1.08	X	X						
	139.44	13	13718	2.83	1.87	1.41	0.93	X	X						
	158.74	11	13718	2.39	1.58	1.20	0.79	X	X	X*					
	188.06	9.3	13718	2.02	1.34	1.01	0.67	X	X*	X*					
	197.45	8.9	13718	1.94	1.28	0.97	0.64	X	X*						
	233.92	7.5	13718	1.63	1.08	0.82	0.54	X	X*						
	249.72	7.0	13718	1.52	1.01	0.76	0.50	X	X*						
	295.85	5.9	13718	1.28	0.85	0.64	0.42	X	X*						
SK 9033.1	167.45	10	13718	1.50	0.99	0.75	0.50	X	X*	X*					
	214.83	8.1	13718	1.50	0.99	0.75	0.50	X	X*	X*					
	267.65	6.5	13718	1.41	0.93	0.71	0.47	X	X*						
	352.25	5.0	13718	1.09	0.72	0.54	0.36	X	X*						
	398.77	4.4	13718	0.96	0.63	0.48	0.32	X*	X*						
	539.10	3.2	13718	0.70	0.46	0.35	0.23	X*							
	691.55	2.5	13718	0.54	0.36	0.27	0.18	X*							
	873.65	2.0	13718	0.44	0.29	0.22	0.14	X*							
	1149.80	1.5	13718	0.33	0.22	0.16	0.11	X*							
	1361.37	1.3	13718	0.28	0.19	0.14	0.09	X*							
	1822.00	0.96	13718	0.21	0.14	0.10	0.07	X*							
	2428.14	0.72	13718	0.16	0.10	0.08	0.05	X*							
	3635.95	0.48	13718	0.10	0.07	0.05	0.03	X*							

* Caution - The motor power may exceed the gear unit's mechanical torque capacity
◈ The mechanical power limit of the solid input shaft type "W" may limit the reducer rating.
All ratings are mechanical. See page 14 for thermal considerations.

lb	W	56C	140TC	180TC	210TC
SK 9032.1	150	154	154	163	183
SK 9033.1	154	165	165	-	-



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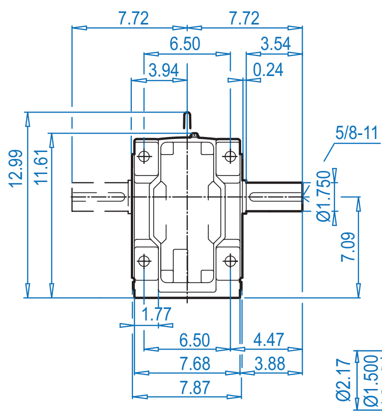
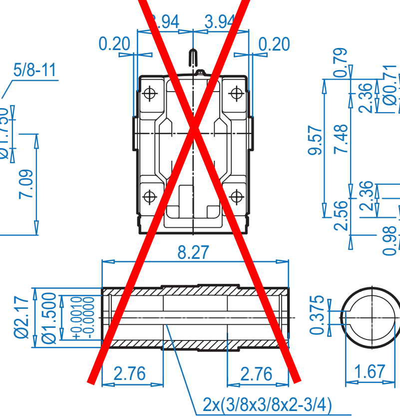
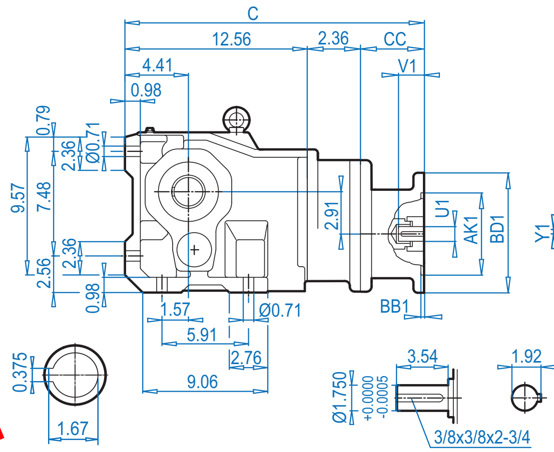


~~SK 9033.1AX~~



NEMA Input



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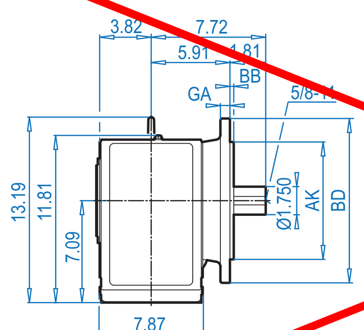
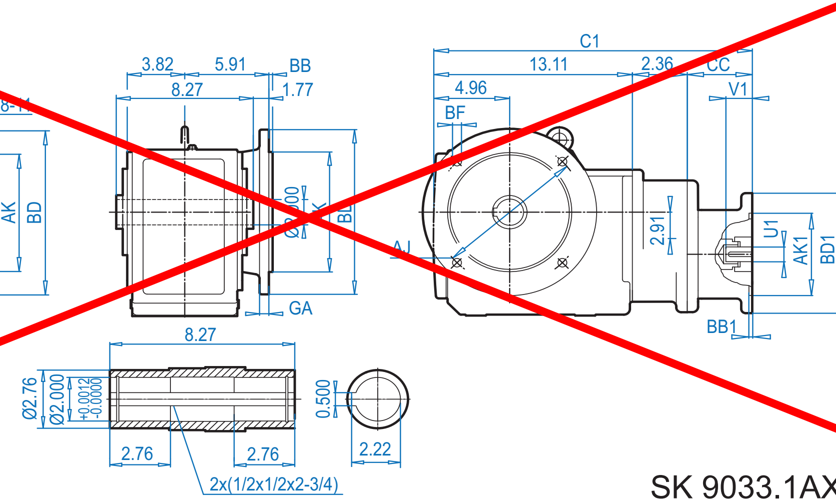
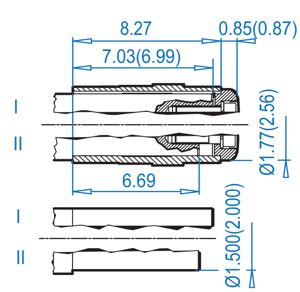


SK 9033.1AF



ALTERNATE SHAFTS SEE PAGES 566 - 573

SK 9033.1AX**B**(AF**B**) ⇨📖 574



Mounting flange

BD (mm)	AJ	AK		BB	BF	GA
9.84 (250)	8.47	7.087	+ 0.0005 - 0.0004	0.16	0.55	0.63
11.81 (300)	10.43	9.055	+ 0.0006 - 0.0005	0.16	0.55	0.79

NEMA Dimensions

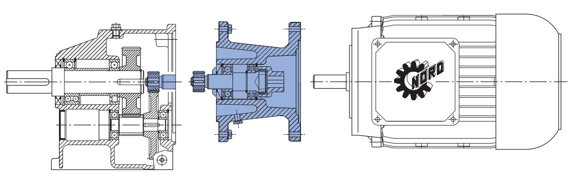
Type	AJ1	AK1	BB1	BD1	BF1	U1	V1	UY1	Y1	C	C1	CC
56C	5.88	4.500	0.18	6.54	0.43	0.625	2.06	0.71	0.188	19.42	19.97	4.50
140TC	5.88	4.500	0.18	6.54	0.43	0.875	2.12	0.96	0.188	19.42	19.97	4.50

NEMA C-Face Motor Adapter

NEMA C-face motor adapters allow for easy installation and removal of industry standard C-face motors. NEMA C-face motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer. Gear units with NEMA C-face adapters are commonly used where applications require specialized motors or the user wants to easily find a replacement motor if failure occurs. NORD also offers high performance NEMA C-face motors and brakemotors, that can be factory installed to the motor adapter.

NORD motor adapters deliver nearly 100% of the torque generated by the motor and can be used from -22ºF (-30ºC) to 212ºF (100ºC). Most motor adapters have specially sealed bearings that are lubricated for life. However, some larger adapters are supplied with an automatic lubricator, which provides time released grease to the outboard adapter bearing. The automatic lubricator needs replacement after a specific service interval, see page 675 for more details.

The maximum input power of a gear unit with a NEMA C-face adapter is generally limited by the power rating of the standard NEMA C-face motor size. The power limit is indicated in the ratings table for a standard 4-pole 1750 rpm motor. In some cases the gearbox limit ($T2_{max}$) will be the limiting capacity. Both the NEMA adapter limit and the gearbox torque limit must be considered. If the speeds required exceed those included in the performance and speed reduction tables please contact NORD.



IEC Motor Adapter (example SK32 – IEC63)

IEC motor adapters allow for easy installation and removal of industry standard IEC motors according to DIN 42677. The IEC adapter is very similar to the NEMA C-face adapter in construction. The maximum input power is generally limited by the IEC motor size. For ratings and dimensions, please consult NORDS's metric catalogs.

Vertical Motor Adapter Applications

Gear units with motors frame sizes 250TC (IEC160) and larger, in a vertical up motor mounting position, NORD recommends using an integral gearmotor instead of a NEMA or IEC input adapter. If your application requires this mounting position and a NEMA or IEC input, please consult NORD. In vertical down motor mounted applications it is recommended to shorten the maintenance interval.

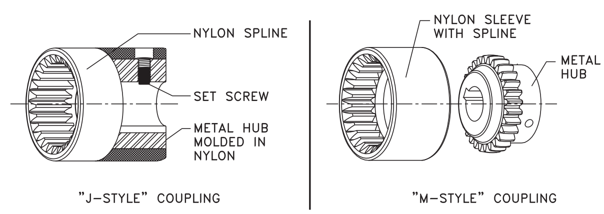
Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending on the size of the C-face input, NORD provides either a gear or jaw type coupling.

Gear Couplings

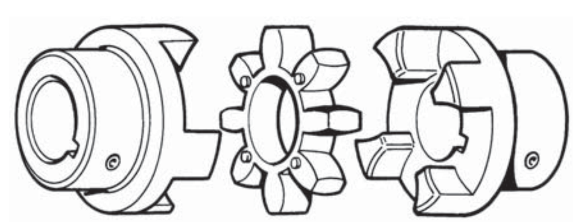
Gear couplings are used with 56C to 280TC adapters and provide a compact space saving design. C-face adapter input shafts have a machined male spline that meshes with a molded nylon spline on the coupling. This specially designed molded nylon sleeve that exhibits high torsional stiffness, resulting in minimum fit-up backlash and reduced internal frictional losses. Gear couplings lightweight design yields low inertia and use blind assembly and slip together components to make inspection easy without disassembly.

NORD incorporates two styles of gear couplings, the "J" and "M" styles. The "J" style is one-piece couplings consisting of a nylon sleeve and metal hub that are fused together. The "M" style is a two-piece coupling consisting of a separate nylon sleeve and metal hub.



Jaw Couplings

Jaw couplings are used with 320TC and larger adapters. The cast iron jaw type couplings have a urethane "spider" that provides smooth transmission of the motor torque and has excellent shock and vibration dampening characteristics. A set screw on the coupling prohibits axial movement along the motor shaft.

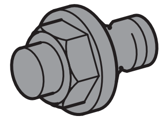


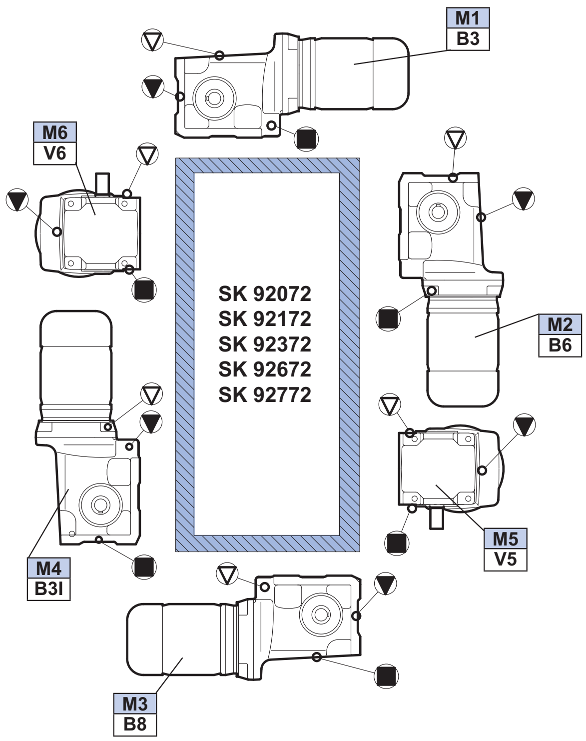
NEMA Motor Adapter Details

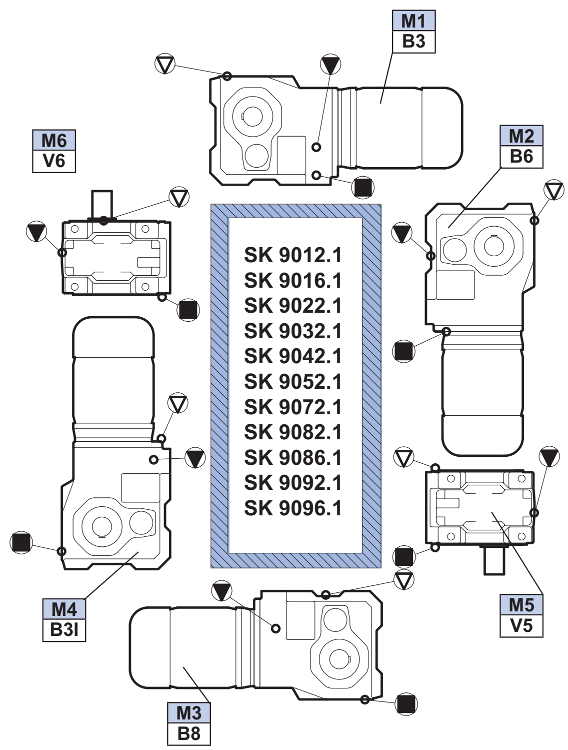
NEMA C-face Motor Frame Size	NEMA Adapter Nomenclature	4 pole Motor HP	Max Motor Weight [lb]	Coupling Descrip-tion	Coupling Bore (inches)	Maximum Cou-pling Torque Capacity (in-lb)	Safety Factor
56 C	- 56C	≤ 1.0	66	J14	0.625	177	3.3 min
56 C	- 56C	≤ 1.5	66	J24	0.875	354	6.6 min
143 TC	- 140TC	≤ 1.5	88				6.6 min
145 TC	- 140TC	≤ 2	110				4.9 min
145 TC	- 140TC	3	110				3.3 min
182 TC	- 180TC	3	130	J28	1.125	797	7.4 min
184 TC	- 180TC	5	175				4.4 min
182 TC	- 180TC	3	130	M38	1.125	1416	13.1 min
184 TC	- 180TC	5	175				7.9 min
213 TC	- 210TC	7.5	220		1.375		5.2 min
215 TC	- 210TC	10	220				4.0 min
254 TC	- 250TC	15	450	M42	1.625	1770	3.3 min
256 TC	- 250TC	20	450				2.5 min
284 TC	- 280TC	25	550	M48	1.875	2478	2.8 min
286 TC	- 280TC	30	550				2.3 min
324 TC	- 320TC	40	770	R65	2.125	11,060	8.0 min
326 TC	- 320TC	50	1100				6.4 min
364 TC	- 360TC	60	1550	R90	2.375	42,480	19.9 min
365 TC	- 360TC	75	1550				16.1 min
404 TSC	- 400TSC	100	2205		2.875		12.1 min

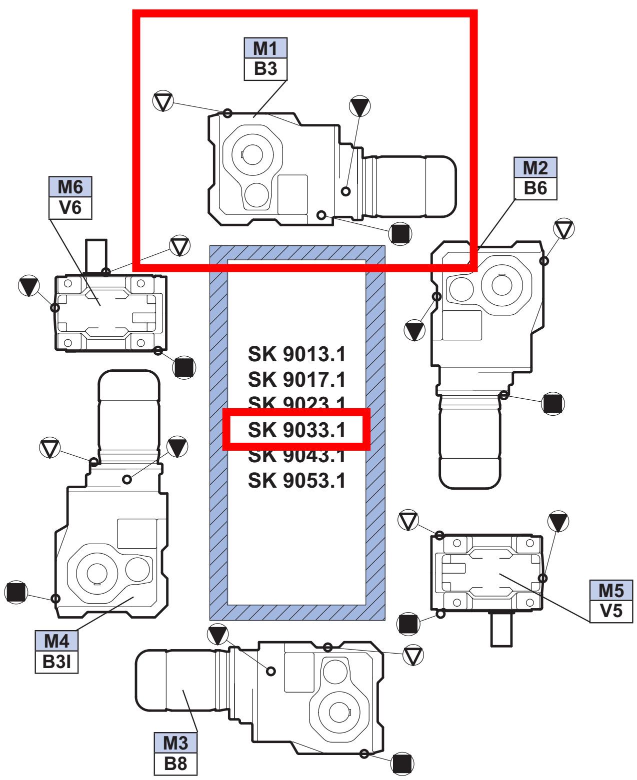
IEC Motor Adapter Details

IEC Motor B5 4 pole	IEC Adapter Nomenclature	HP / kW	Max Weight Limit [lb]	Coupling Descrip-tion	Coupling Bore (mm)	Maximum Cou-pling Torque Capacity (Nm)	Safety Factor
63 S/4	- IEC 63	0.16 / 0.12	56	J14	11	20	23.2 min
63 L/4	- IEC 63	0.25 / 0.18	56				15.8 min
71 S/4	- IEC 71	0.33 / 0.25	67		14		11.5 min
71 L/4	- IEC 71	0.50 / 0.37	67				7.8 min
80 S/4	- IEC 80	0.75 / 0.55	89	J24	19	40	10.4 min
80 L/4	- IEC 80	1.00 / 0.75	89				7.6 min
90 S/4	- IEC 90	1.5 / 1.1	111		24		5.3 min
90 L/4	- IEC 90	2.0 / 1.5	111				3.8 min
100 L/4	- IEC 100	3.0 / 2.2	133	J28	28	90	6.1 min
100 L/40	- IEC 100	5.0 / 3.7	133				4.4 min
112 M/4	- IEC 112	5.3 / 4.0	177				3.4 min
132 S/4	- IEC 132	7.5 / 5.5	221	M38	38	160	4.3 min
132 M/4	- IEC 132	10 / 7.5	221				3.2 min
160 M/4	- IEC 160	15 / 11	441	M42	42	200	2.2 min
160 L/4	- IEC 160	20 / 15	441				1.6 min
180 M/4	- IEC 180	25 / 18.5	552	M48	48	280	2.3 min
180 L/4	- IEC 180	30 / 22	552				1.9 min
200 L/4	- IEC 200	40 / 30	772	R65	55	1250	6.3 min
225 S/4	- IEC 225	50 / 37.5	1103		60		5.2 min
225 M/4	- IEC 225	60 / 45	1103				4.2 min
250 M/4	- IEC 250	75 / 55	1544	R90	70	4800	13.5 min
280 S/4	- IEC 280	100 / 75	1544		80		9.9 min
280 M/4	- IEC 280	125 / 90	2205				8.2 min
315 S/4	- IEC 315	150 / 110	3307		85		6.7 min
315 M/4	- IEC 315	175 / 132	3307				5.6 min
315 L/4	- IEC 315	250 / 200	3307				3.7 min









▽ = Vent ▼ = Oil Level ■ = Oil Drain

SERVICE

DRIVESYSTEMS www.nord.com

NORD Gear Corporation
National Customer Service Toll-Free: 888.314.6673
Info.us@nord.com

NORD Gear Limited
Toll-Free in Canada: 800.668.4378
info.ca@nord.com

WEST
Corona, CA (Los Angeles)
Phone: 608.849.0190

MIDWEST
Waunakee, WI (Madison)
Phone: 608.849.7300

EAST
Charlotte, NC
Phone: 608.849.0140

CANADA
Brampton, ON (Toronto)
Phone: 905.796.3606

100200001/01.11

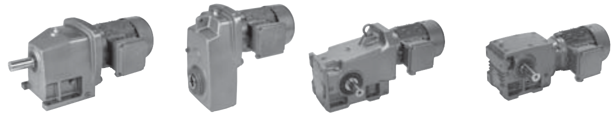
CONSTANT SPEED DRIVES

SIMPLE RELIABLE EFFICIENT

UNICASE™

NORD
DRIVESYSTEMS

NORD Gear



Company Overview

Since 1965, NORD Gear has grown to global proportions on the strength of product performance, superior customer service, and intelligent solutions to a never ending variety of industrial challenges.

All mechanical and electrical components of a drive are available from NORD Gear. Our products cover the full range of drive equipment: helical in-line, Clincher™ shaft-mount, helical-bevel, helical-worm gearboxes, motors and AC drives from 1/6 hp to 250 hp, with torques from 90 lb-in to 900,000 lb-in.

But NORD Gear does far more than manufacture the world's finest drive components. We provide our customers with optimum drive configurations for their specific purposes, providing each and every one of them with truly complete and efficient systems at a price/quality ratio unmatched in today's fast-changing markets.

NORD Gear makes its wide range of products easily available through a global network that provides all customers with prompt delivery and expert support services to consistently exceed customer expectations. We are firmly committed to being totally responsive to the ideas and specifications of every customer, anywhere in the world.

UNICASE™

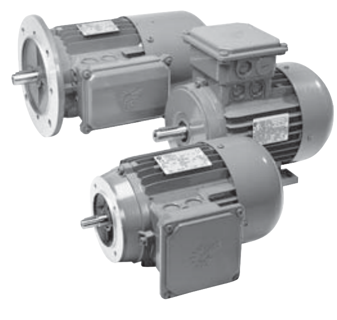
NORD heavy-duty, one-piece housings are precisely machined to exacting standards. Internal reinforcements further increase strength and rigidity. All bearings and seal seats are contained within the casting, eliminating splits or bolt-on carriers that can weaken the housing and allow oil leakage. Bores and mounting faces are machined in one step, producing extremely precise tolerances — thus ensuring accurate positioning of gear teeth, bearings and seals, and longer life for all components.

Benefits

- Leak-free design
- Quiet operation
- High output torque capabilities
- Extended lubrication life
- Longer gear and bearing life
- Superior dependability/low maintenance/longer life

High-Performance Motors & Brakemotors

NORD motors are designed to run cool for longer service life. Low rotor inertia and high starting torque allow peak performance in the most difficult applications for inverter and vector duty per NEMA MG 1-1998 Section 31.4.4.2 voltage spikes. Our motors are internationally accepted, conforming to North American NEMA MG 1 and international IEC electrical specifications. High performance options include brakes, encoders, and forced cooling fans.



Short, On-Time Delivery

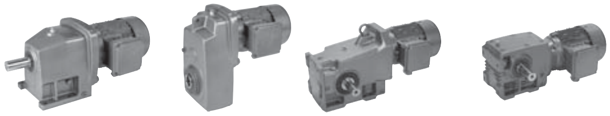
As a NORD customer, you can rest assured that your order will be delivered on time. Because NORD has both decentralized assembly and manufacturing operations and a linked global network, we offer our customers:

- Fast, reliable responses
- Greater product versatility
- Shorter lead times
- Timely shipping
- Rapid delivery

Quality

Quality is assured at NORD assembly and manufacturing facilities, based on ISO 9000 standards — from careful inspection of incoming materials to closely monitored machining operations including gear cutting, turning, hardening & grinding as well as finishing & assembly.

QUALITY ASSURED ISO 9000 GERMANISCHER LLOYD



NORD 911

Trouble? Just call 715-NORD-911 (in Canada, 905-796-3606). Emergency service is available 24 hours a day, 7 days a week. We'll answer your call, ship the parts, or build a unit and have it shipped directly to you to provide what you need, when you need it.

24-HOUR EMERGENCY RESPONSE 911 NORD GEAR CORPORATION (715) NORD-911

Manufacturing

NORD continually invests in research, manufacturing and automation technology. This is to ensure the highest possible quality at affordable prices. NORD invests heavily in our North American facilities as well as our factories around the world. Recent examples include expanding our Waunakee factory and adding numerous new large gear unit assembly cells. In our Glinde, Germany gear factory we added a state-of-the-art Vacuum multi-chamber carburization system.

Global Availability

From Shanghai to Charlotte, and all points between, NORD reaches customers around the world. Deliveries, service, and product support are close at hand, regardless of your location.

Worldwide Standards

NORD products are designed and manufactured based on the latest North American and global standards.

Increased North American Presence

NORD covers North America with over 30 district offices and over 500 distributor branches. NORD operates a manufacturing and assembly facility in Waunakee, WI, Charlotte, NC, Corona, CA, Brampton, ON, and Monterrey, Mexico, resulting in an ever-increasing capacity in the United States and Canada and giving our customers the shortest lead times in the industry.

Energy Efficiency

Lowering your operating costs is one of our greatest goals! NORD research and development focuses on energy efficiency, with gearboxes, motors, and frequency inverters designed for lower energy consumption. Our fully diverse line of in-line or right-angle units and motors has been developed to suit your needs.

Modular Design

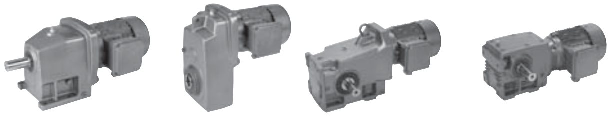
NORD's modular design philosophy provides you with a competitive edge by allowing you to configure drive systems to exactly fit your applications.

More than 20,000,000 combinations of totally unique gearmotors and speed reducers are possible – assembled in-line or right-angle, mounted by foot or flange, featuring solid or hollow shafts with either metric or inch shaft extensions – to give you complete freedom to specify a drive solution that's perfect for you.

Benefits

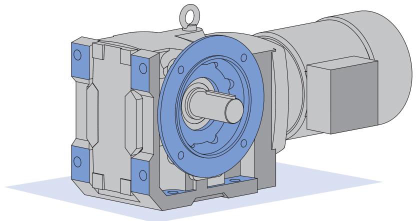
- More output speeds
- More mounting arrangements / Greater flexibility
- Fewer gear stages/Lower cost
- Metric and inch products

NORD engineers stand ready to assist you with your custom applications. Most standard drives can be modified to your purposes, and custom designs can be developed for special applications.



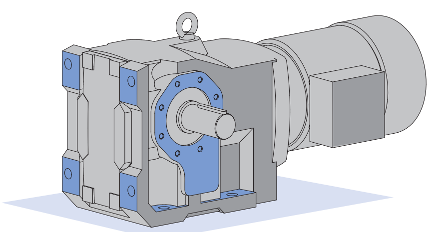
Foot Mounted with B5 Flange (XF)

NORD can supply some foot mounted reducers with a B5 flange as well. These type XF reducers are designed to be foot and not flange mounted. The B5 flange is normally used to mount auxiliary equipment to the speed reducer. If the B5 flange is going to be used to mount the reducer, additional support will normally be required.



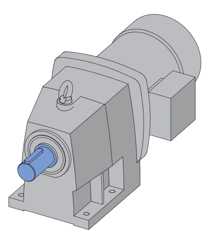
Foot mounted with B14 Face Flange (XZ)

NORD can supply some foot mounted reducers with a B14 face flange as well. These type XZ reducers are designed to be foot and not flange mounted. The B14 face flange is normally used to mount auxiliary equipment to the speed reducer. If the B14 face flange is going to be use to mount the reducer, additional support will normally be required.



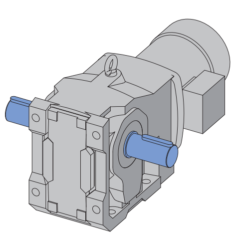
Shaft Options

Solid Shaft (Blank or V)



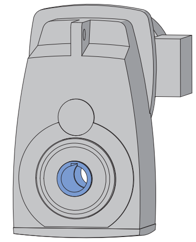
NORD's standard keyed solid shafts include a centered threaded hole. Shafts are available as inch or metric versions. The standard shaft material is 1045 or 4140 or equivalent.

Double Solid Shaft (L)



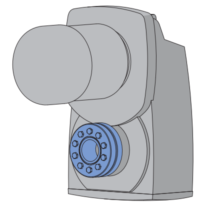
The standard solid shaft end is projected out both sides of the speed reducer. This option is commonly used to transfer torque out of both sides of the reducer or to mount a speed-monitoring device such as an encoder on one of the shaft ends. If you need the keyways to be alligned you must specify with NORD upon ordering

Keyed Hollow Shaft (A)



NORD's standard keyed hollow shafts are made from SAE 1045 high carbon steel. They feature standard keyway dimensions and are available both inch and metric designs. Many NORD reducers offer a variety of hollow shaft diameters.

Shrink Disc (S) (SH)



The shrink disc relies on the proven wedge principle to create a keyless, mechanical interference fit by converting locking screw tension into radial contact pressure on shaft and hub in effect "shrinking" it on to the customer shaft. Shrink discs result in a zero backlash mechanical interference fit that can accommodate high torque unlike other mounting technologies and will never wear or pound out, even for high cycle fluctuating and reversing loads.

Other shrink disc advantages include:

- Elimination of fretting corrosion associated with key connections.
- Generous clearance for easy mounting & dismounting.
- Allow for larger bores sizes compared to keyed hollow shafts.
- For more information see page 72

Heavy Duty Shrink Disc (VS)

NORD heavy duty shrink discs offer increased clamping force and safety factor for severe applications.

Special Shafts & Shaft Materials

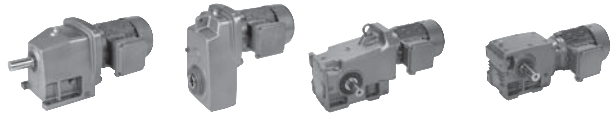
Stainless Steel Output Shaft (SM5)

Output shafts made from stainless steel are available and are frequently used in food, pharmaceutical, and washdown applications. In some cases solid input shafts can also be provided in stainless.

Special Solid Shaft (SWV)

Special solid shaft diameters and lengths can be provided for a nominal price adder. Special features are also available including keyless shafts, cross drilled shafts or special threaded taps. Different shaft materials are also available. NORD has in-house drafting design and machining departments so we can provide special requirements in short lead times. Specify your shaft requirements and NORD will verify the design feasibility.

Gear Unit Options



Special Hollow Shaft (SWA)

Special hollow bore shafts can also be provided. Special hollow bore shafts can be provided with special diameters, multiple keyways, and even special extended hollow shafts that are frequently used with counter rotating drives. Different shaft materials are also available. Specify your shaft requirements and NORD will verify the design feasibility.

Hollow Shaft with Spline (EA)

Hollow shafts with a metric involute spline profile according to DIN 5480 are available for some NORD hollow shaft reducers. These spline shafts are commonly used on crane travel drives. See pages 573 & 671 for details.

Heavy Duty Output Bearings (VL)

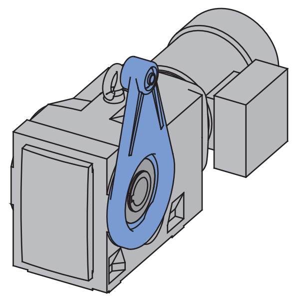
Replacing standard output bearings with heavy-duty versions will increase the external load carrying capacityof the speed reducer. Increased capacity in either or both overhung (radial) or thrust (axial) loading insures that premature bearing failure will not occur due to high stresses in the bearing elements. The increased bearing capacity will also keep the speed reducer as small as possible by not having to select the next larger case size in order to handle the bearing loads. If increased bearing life is desired, larger bearings will reduce the relative stress on the bearings and increased B10 bearing life.

(FKM) Fluoro-rubber Seals (VI)

The NORD standard oil seals are made of Nitrile or rubber and are rated for temperatures up to 125°C or 250°F. If ambient or oil temperatures rise above this level NORD recommends using fluoro-rubber (also called FKM) oil seals. FKM seals are rated from -30°F to 400°F (-35°C to 200°C).

Torque Arm (D)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the reducers B14 flange. The tear drop shaped torque arm has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.

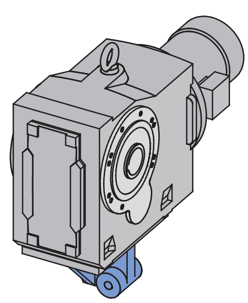


Specify the torque arm location and orientation when ordering

Torque arm location ____________
Torque arm orientation ____________
See Page 18 for details

Bottom Mount Torque Arm (K)

A torque arm is a compact, simple way to secure a shaft mounted reducer. It is bolted onto the base of the reducer. The torque tab has a rubber bushing located at the fastening hole-end to act as a shock absorber to dampen out peak shock loads.The torque tab is available for bevel units SK 90.1.



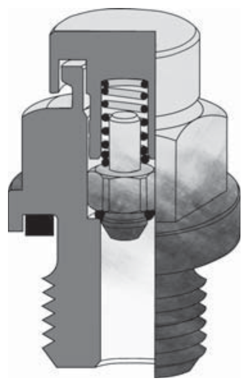
Specify the torque tab location when ordering

Torque tab location ____________
See Page 18 for details____________

Oil Sight Glass (OSG)

The oil sight glass provides a visible oil level indication on the reducer. The sight glass replaces the standard steel fill plug and consists of a sealed clear porthole centered in the middle of a brass plug. The sight glass allows for quick oil level and color inspection.

Autovent™ (DR)



The Autovent™ prevents entry of foreign material, such as water, dust, corrosives, etc… and is perfect for washdown and dusty environments. The Autovent™ is a ball and spring check valve that opens at 2 psi and during operation and closes tightly when the gearbox cools. The Autovent™ is standard on all vented NORD reducers some of the benefits are cleaner gearbox oil, extended lubrication life and longer lasting seals, gears, and bearings.

Open Vent (OV)

An open vent can be optionally supplied on NORD reducers. The open vent allows for air pressure differences between the inner space of the reducer and the atmosphere. This open vent will be closed upon delivery to prevent oil leakage. Before the reducer is put in service the open vent should be activated by removing the sealing plug.

Filtered Vent (FV)

NORD offers a filtered vent, which allows gases to permeate, but does not allow dust and debris to pass through the vent.

Magnetic Drain Plug (MDP)

Magnetic drain plugs attract and hold ferrous metal particles that may circulate inside the reducer's lubrication system. These potentially abrasive particles may cause excessive wear in the reducer if they remain circulating. An increase of collected material may be a warning sign of future problems.

Special Drain Plugs

NORD oil drain valves are offered to make draining the oil from the gearbox clean and easy. The drain hose needs to be supplied by the customer. The hose fittings are offered in either 90° or straight to accommodate the user.

A brass drain valve is threaded into the existing oil drain port of the gearbox. The spring valve is closed using a rubber o-ring. When the hose fitting is threaded into the drain valve, the spring valve is pushed open and allows oil to drain. When the hose fitting is removed, the drain valve closes. A brass, threaded cap is supplied to cover the drain valve when not in use.

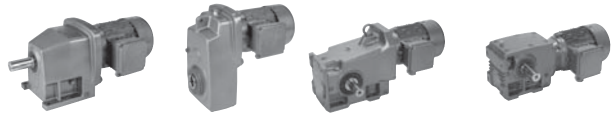
Additional Drain Plug Hole (ADP)

NORD can add an additional drain hole to the reducer housing for a small surcharge if required for special oil plumbing needs.

Long Term Storage (LL)

Speed reducers are frequently put in storage prior to installation for long periods of time and in some cases exposed to the elements. NORD's long term storage option protects the unit from moisture or corrosion by coating all unpainted surfaces with a dry, transparent, durable waxy film. Once installation is necessary this waxy film can be easily removed with a commercial de-greaser or petroleum solvent. If possible the store room should be vented and dry, with room temperatures between 23°F and 104 °F (-5 °C and 40 °C).

Gear Unit Options



Paint Coatings

NORD's standard paint coating is a two component, aliphatic polyurethane finish contaning 316 stainless steel material.This gray stainless steel paint has excellent appearance and outstanding physical properties. It is suitable for both indoor and outdoor applications.

Advantages of NORD's stainless steel two component polyurethane:

- Excellent adhesion to cast iron, aluminum, steel, and plastics
- Excellent corrosion resistance
- Excellent chemical resistance
- Excellent gloss and color retention
- Suitable for indoor and outdoor exposure
- Nonporous and excellent abrasion resistance
- USDA Compliant

NORD also offers a variety of severe duty paint coatings that provide a high level of protection against water and severe environments both indoors and outdoors. NSD+ (NORD Severe Duty) consists of a primer undercoat and a stainless steel polyurethane topcoat. For the most demanding environments, NORD offers NSD-X3 (NORD Severe Duty triple coated) which consists of a primer undercoat, stainless steel polyurethane coating, and a clear topcoat. Paint coatings are also available in alternate colors as seen in the table below.

Additionally a variety of coating options are available including our Severe Duty coatings:

Finish	Color	Coating	Use
Standard (stainless steel paint)	Stainless steel silver (Gray)	1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color	Black, Blue, Red, Orange	1 x Color top coat (polyurethane)	Indoor or outdoor protected

NSD+

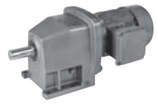
Finish	Color	Coating	Use
NORD Severe Duty + NSD+	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) top coat (polyurethane)	Indoor or outdoor moderate environment
NORD Severe Duty +W NSD+W	White	1 x Primer high solid alkyd system 1 x White top coat (polyurethane)	Indoor or outdoor moderate environment
Alternate color NSD+	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color top coat (polyurethane)	Indoor or outdoor moderate environment

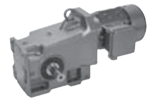
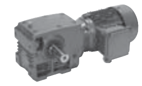
NSD X3

Finish	Color	Coating	Use
NORD Severe Duty Extreme NSD-X3	Stainless steel silver (Gray)	1 x Primer high solid alkyd system 1 x Stainless steel (316) (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
NORD Severe Duty Extreme NSD-X3W	White	1 x Primer high solid alkyd system 1 x White (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment
Alternate color NSD-X3	Black, Blue, Red, Orange	1 x Primer high solid alkyd system 1 x Color (polyurethane) 1 x Clear top coat (polyurethane)	Indoor or outdoor more severe environment

Special colors and paints possible please contact NORD with your specific requirements.

Lubrication



Lubrication Types

Proper gearbox lubrication is essential in order to reduce friction, heat, and component wear. Lubricants reduce heat and wear by inserting a protective "fluid boundary" between mating parts and preventing direct metal to metal contact. Lubricants also help prevent corrosion and oxidation, minimize foam, improve heat transfer, optimize reducer efficiency, absorb shock loads and reduce noise.

Mounting position not only determines the proper fill-level but may also have some effect on final reducer assembly. If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering. Unless otherwise specified, NORD supplies most all gear units (*) factory-filled with the standard lubrication type and the appropriate amount of lubricating oil.

* Gear units SK10282, SK10382, SK11282, SK11382, SK12382, and SK9096.1 are supplied without oil.

Standard Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG220	MIN-EP	0 to 40°C (32 to 104°)	Mobilgear 600XP220	🌢❶
	VG220	PAO	-35 to 60°C (-31 to 140°F)	Mobil SHC630	🌢❷
	VG220	FG	-5 to 40°C (23 to 104°F)	Fuchs FM220	🌢
Helical Worm	VG680	PAO	0 to 60°C (32 to 140°F)	Mobil SHC636	🌢

Optional Oil Lubricants

Gear Unit Type	ISO Viscosity	Oil Type	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Helical In Line, Parallel-Shaft & Bevel	VG460	PAO	-35 to 80°C (-31 to 176°F)	Mobil SHC 634	-
	VG150	PAO	-35 to 25°C (-31 to 77°F)	Mobil SHC629	-
	VG220	FG-PAO	-35 to 60°C (-31 to 140°F)	Mobil/Cibus SHC220	-
Helical Worm	VG460	PAO	0 to50°C (32 to 122°F)	Mobil SHC 634	-
	VG460	FG-PAO	0 to50°C (32 to 122°F)	Mobil/Cibus SHC460	-

Standard Bearing Grease Lubricants

Grease Type/Thickener	NLGI Grade	Ambient Temperature Range	Manufacturer Brand/Type	Notes
Standard (Li-Complex)	NLGI 2	-30 to 60°C (-22 to 140°F)	Mobil Grease XHP222	🌢❶
High Temp (Polyurea)	NLGI 2	-25 to 80°C (-13 to 176°F)	Mobil Polyrex EP 2	🌢❷
Food-Grade (AL-Complex)	NLGI 2	-25 to 40°C (-13 to 104°F)	Mobil Grease FM222	🌢

🌢 Stocked Lubricants

❶ Standard product on serviceable gear units

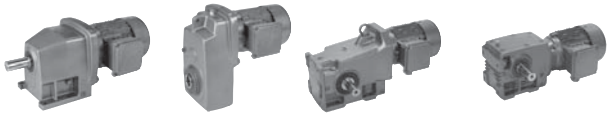
❷ Standard product on maintenance free gear units

Oil Formulation Codes

MIN-EP	Mineral Oil with EP Additive
PAO	Synthetic Polyalphaolefin Oil
PG	Synthetic Polyglycol Oil
FG	Food-Grade Oil
FG-PAO	Food-Grade, Synthetic Polyalphaolefin Oil

Important Notes

- In worm gears avoid using (EP) gear oils that contain sulfur-phosphorous chemistries, as these additives can react adversely with bronze worm gears and accelerate wear.
- Food grade lubricants must be in compliance with FDA 212 CFR 178.3570 and qualify as a NSF-H1 lubricant. Please consult with lubrication manufacture for more information.
- When making a lubrication change, check with the lubrication supplier to assure compatibility & to obtain recommended cleaning or flushing procedures.
- Do not mix different oils with different additive packages or different base oil formulation types. Polyglycol (PG) oils are not miscible with other oil types and should never be mixed with mineral oil, or Polyalphaolefin (PAO) oil.
- Please Consult NORD if considering cold-temperature oils below an ISO Viscosity VG100 or lower.



Ventilation

Most gear reducers (except for SK0182NB, SK0282NB and SK1382NB) are equipped with a vent which helps compensate for air pressure differences between the inner space of the gear unit and the atmosphere.

The spring-pressure vent (Autovent™) is commonly supplied and factory-installed. Normally open vents may also be supplied as an option; normally-open vents are closed upon delivery in order to prevent oil leakage during transport. When normally open vents are supplied, the sealing plugs must be removed prior to commissioning the reducer.

Prior to reducer start-up, it is important to check the maintenance manual to verify that the vent is properly located with respect to mounting position.

Mounting Position

The reducer mounting position determines the approximate oil fill-level and the appropriate vent location. In some cases mounting position may dictate possible variation in final reducer assembly.

If considering any mounting positions that are not shown as catalog-standard options, it is critical that the customer consult with NORD prior to ordering.

Oil Fill Quantities

Oil fill quantities shown in the catalog or maintenance instructions are approximate amounts. The actual oil volume varies depending upon the gear ratio. Prior to commissioning the reducer, the oil-fill level should be checked using the reducer’s oil-level plug. It may be necessary to drain excess oil or add additional oil.

Unless otherwise specified, NORD supplies most all gear units factory-filled with the standard lubrication type per the specified mounting position. Gear units SK10282, SK10382, SK11282, SK11382, and SK12382 are supplied without oil.

Lubrication Replacement

If the gear unit is filled with mineral oil, the lubricant should be replaced at least after every 10,000 operating hours or after every two years. If the gear unit is filled with synthetic oil, the lubricant should be replaced at least after every 20,000 operating hours or after every four years.

Often gear reducers are exposed to extreme ambient conditions, hostile environments, wet conditions, or dirty and dusty operating areas. Especially in these situations, it is important to change the reducer lubricant more often that what is suggested as a typical guideline.

The Importance of Routine Oil Analysis

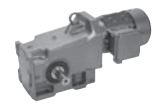
Routine oil analysis, sound lubrication practices, and good tracking of oil performance trends as related to specific equipment, will help establish proper lubrication maintenance and change-out intervals.

To maximize equipment reliability, NORD Gear generally recommends a condition-based lubrication maintenance program. One may take exceptions to this general recommendation on sealed-for-life or maintenance-free gear units or smaller and less costly gear units. In these instances, the replacement cost of the gear unit is often small compared to the costs associated with this type of oil analysis program.

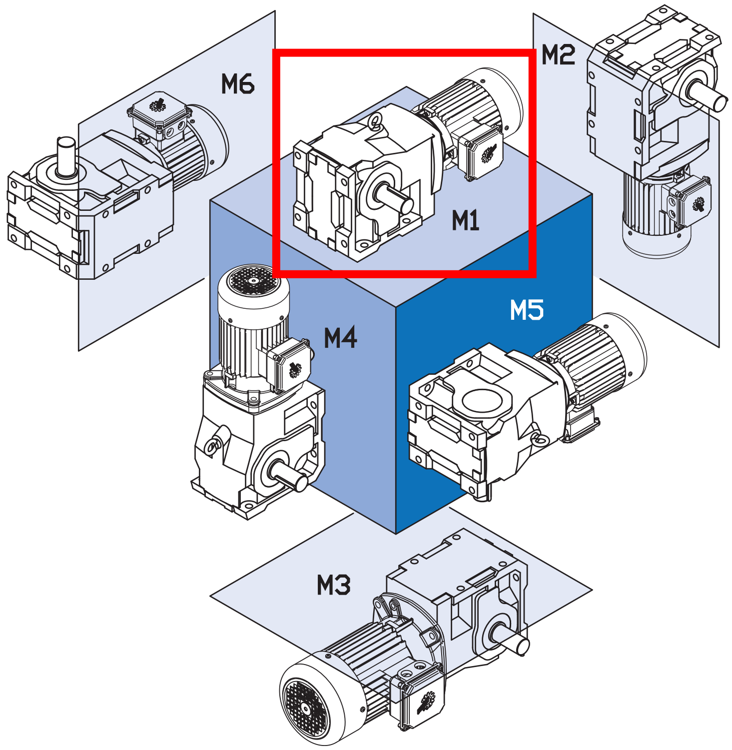
NORD suggests replacing the gear oil if oil analysis indicates any of the following:

- Viscosity has changed by approximately 10% or more.
- Debris particles (silicon, dust, dirt or sand) exceed 25 ppm.
- Iron content exceeds 150-200 ppm.
- Water content is greater than 0.05% (500 ppm).
- Acid number tests indicate a significant level of oxidative break-down of the oil and a critical reduction in performance.

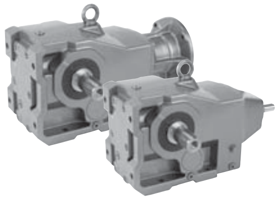
Helical-Bevel Foot Mount Positions & Oil Fill Quantities



NORD DRIVESYSTEMS



Mounting Position	M1		M2		M3		M4		M5		M6	
	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters	Quarts	Liters
SK92072	0.42	0.40	0.63	0.60	0.53	0.50	0.53	0.50	0.42	0.40	0.42	0.40
SK92172	0.58	0.55	0.95	0.90	1.00	0.95	1.16	1.10	0.79	0.75	0.66	0.62
SK92372	0.95	0.90	1.37	1.30	1.53	1.45	1.69	1.60	1.27	1.20	1.27	1.20
SK92672	1.90	1.80	3.70	3.50	3.38	3.20	3.59	3.40	2.75	2.60	2.75	2.60
SK92772	2.43	2.30	4.76	4.50	4.86	4.60	5.60	5.30	4.33	4.10	4.33	4.10
SK9012.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9013.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9016.1	0.74	0.70	1.69	1.60	2.01	1.90	2.54	2.40	1.27	1.20	1.80	1.70
SK9017.1	1.27	1.20	2.11	2.00	2.33	2.20	3.17	3.00	1.48	1.40	2.01	1.90
SK9022.1	1.37	1.30	2.75	2.60	3.70	3.50	4.44	4.20	2.11	2.00	2.96	2.80
SK9023.1	2.54	2.40	3.17	3.00	4.02	3.80	5.60	5.30	2.33	2.20	3.28	3.10
SK9032.1	1.80	1.70	5.07	4.80	6.76	6.40	7.08	6.70	4.33	4.10	5.39	5.10
SK9033.1	3.49	3.30	6.98	6.60	7.40	7.00	8.24	7.80	4.55	4.30	5.39	5.10
SK9042.1	4.65	4.40	9.20	8.70	10.6	10.0	10.4	9.80	7.19	6.80	7.93	7.50
SK9043.1	4.86	4.60	10.8	10.2	11.3	10.7	13.5	12.8	5.50	5.20	7.08	6.70
SK9052.1	6.87	6.50	16.9	16.0	20.1	19.0	22.7	21.5	11.6	11.0	16.4	15.5
SK9053.1	10.6	10.0	18.0	17.0	21.1	20.0	25.6	24.2	12.2	11.5	17.4	16.5
SK9072.1	10.6	10.0	29.1	27.5	33.8	32.0	38.1	36.0	19.0	18.0	25.4	24.0
SK9082.1	18.0	17.0	54.4	51.5	66.1	62.5	75.6	71.5	34.9	33.0	49.2	46.5
SK9086.1	30.7	29.0	77.2	73.0	89.8	85.0	108	102	50.7	48.0	65.5	62.0
SK9092.1	38.1	36.0	166	157	180	170	182	172	84.6	80.0	95.1	90.0
SK9096.1	74.0	70.0	198	187	205	194	268	254	115	109	161	152



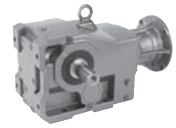
SK 9022.1 , SK 9023.1
NEMA-C + W
Ratings & Combinations

Model Type	Gear Ratio i_{tot}	Output Speed n_2 1750 rpm [rpm]	Output Torque* $T_{2\,max}$ [lb-in]	Maximum input power◈ Solid input shafts type "W" – Input Speed 1750 rpm [hp]	1150 rpm [hp]	875 rpm [hp]	580 rpm [hp]	NEMA C-Face* Available Combinations – 56C	140TC	180TC	210TC	250TC	280TC	320TC	360TC
SK 9022.1	8.78	199	4248	5.00	3.30	2.50	1.65	X	X	X					
	11.13	157	4602	5.00	3.30	2.50	1.65	X	X	X					
	12.51	140	4779	5.00	3.30	2.50	1.65	X	X	X					
	14.56	120	5133	5.00	3.30	2.50	1.65	X	X	X					
	16.30	107	5487	5.00	3.30	2.50	1.65	X	X	X					
	17.52	100	6372	5.00	3.30	2.50	1.65	X	X	X					
	19.93	88	6726	5.00	3.30	2.50	1.65	X	X	X					
	22.41	78	6903	5.00	3.30	2.50	1.65	X	X	X					
	24.56	71	7611	5.00	3.30	2.50	1.65	X	X	X					
	26.07	67	7611	5.00	3.30	2.50	1.65	X	X	X					
	29.20	60	7611	5.00	3.30	2.50	1.65	X	X	X					
	31.38	56	7257	5.00	3.30	2.50	1.65	X	X	X					
	33.26	53	7611	5.00	3.30	2.50	1.65	X	X	X					
	39.77	44	7611	5.00	3.30	2.50	1.65	X	X	X					
	44.71	39	7611	4.71	3.11	2.35	1.55	X	X	X*					
	49.01	36	7611	4.35	2.87	2.17	1.43	X	X	X*					
	52.02	34	7611	4.11	2.71	2.05	1.35	X	X	X*					
	58.25	30	7611	3.62	2.39	1.81	1.20	X	X	X*					
	66.42	26	7611	3.14	2.07	1.57	1.04	X	X	X*					
	78.89	22	7611	2.66	1.75	1.33	0.88	X	X	X*					
	85.11	21	7611	2.54	1.67	1.27	0.84	X	X						
	98.88	18	7611	2.17	1.43	1.09	0.72	X	X						
	115.74	15	7611	1.81	1.20	0.91	0.60	X	X*						
	137.57	13	7611	1.57	1.04	0.78	0.52	X	X*						
	169.81	10	7611	1.21	0.80	0.60	0.40	X	X*						
	184.46	9.5	7611	1.15	0.76	0.57	0.38	X	X*						
	219.25	8.0	7611	0.97	0.64	0.48	0.32	X*	X*						
	232.92	7.5	6195	0.74	0.49	0.37	0.24	X*							
	276.86	6.3	7080	0.71	0.47	0.35	0.23	X*							
SK 9023.1	**228.47**	7.7	5753	0.70	0.46	0.35	0.23	X*							
	297.67	5.9	7611	0.71	0.47	0.36	0.24	X*							
	339.41	5.2	7611	0.63	0.41	0.31	0.21	X*							
	472.43	3.7	7611	0.45	0.29	0.22	0.15	X*							
	561.55	3.1	7611	0.37	0.25	0.19	0.12	X*							
	678.31	2.6	7611	0.31	0.21	0.16	0.10	X*							
	753.86	2.3	7611	0.28	0.18	0.14	0.09	X*							
	951.94	1.8	7611	0.22	0.14	0.11	0.07	X*							
	1120.38	1.6	7611	0.19	0.13	0.10	0.06	X*							
	1504.07	1.2	7611	0.14	0.10	0.07	0.05	X*							
	1899.26	0.92	7611	0.11	0.07	0.06	0.04	X*							

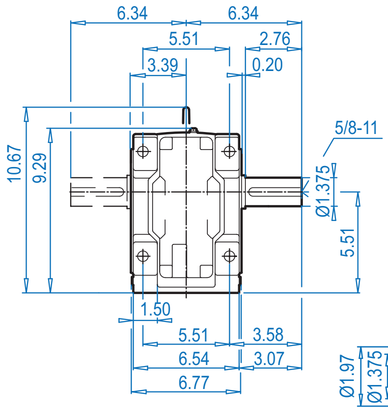
* Caution - The motor power may exceed the gear unit's mechanical torque capacity
◈ The mechanical power limit of the solid input shaft type "W" may limit the reducer rating.
All ratings are mechanical. See page 14 for thermal considerations.

lb	W	56C	140TC	180TC
SK 9022.1	93	104	104	119
SK 9023.1	104	108	-	-

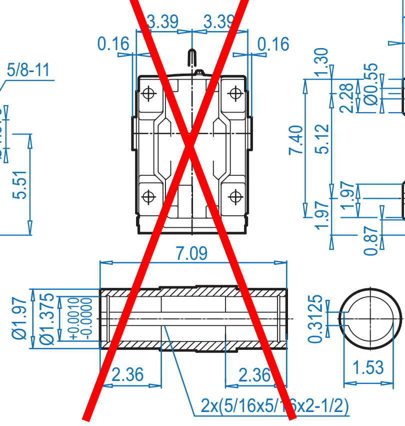
W + NEMA



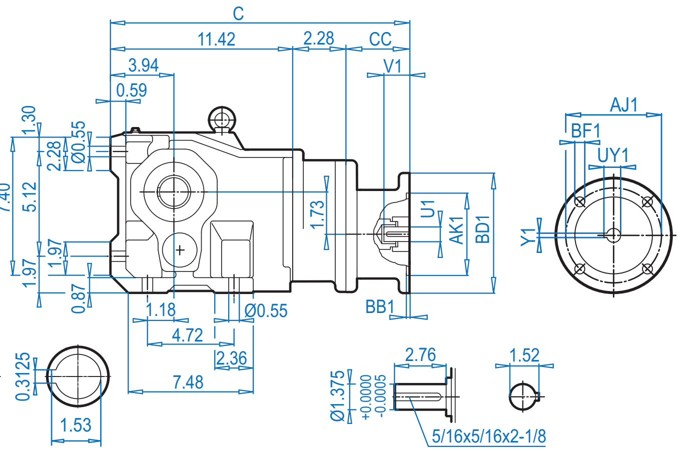
SK 9023.1



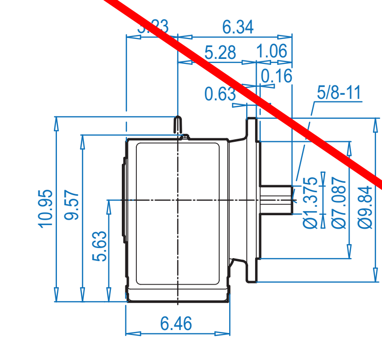
SK 9023.1AX



NEMA Input



SK 9023.1VF



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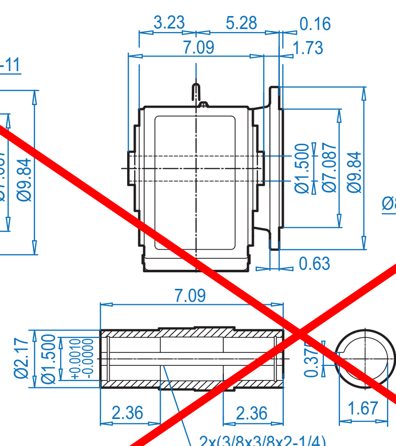
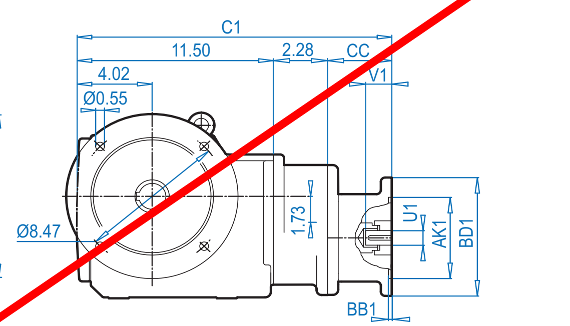
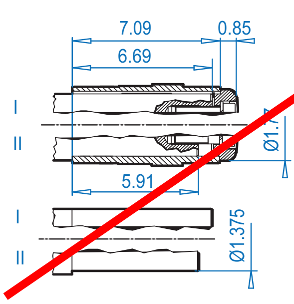


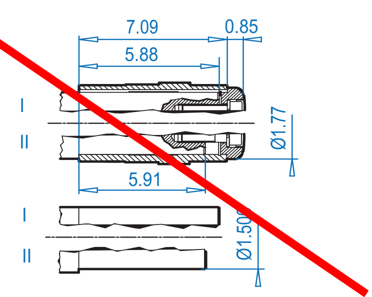


ALTERNATE SHAFTS SEE PAGES 566 - 573

SK 9023.1AXB ➩📖 574



SK 9023.1AFB ➩📖 574



NEMA Dimensions

Type	AJ1	AK1	BB1	BD1	BF1	U1	V1	UY1	Y1	C	C1	CC
56C	5.88	4.500	0.18	6.54	0.43	0.625	2.06	0.71	0.188	18.20	18.28	4.50

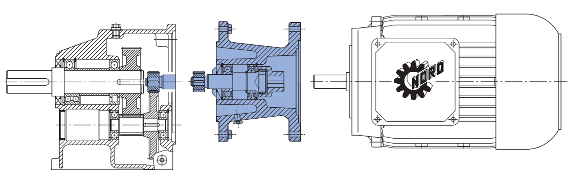
NORD DRIVESYSTEMS

NEMA C-Face Motor Adapter

NEMA C-face motor adapters allow for easy installation and removal of industry standard C-face motors. NEMA C-face motor adapters consist of a coupling and an adapter housing that connects the motor to the gear reducer. Gear units with NEMA C-face adapters are commonly used where applications require specialized motors or the user wants to easily find a replacement motor if failure occurs. NORD also offers high performance NEMA C-face motors and brakemotors, that can be factory installed to the motor adapter.

NORD motor adapters deliver nearly 100% of the torque generated by the motor and can be used from -22°F (-30°C) to 212°F (100°C). Most motor adapters have specially sealed bearings that are lubricated for life. However, some larger adapters are supplied with an automatic lubricator, which provides time released grease to the outboard adapter bearing. The automatic lubricator needs replacement after a specific service interval, see page 675 for more details.

The maximum input power of a gear unit with a NEMA C-face adapter is generally limited by the power rating of the standard NEMA C-face motor size. The power limit is indicated in the ratings table for a standard 4-pole 1750 rpm motor. In some cases the gearbox limit ($T2_{max}$) will be the limiting capacity. Both the NEMA adapter limit and the gearbox torque limit must be considered. If the speeds required exceed those included in the performance and speed reduction tables please contact NORD.



IEC Motor Adapter (example SK32 – IEC63)

IEC motor adapters allow for easy installation and removal of industry standard IEC motors according to DIN 42677. The IEC adapter is very similar to the NEMA C-face adapter in construction. The maximum input power is generally limited by the IEC motor size. For ratings and dimensions, please consult NORDS's metric catalogs.

Vertical Motor Adapter Applications

Gear units with motors frame sizes 250TC (IEC160) and larger, in a vertical up motor mounting position, NORD recommends using an integral gearmotor instead of a NEMA or IEC input adapter. If your application requires this mounting position and a NEMA or IEC input, please consult NORD. In vertical down motor mounted applications it is recommended to shorten the maintenance interval.

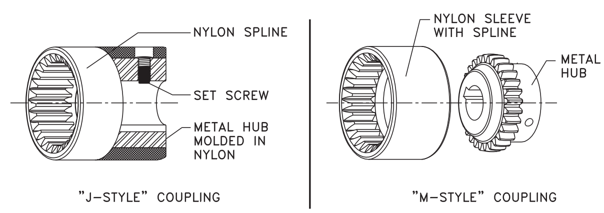
Couplings

Couplings are made with tough abrasion resistant materials, which resist most chemicals and petroleum products. They are electrically isolated (prevent metal to metal contact) and require no lubrication or maintenance. Depending on the size of the C-face input, NORD provides either a gear or jaw type coupling.

Gear Couplings

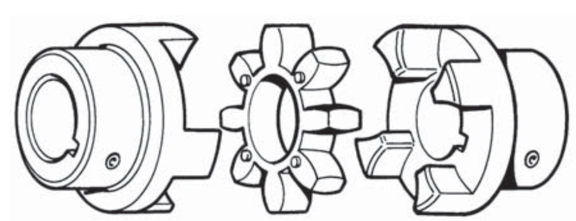
Gear couplings are used with 56C to 280TC adapters and provide a compact space saving design. C-face adapter input shafts have a machined male spline that meshes with a molded nylon spline on the coupling. This specially designed molded nylon sleeve that exhibits high torsional stiffness, resulting in minimum fit-up backlash and reduced internal frictional losses. Gear couplings lightweight design yields low inertia and use blind assembly and slip together components to make inspection easy without disassembly.

NORD incorporates two styles of gear couplings, the "J" and "M" styles. The "J" style is one-piece couplings consisting of a nylon sleeve and metal hub that are fused together. The "M" style is a two-piece coupling consisting of a separate nylon sleeve and metal hub.



Jaw Couplings

Jaw couplings are used with 320TC and larger adapters. The cast iron jaw type couplings have a urethane "spider" that provides smooth transmission of the motor torque and has excellent shock and vibration dampening characteristics. A set screw on the coupling prohibits axial movement along the motor shaft.

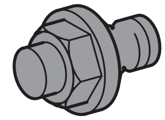


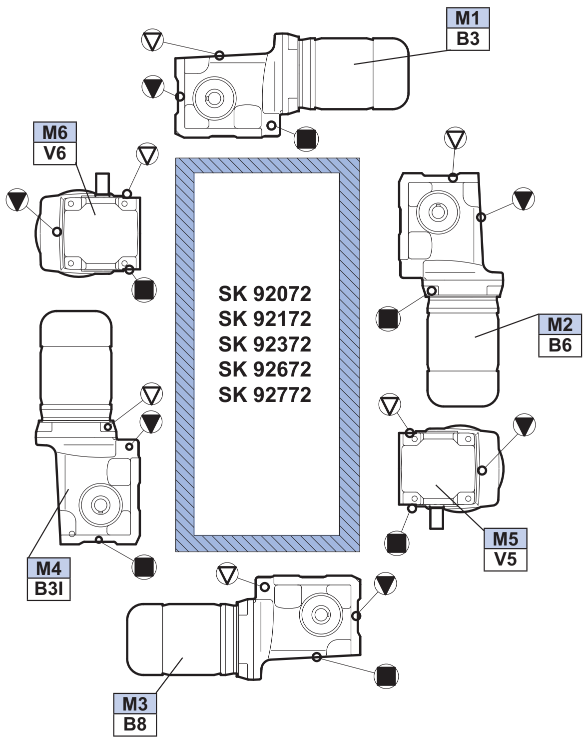
NEMA Motor Adapter Details

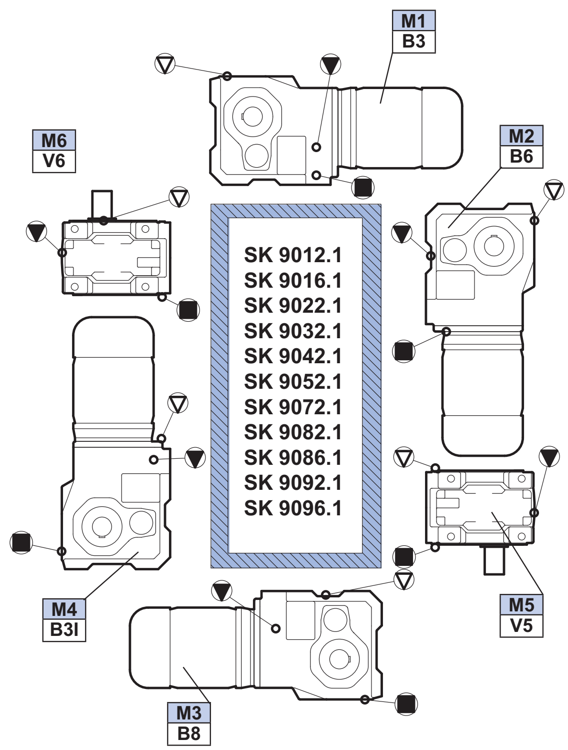
NEMA C-face Motor Frame Size	NEMA Adapter Nomenclature	4 pole Motor HP	Max Motor Weight [lb]	Coupling Descrip-tion	Coupling Bore (inches)	Maximum Cou-pling Torque Capacity (in-lb)	Safety Factor
56 C	- 56C	≤ 1.0	66	J14	0.625	177	3.3 min
56 C	- 56C	≤ 1.5	66	J24	0.875	354	6.6 min
143 TC	- 140TC	≤ 1.5	88				6.6 min
145 TC	- 140TC	≤ 2	110				4.9 min
145 TC	- 140TC	3	110				3.3 min
182 TC	- 180TC	3	130	J28	1.125	797	7.4 min
184 TC	- 180TC	5	175				4.4 min
182 TC	- 180TC	3	130	M38	1.125	1416	13.1 min
184 TC	- 180TC	5	175				7.9 min
213 TC	- 210TC	7.5	220		1.375		5.2 min
215 TC	- 210TC	10	220				4.0 min
254 TC	- 250TC	15	450	M42	1.625	1770	3.3 min
256 TC	- 250TC	20	450				2.5 min
284 TC	- 280TC	25	550	M48	1.875	2478	2.8 min
286 TC	- 280TC	30	550				2.3 min
324 TC	- 320TC	40	770	R65	2.125	11,060	8.0 min
326 TC	- 320TC	50	1100				6.4 min
364 TC	- 360TC	60	1550	R90	2.375	42,480	19.9 min
365 TC	- 360TC	75	1550				16.1 min
404 TSC	- 400TSC	100	2205		2.875		12.1 min

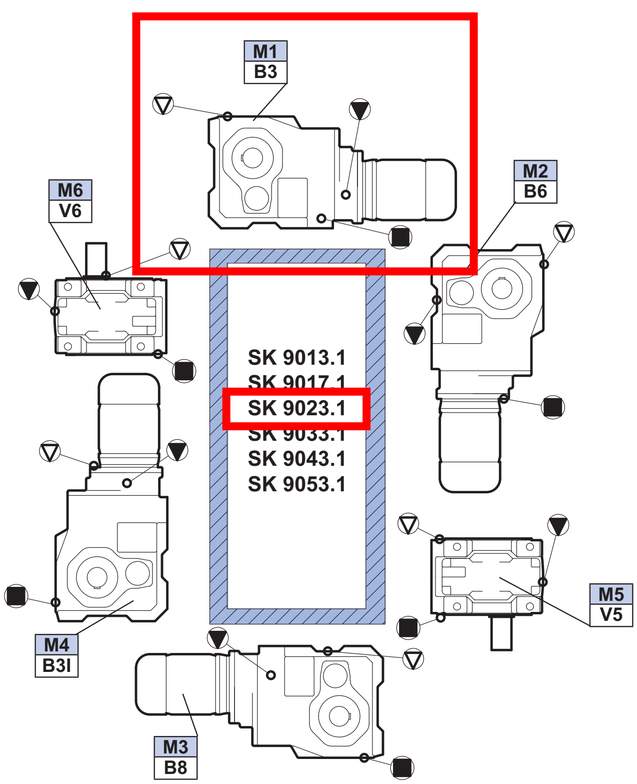
IEC Motor Adapter Details

IEC Motor B5 4 pole	IEC Adapter Nomenclature	HP / kW	Max Weight Limit [lb]	Coupling Descrip-tion	Coupling Bore (mm)	Maximum Cou-pling Torque Capacity (Nm)	Safety Factor
63 S/4	- IEC 63	0.16 / 0.12	56	J14	11	20	23.2 min
63 L/4	- IEC 63	0.25 / 0.18	56				15.8 min
71 S/4	- IEC 71	0.33 / 0.25	67		14		11.5 min
71 L/4	- IEC 71	0.50 / 0.37	67				7.8 min
80 S/4	- IEC 80	0.75 / 0.55	89	J24	19	40	10.4 min
80 L/4	- IEC 80	1.00 / 0.75	89				7.6 min
90 S/4	- IEC 90	1.5 / 1.1	111		24		5.3 min
90 L/4	- IEC 90	2.0 / 1.5	111				3.8 min
100 L/4	- IEC 100	3.0 / 2.2	133	J28	28	90	6.1 min
100 L/40	- IEC 100	5.0 / 3.7	133				4.4 min
112 M/4	- IEC 112	5.3 / 4.0	177				3.4 min
132 S/4	- IEC 132	7.5 / 5.5	221	M38	38	160	4.3 min
132 M/4	- IEC 132	10 / 7.5	221				3.2 min
160 M/4	- IEC 160	15 / 11	441	M42	42	200	2.2 min
160 L/4	- IEC 160	20 / 15	441				1.6 min
180 M/4	- IEC 180	25 / 18.5	552	M48	48	280	2.3 min
180 L/4	- IEC 180	30 / 22	552				1.9 min
200 L/4	- IEC 200	40 / 30	772	R65	55	1250	6.3 min
225 S/4	- IEC 225	50 / 37.5	1103		60		5.2 min
225 M/4	- IEC 225	60 / 45	1103				4.2 min
250 M/4	- IEC 250	75 / 55	1544	R90	70	4800	13.5 min
280 S/4	- IEC 280	100 / 75	1544		80		9.9 min
280 M/4	- IEC 280	125 / 90	2205				8.2 min
315 S/4	- IEC 315	150 / 110	3307		85		6.7 min
315 M/4	- IEC 315	175 / 132	3307				5.6 min
315 L/4	- IEC 315	250 / 200	3307				3.7 min









▽ = Vent ▼ = Oil Level ■ = Oil Drain

SERVICE

NORD DRIVESYSTEMS www.nord.com

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National Customer Service Toll-Free: 888.314.6673
Info.us@nord.com

NORD Gear Limited
Toll-Free in Canada: 800.668.4378
info.ca@nord.com

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Phone: 608.849.0190

MIDWEST
Waunakee, WI (Madison)
Phone: 608.849.7300

EAST
Charlotte, NC
Phone: 608.849.0140

CANADA
Brampton, ON (Toronto)
Phone: 905.796.3606

100200001/01.11

ABB Motors and
Mechanical Inc.

Formal Quotation

Quote / Rev. Number:	Customer Number:	Your Inquiry No.:	Quote Date:		
1100805185-20	100066		04/05/2022		

Sales Person:	Manufacturing Plant:	Quote Entered By:	Contact No:
Kraig Arenz	Baldor-Reliance Fort Smith	Larry Berg	262-784-5940

Lead Time Based on Current Availability:	Project ID:	Customer Approval:
21 Week(s) after receipt of customer approval.		Hold for Document Approval Required

Quoted To:	Ship To:
EVOQUA WATER TECHNOLOGIES LLC 2607 N Grandview Blvd Ste 130 Waukesha, WI 53188 United States	EVOQUA WATER TECHNOLOGIES 1828 METCALF AVE THOMASVILLE, GA 31792 United States

LineNo.	Qty	Part No.	Description
000020	20	MACCUSTOMMOTOR	0.5HP,1800,56C,TEFC
	20		Test Charge

Basic Configuration: Medium AC Motors

Power	Enclosure	Enclosure Enhancement / Ingress Protection	Efficiency	Frame Size	Duty
0.5 HP	TEFC	841-XL / IP56	Premium Eff. (NEMA 12-12)	56C	CONT

Speed (RPM)	Bearing Type	Phase/Hertz/Voltage	Insulation System	Insulation	Service Factor
1800	Ball / Ball	3 / 60 / 460		F	1.00

Division	Class 1, Group / Class 2, Group	Temp Code	Motor Standard	Design Letter	Ambient (ºC)	Altitude (ft)
Div. 2	A, B, C & D / None	T3	NEMA-T	B	40	5000

Additional Specifications:

BASIC CONFIGURATION

Partial Motor Design	No
Frame Band	305
Customer Application	General Industrial
Industry Spec	IEEE-841
Variable Frequency Drive Op	Yes
HP on Sine Wave Power	1.00
Inverter Torque	6:1 Constant Torque
SF on Sine Wave Power	1.15
Division	Div. 2
Hazardous Location Group Code	B

Hazardous Location Group Code	A
Hazardous Location Group Code	C
Hazardous Location Group Code	D
Temp Code	T3

ELECTRICAL

Ambient Minimum	-25C
Starting Method	Standard Start
Motor Space Heater	Yes
Space Heater Rated for	1Ph/50-60Hz/100-125V
Space Heater Operating Voltage	120
Maximum Sheath Temperature	Standard(140 Deg C)
Space Heater Qty	1
Space Heater To Main Cbox	Yes
Additional Motor Space Heater	No

MOUNTING

Mounting Flange - DE	C-Face
Mounting Position	F-1
Frame Mounting	Footless
Drive Method	Direct
Mounting Orientation	Horizontal
Shaft - Special Material	No
Shaft - Special Extension	No

BEARINGS

Locked Bearing	Drive End
Drive End Seal	Inpro
Opposite Drive End Seal	Inpro
Lube Type	Grease
Grease Type	Exxon Polyrex EM
Grease Fittings Rqd	Yes
Grease Fitting Type	Alemite 1610 or equal

MECHANICAL

Balance	Ultra-Standard (0.08 in/sec)
Rotation Facing ODE	Bi-directional
Fan Material	Standard
Ingress Protection	IP56
Paint System	Standard (C2)
Paint Color Specification	Standard Epoxy
Paint Color	Blue-Green
Baldor-Reliance Paint Spec No	004824-007K / MG1025N19
Auto Drain Type	“T” Drain – Stainless Steel

MONITORING DEVICES

Winding Thermostat	Yes
Winding Thermostat Type	High Limit
Thermostat High Limit Contacts	Normally Closed
Winding Thermostat Qty	3 Total - One per Phase
Wdg Thermostat To Main Cbox	Yes

Thermal Protection	None

CONDUIT BOX

Main Conduit Box	Required
Main Conduit Box Location	Standard (side)
Main Conduit Box Material	Cast Iron
Main Conduit Box Size	Standard Oversize
Terminal Panel	No
Lead Entry Location	Toward Feet - Down
Lugs	Yes
Grounding	Yes
Ground Servit Post	No
Bus Bars / Standoffs	No

NAMEPLATE / LABELS

Nameplate Language	English
Customer Logo On Nameplate	No
Nameplate Material	Standard
Customer Part Number Marks	Yes
Customer Part Number	CUSTOMER TO ADVISE
Additional Haz Loc Marks	Yes
Additional Haz Loc Text	CL I, ZONE 2, GP IIC IIB IIA,
Space Heater Nameplate	Yes
Additional heater Markings	No
Label "Heater Energized"	Yes
Heater Energized Message	Energized Message
Space Heater Text	SPACE HEATERS MAY BE ENERGIZED
Special Nameplate Rqd	Yes
Variable Frequency Marks	Yes
Derate	Yes
Label CSA	Yes
Label UR	Yes

PACKAGING

Packaging Type	Standard Packing

TESTING

Routine Report w/Vibration	Yes
IEEE112 Routine Test	Non-witnessed
No-Load Vibration/Mech Run	Non-witnessed

DOCUMENTATION

Document Unit of Measure	US
Certified Dimension Sheet	Yes
Performance Data/Curves	Yes
Standard Connection Diagram	Yes
Motor Instruction Manual	Yes
Renewal Parts List	Yes
Nameplate Data	Yes
Documentation Format	PDF

SPECIAL ITEMS

Custom Requirements	Yes
Custom Requirements	External ground lug adjacent to conduit box.

COMMERCIAL COMMENTS

Estimated Lead Time	Estimated Lead Time is based on plant loading at the time of quotation and is intended to be used as a guide for our customers. This estimation includes the Engineering and Manufacturing time only. It DOES NOT include shipping time. Please contact your ABB Motors and Mechanical Inc. representative if specific delivery requirements are needed.

Comments:

UPS ACCOUNT 75V337 SEE ROUTING INSTRUCTIONS
ACCOUNT 75V337 MAIL FREIGHT BILL TO SIEMENS WATER
TECHNOLOGIES/ENVIREX 221012 c/o CASS INFORMATION SYSTEMS, INC PO BOX
67, ST LOUIS MO 63166-0067

21 Week(s) after receipt of customer approval.

Terms & Conditions

This quotation is expressly conditioned on and subject solely to the provisions of ABB Motors and Mechanical Inc.'s standard terms and conditions listed at:
http://www.baldor.com/resources/product-support/sales-terms-and-conditions
ABB assures the purchaser that the articles specified herein are produced in compliance with all applicable requirements of Section 6, 7 and 12 of the Fair Labor Standards act, as amended, and of regulations and orders of the United States Department of Labor issued under Section 14 thereof. The manufacturing lead time shown in the quotation is based on current operating conditions and is subject to adjustment without notification.

Both ABB and the Customer are aware of the outbreak of a Coronavirus (commonly known as COVID-19) or any mutation of such virus which is impacting or may impact the normal business. ABB hereby reserves the right to amend the delivery date, the price, the scope of supply and/or other terms and conditions set out in this offer if and to the extent affected by COVID-19, whether directly or indirectly, and regardless of when the disrupting event may occur during the term of the contract. Notwithstanding anything to the contrary, the foregoing paragraph is deemed to be incorporated into any subsequent concluded contract.

BALDOR • RELIANCE

Customer information packet

0~~5G896X280G~~1

.5HP, 1750RPM, 3PH, 60HZ, 56C, 0520M, TEFC
Class - CLI GP A,B,C,D; CLII GP F,G
Division - Division II

Specifications

Enclosure	TEFC
Frame	56C
Frame Material	Iron
Frequency	60.00 Hz
Output @ Frequency	.500 HP @ 60 HZ
Phase	3
Synchronous Speed @ Frequency	1800 RPM @ 60 HZ
Voltage @ Frequency	460.0 V @ 60 HZ
XP Class and Group	CLI GP A,B,C,D; CLII GP F,G
XP Division	Division II
Agency Approvals	CSA UR
Ambient Temperature	40 °C
Auxillary Box	No Auxillary Box
Auxillary Box Lead Termination	None
Base Indicator	No Mounting
Bearing Grease Type	Polyrex EM (-20F +300F)
Blower	None
Constant Torque Speed Range	6
Current @ Voltage	.700 A @ 460.0 V
Design Code	B
Drip Cover	No Drip Cover
Duty Rating	CONT
Efficiency @ 100% Load	84.0 %
Electrically Isolated Bearing	Not Electrically Isolated
Feedback Device	NO FEEDBACK
Front Face Code	Standard
Front Shaft Indicator	None
Heater Indicator	No Heater
High Voltage Full Load Amps	0.7 a
Insulation Class	H
Inverter Code	Inverter Duty

Part detail

Revision	H
Type	AC
Mech. spec.	05G896
Base	
Status	PRD/A
Elec. spec.	05WGX280
Layout	05LYG896
Eff. date	07-08-2019
CD Diagram	CD0006
Poles	04
Leads	3#18
Proprietary	False
Created date	09-16-2015

KVA Code	L
Lifting Lugs	Standard Lifting Lugs
Locked Bearing Indicator	Locked Bearing
Max Speed	2700 rpm
Motor Lead Exit	Ko Box
Motor Lead Quantity/Wire Size	3 @ 18 AWG
Motor Lead Termination	Flying Leads
Motor Standards	NEMA
Motor Type	0520M
Mounting Arrangement	W6
Number of Poles	4
Overall Length	13.07 IN
Power Factor	77
Product Family	Chemical Processing (Not DC)
Pulley End Bearing Type	Ball
Pulley Face Code	C-Face
Pulley Shaft Indicator	Standard
Rodent Screen	None
Service Factor	1.00
Shaft Diameter	0.625 IN
Shaft Extension Location	Pulley End
Shaft Ground Indicator	No Shaft Grounding
Shaft Rotation	Reversible
Shaft Slinger Indicator	No Slinger
Speed	1750 rpm
Speed Code	Single Speed
Starting Method	Direct on line
Thermal Device - Bearing	None
Thermal Device - Winding	None
Vibration Sensor Indicator	No Vibration Sensor
Winding Thermal 1	None
Winding Thermal 2	None
XP Temp Code	T3C

Nameplate

NP2746E

CAT NO							
SPEC.	~~05G896X280G1~~	ENCL	TEFC				
FRAME	56C	HP	.5				
VOLTS	460						
MAG CUR	.4	FLA	.7				
RPM	1750	RPM MAX	2700				
HZ	60	PH	3	CLASS	~~H~~ F		
SER.F.	1.00	DES	B	SL HZ	1.7		
NEMA-NOM-EFF	84	WK2	0.118				
RATING	40C AMB-CONT						
DE BRG	6205	ODE BRG	6203				
INV.TYPE	PWM	C HP FR	60	C HP TO	90	T. CODE	T3C
CT HZ FROM	6	CT HZ TO	60	VT HZ FROM	6	VT HZ TO	60
CC		SN					

AC Induction Motor Performance Data
Record # 52930
Typical performance - not guaranteed values

Winding: 05WGX280-R009	**Type:** 0520M	**Enclosure:** TEFC

Nameplate Data			
Rated Output (HP)			.5
Volts			460
Full Load Amps			.7
R.P.M.			1750
Hz	60	Phase	3
NEMA Design Code	B	KVA Code	L
Service Factor (S.F.)			1
NEMA Nom. Eff.	84	Power Factor	77
Rating - Duty			40C AMB-CONT

460 V, 60 Hz: Single Voltage Motor	
Full Load Torque	1.48 LB-FT
Start Configuration	direct on line
Breakdown Torque	6.51 LB-FT
Pull-up Torque	3.84 LB-FT
Locked-rotor Torque	4.58 LB-FT
Starting Current	5.97 A
No-load Current	0.421 A
Line-line Res. @ 25ºC	34.6 Ω
Temp. Rise @ Rated Load	19°C
Locked-rotor Power Factor	63.6
Rotor inertia	0.118 LB-FT2

Load Characteristics 460 V, 60 Hz, 0.5 HP

% of Rated Load	25	50	75	100	125	150
Power Factor	37	55	69	77	83	86
Efficiency	69.3	80.7	84	84.2	84	81.8
Speed	1789	1776	1763	1749	1734	1715
Line amperes	0.45	0.514	0.605	0.714	0.841	1

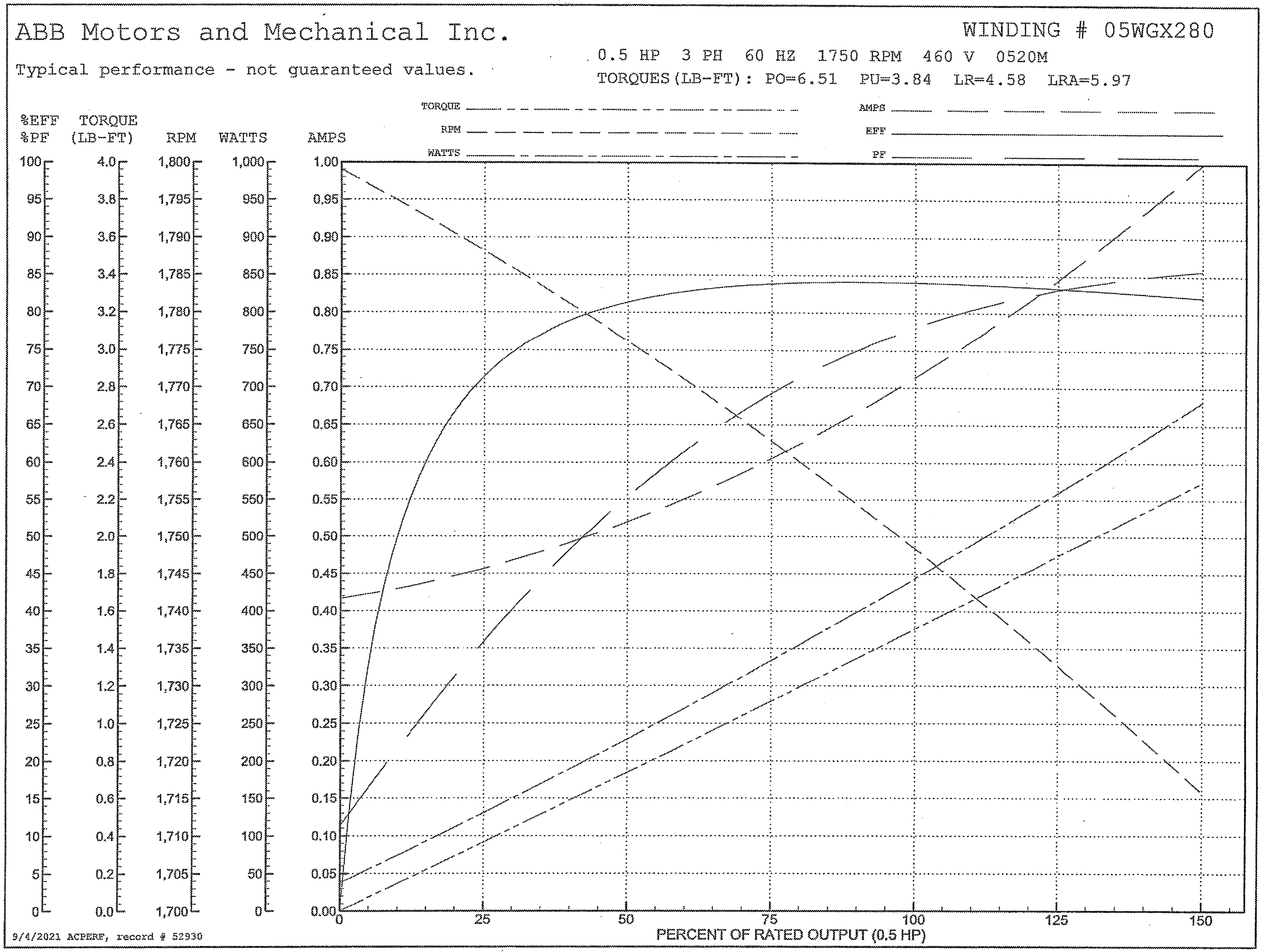
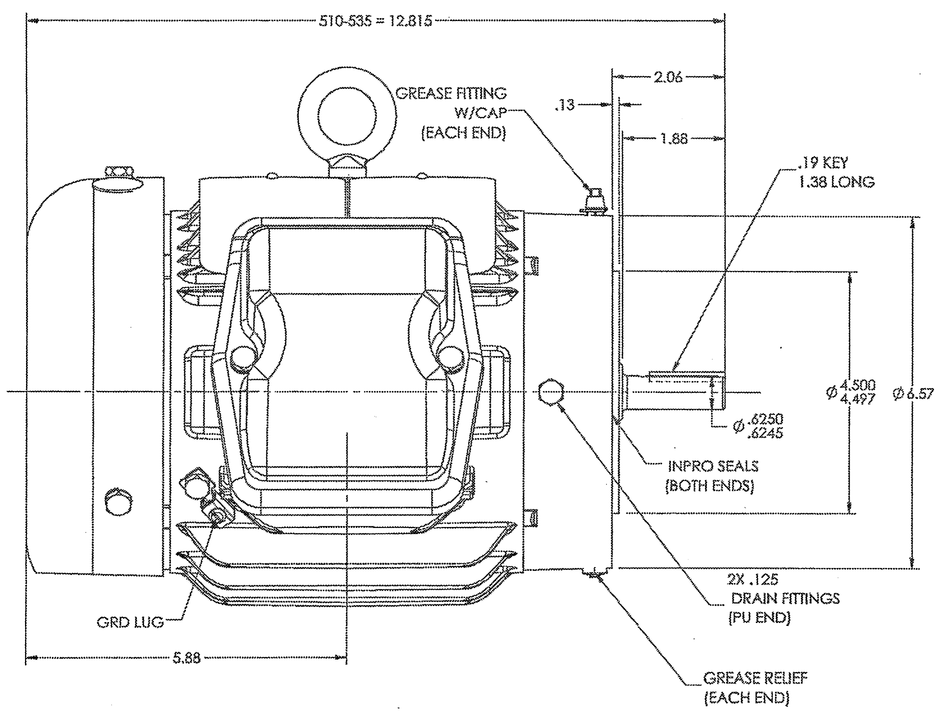
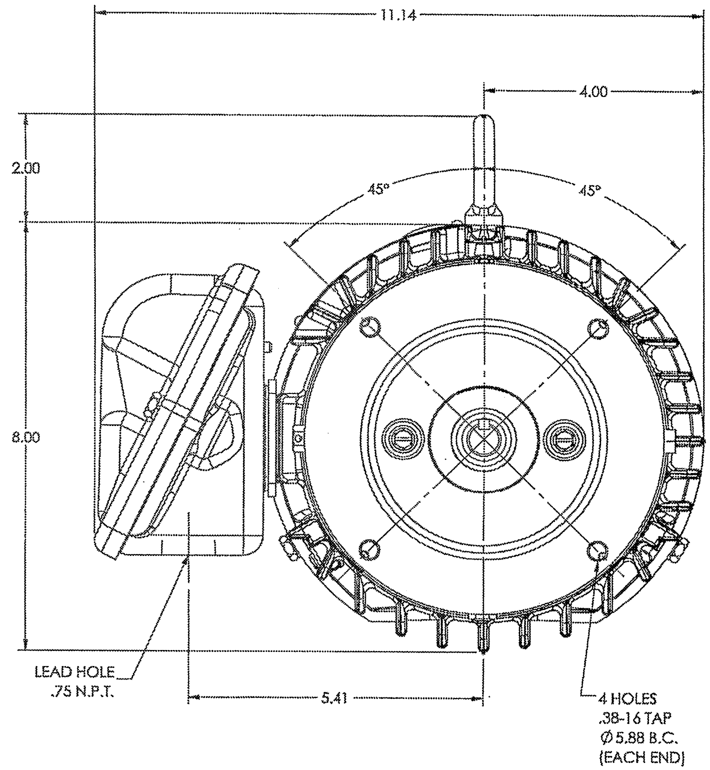
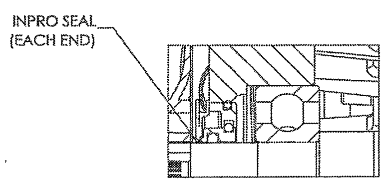


ABB Motors and Mechanical Inc.
Typical performance - not guaranteed values.
WINDING # 05WGX280
0.5 HP 3 PH 60 HZ 1750 RPM 460 V 0520M
TORQUES (LB-FT): PO=6.51 PU=3.84 LR=4.58 LRA=5.97
TORQUE
RPM
WATTS
AMPS
EFF
PF
%EFF %PF
TORQUE (LB-FT)
RPM
WATTS
AMPS
PERCENT OF RATED OUTPUT (0.5 HP)
9/4/2021 ACPERF, record # 52930

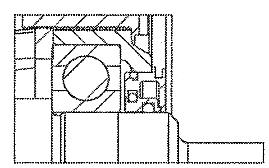
05LY-000-396







FRONT END DETAIL



PULLEY END DETAIL

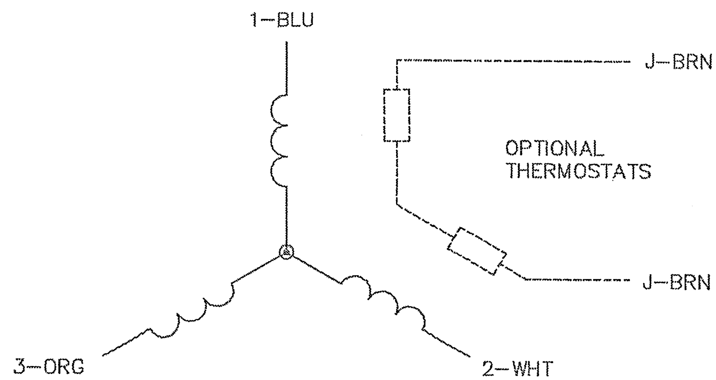
CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

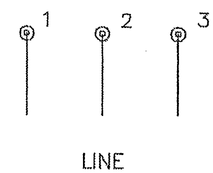
REV. DESC: NEW				BALDOR - RELIANCE®
REV: -	VERSION: 00	REVISED: 10:32:22 02/10/2021	TDR: 000001157860	
MODEL NO. 05LY-000-396			REF: -	VERT 56C TEFC 05M (ECP) 841 6206 PU END SH 1of 1
BY: CKMICR0	Material: -			

05LY-000-396

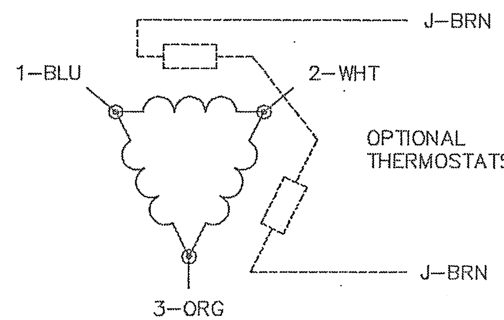
CD0006

TYPICAL WYE–CONNECTED MOTOR





TYPICAL DELTA–CONNECTED MOTOR



NOTES:

1. THREE LEAD MOTOR MAY BE EITHER WYE CONNECTED OR DELTA CONNECTED.
2. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
3. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
4. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY VARY.
5. LEAD COLORS ARE OPTIONAL. LEADS MUST BE NUMBERED AS SHOWN.

REV. DESC: ADD CLASS CONN00000007			BALDOR - RELIANCE®
REV. LTR: E	VERSION: 01	TDR: 000001099922	
FILE: \AAA\00005\141	REVISED: 10:24:49 02/19/2019	BY: ENBRIRO	3PH, SV, 3 LEADS, WYE OR DELTA CONNECTED
MTL: –			SH 1 of 1

CD0006

CONNECTION DIAGRAM

ACCESSORIES

SPACE HEATERS					
VOLTS	120	AMPS	.25	WATTS	30
PHASE	1	HERTZ	60	FIGURE	1

FIGURE 1

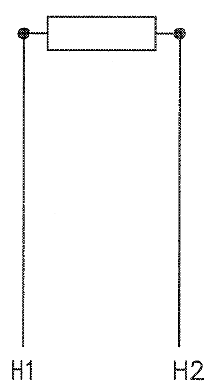
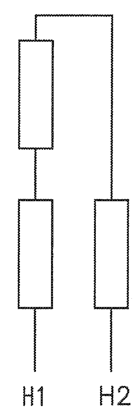


FIGURE 3



CUSTOMER EVOQUA WATER

CUSTOMER ORDER NO. ______

RELIANCE S. O. NO. ______

RELIANCE ELECTRIC CLEVELAND, OHIO 44117	DR. BY N.F.JUESCHKE CK. BY G.BRAIDICH APP. BY P.LICURS,JR. DATE 3/11/77	CONNECTION DIAGRAM	416820-71 ISSUE DATE MARCH 11, 1977

CONNECTION DIAGRAM

ACCESSORIES

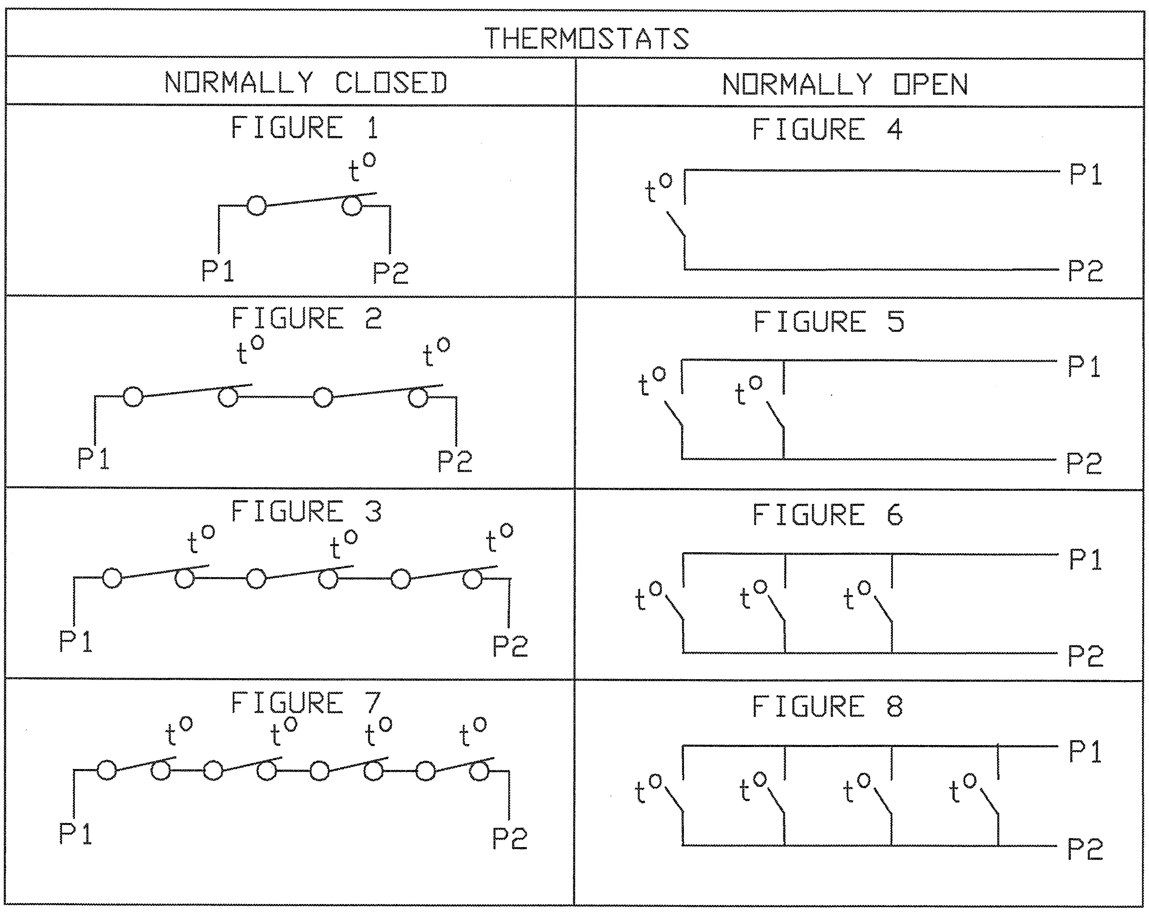
MOTOR WINDING THERMOSTATS

CONTACTS 3 @ 150 °C

FIGURE NUMBER 3

CONTACT RATING

VOLTS	CONTINUOUS AMPERES	INRUSH AMPERES
110-120	3.0	30
220-240	1.5	15
440-480	0.75	7.5
550-600	0.60	6.0



CUSTOMER ______________ CUSTOMER ORDER NO. ______________ RELIANCE S.O. NO. ______________

RELIANCE ELECTRIC CLEVELAND, OHIO 44117 U.S.A.	DR.BY L. FOURNIER CK.BY J. P. TSAO APP.BY D. H. MAY DATE 11-06-91	CONNECTION DIAGRAM SHEET 1 OF 2	418174-6 ISSUE DATE: NOV. 14, 1996

C/R 358606

Brunel Safety Element Torque Limiters

General Engineering Data

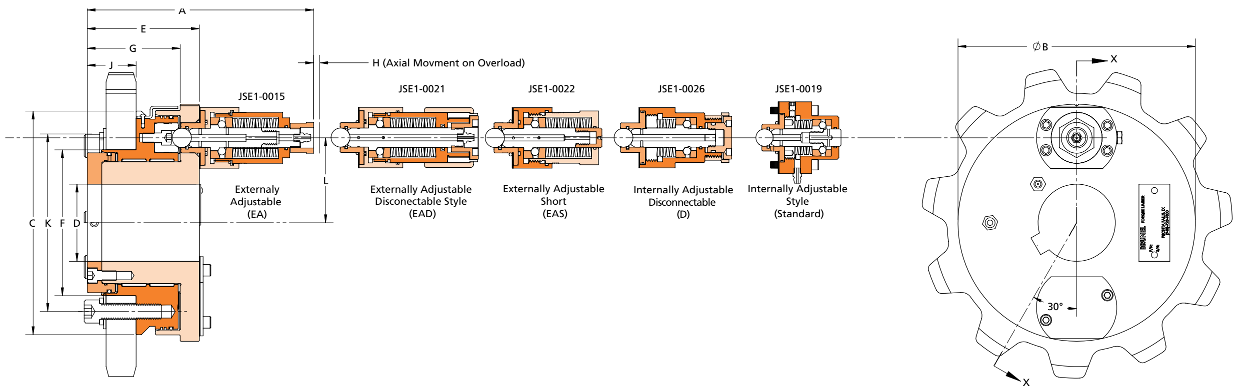
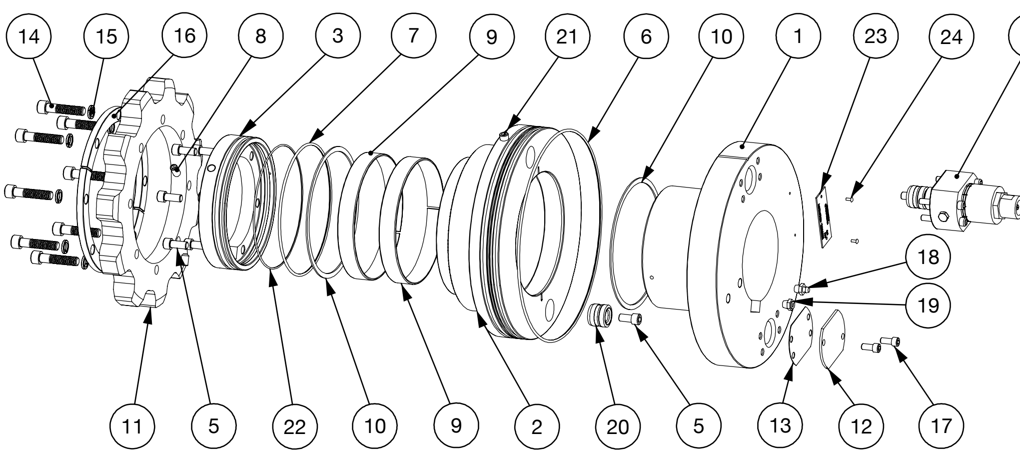


Chart 1

Brunel Part No. Series	Safety Element Qty.	Externally Adjustable Torque Range lb in	Internally Adjustable Torque Range lb in	Safety Element Style	A	B	C	D max.	E	F	G	H	J	K	L	M	Min H78 Sprocket
				EA	7.32							.211					
				EAD	7.57							.250					
JSE1-0100	1 2	1,604 - 7,356 3,208 - 14,712	1,105 -9,044 2,210 - 18,086	EAS	6.54	6.10	5.66	1.750	3.62	3.64	3.00	.211	1.58	4.50	1.925	Qty 6 3/8 -16	9 Tooth
				D	6.72							.162					
				Standard	5.84							.162					
				EA	7.29							.211					
				EAD	7.46							.250					
JSE1-0150	1	2,024 - 9,287	1,395 - 11,415	EAS	6.42	7.00	7.00	2.50	3.50	4.72		.211	1.94	5.75	2.425	Qty 6 1/2 - 13	11 Tooth
				D	6.60							.162					
				Standard	5.80							.162					
				EA	7.32							.211					
				EAD	7.56							.250					
JSE1-0200	1 2	2,291 - 10,510 4,582 - 21,021	1,579 - 12,920 3,157 - 25,840	EAS	6.54	7.68	7.25	2.938	3.62	4.724	3.00	.211	1.58	5.75	2.75	Qty 6 1/2 - 13	11 Tooth
				D	6.72							.162					
				Standard	5.84							.162					
				EA	8.90							.211					
				EAD	7.56							.250					
JSE1-0400	1 2 3 4	3,107 - 14,256 6,214 - 28,512 9,321 - 42,768 12,428 - 57,023	2,141 - 17,523 4,282 - 35,047 6,423 - 52,570 8,564 - 70,093	EAS	8.02	9.75	7.25	3.75	5.10	6.00	3.00	.211	1.58	6.60	3.83	Qty 8 3/8 - 16	11 Tooth
				D	8.20							.162					
				Standard	7.42							.162					



400 Series Exploded View P/N: JSE1-0401EA

Chart 2

Item	Description	Qty.	Item	Description	Qty.	Item	Description	Qty.
1	Module Carrier Hub	1	9	PTFE Bearing	2	17	Blanking Plate Bolts	2
2	Detent Pocket Plate	1	10	PTFE Thrust ring	2	18	Grease Zerk	1
3	Retaining Plate	1	11	Sprocket	1	19	Grease Relief Valve	1
4	JSE1-0015 EA SE	1	12	Blanking Plate	1	20	JSE1 Detent	1
5	Retaining Plate Bolts	6	13	Blanking Plate Seal	1	21	Alignment Bolt	1
6	O-ring Seal	1	14	Sprocket Bots (SHCS)	8	22	O-ring Seal	1
7	O-ring Seal	1	15	Sprocket Lock Washers	8	23	Name Plate	1
8	Socket Set Screw	2	16	Split Clamping Ring	2	24	Rivets	2

Consult factory for special application

15. Limit Switch - Honeywell, 11CX12

Honeywell

MICRO SWITCH™ Weather-Sealed, Explosion-Proof Switches

CX Series

Datasheet

MICRO SWITCH™ CX Series
Weather-Sealed, Explosion-Proof Switches

MICRO SWITCH™ CX switches are built especially for outdoor use in hazardous atmospheres. These enclosures are constructed to withstand the pressure of an internal explosion. Flame paths cool the exploded gases to a point less than the lowest safe operating temperature of the surrounding gas.

MICRO SWITCH™ 80CX Series switches have rugged bronze housings that are designed to be resistant to salt water and other corrosive environments. They comply with the NEMA 4X requirement for protection against corrosion, in addition to NEMA enclosure standards met by other CX switches.

The product's o-ring seals make the enclosure rain tight, but are outside of required flame paths so explosion proof requirements are maintained. Unless special ordered, all basic switches operate on clockwise and counterclockwise rotation. The actuating mechanism can be field adjusted for CW or CCW operation only. No tools are required.

What makes our switches better?

- Building block design allows for digital switching outputs, or 4 mA to 20 mA analog output, or digital switching outputs with a 4 mA to 20 mA analog output
- Weather sealed to NEMA and IP ratings
- UL, CSA, ATEX, IEC Ex, INMETRO certified for hazardous (explosive) environments
- Designed with the end user in mind, these switches help to create user-friendly interfaces with broad application possibilities to help meet the challenges of many different environments
- Available with gold contacts, low-temp seals, and bronze corrosion-resistant housing

COST OPTIMIZATION
RELIABILITY • GLOBALLY ACCEPTED

Features and Benefits

WELL-SUITED FOR EXPLOSIVE ENVIRONMENTS

MICRO SWITCH™ CX Series switches are certified for applicable portions of **NEMA 7 and 9** for hazardous locations (explosive environments). Select CX switches are certified to ATEX, IEC Ex, and INMETRO specifications for global applications.

Available with digital or analog outputs

WATERTIGHT AND DUST-TIGHT FOR OUTDOOR USE

Due to its engineering design and sealing (NEMA 1, 3, 4, 4X, 6, 6P, and 13), the MICRO SWITCH™ CX Series is rated for **rain, wind, snow, ice, and blowing dust environments**.

CORROSION RESISTANT

Bronze housing material is available on 80CX Series catalog listings.

4 MA TO 20 MA ANALOG OUTPUT AVAILABLE

Allows for use in accurate positioning applications, such as those found on seaside grain and fuel-loading docks, oil and gas wells, refineries, chemical plants, and more.

MEETS HAZARDOUS AREA REQUIREMENTS

UL Listed, file #E14274, Analog UL file #E68247, CSA Certified, file #LR57324, ATEX certificate KEMA 01ATEX2111 X, IEC Ex certificate IEC Ex TSA 06.003X, and INMETRO certificate TUV 14.0553.

OPTIONAL HOUSING CHOICES

CX Series switches offer a **choice of rugged cast aluminum or bronze housings**. Both housings withstand harsh environments, and bronze is available for use in corrosive environments.

UNIQUE DESIGN FEATURES

Featuring **field-adjustability**, the CX Series allows pretravel, overtravel, and actuating sequence to be field adjusted without tools (all basics can be adjusted individually). Rotary types convert in seconds to clockwise, counterclockwise, or both-way operation. These features **may help to reduce set up time** while allowing for quick and easy changes to switch operation.

Potential Applications

INDUSTRIAL

- Seaside grain and fuel loading docks that may require explosion proof and corrosion resistant switches
- Oil and gas wells, refineries, and fuel storage facilities that may require explosion proof and corrosion resistant switches
- Chemical plants with corrosive environments

0518

INMETRO

Table 1. Specifications

Characteristic	Parameter
Actuators	side rotary (choice of levers), ~~side rotary (with flat shaft), plunger actuator~~
Housing material	aluminum with electrostatic epoxy coating ~~or corrosion resistant bronze~~
Termination	3/4 x 14 NPT, ~~M25 x 1,5 mm conduit~~
Sealing	NEMA 1, 3, 4, 4X, 6, 6P, and 13; IP66
Hazardous area designations	NEMA 7: Class I, Div.1 & Div. 2, Groups B (14CX, 16CX, 24CX, 26CX, 36CX only), C, and D; NEMA 9: Class II, Div.1 & Div. 2, Groups E, F, and G ATEX/IEC Ex, INMETRO (Gas) II 2 G; Exd IIC T6 ATEX/IEC Ex, INMETRO (Dust) II 2 D; Exd tD A21 T85°C
Operating temperature	-25 °C to 85 °C [-13 °F to 185 °F]
Agency approvals	UL Listed, file #E14274, Analog UL file #E68247 CSA Certified, file #LR57324 ATEX certificate KEMA 01ATEX2111 X IEC Ex certificate IEC Ex TSA 06.003X INMETRO certiticate TUV 14.0553

Table 2. Electrical Ratings (in amperes)

Rating Code	Switch Description	UL/CSA
A	BZ basic switch, SPDT	15 A 120/240/480 Vac; 1/8 HP, 120 Vac 1/4 HP, 240 Vac; 0.5 A, 125 Vdc; 0.25 A, 250 Vdc
B	BA basic switch, SPDT	20 A 120/240/480 Vac; 1 HP, 120 Vac; 2 HP, 240 Vac; 0.5 A, 125 Vdc; 0.25 A, 250 Vdc
C	DT basic switch, DPDT	10 A 120/240/480 Vac, 0.3 A 125 Vdc; 0.15 A, 250 Vdc
D	HS basic switch (hermetic sealed), SPDT	1 A, 125 Vac; 5 A, 28 Vdc
F	BZ basic switch (gold contacts) SPDT	1 A, 125 Vac

Table 3. Analog Position Sensing Specifications

Specification	Parameter
Voltage compliance range	12.5 Vdc to 40 Vdc
Replacement PC board	15PA261-CX
Current signal output	4 mA to 20 mA
Span	Adjustable from 15 ° to 90 ° of angular rotation
Null	4 mA position may be set at any angular position

MICRO SWITCH™ Weather-Sealed, Explosion-Proof Switches

PRODUCT NOMENCLATURE

Switch Type

CX Series Hazardous Area Limit Switch

1

Housing Style & Actuator Type

1	Short housing, side rotary
2	Standard housing, side rotary
3	Short housing, plunger actuator
4	Standard housing, plunger actuator
6	Short housing, black epoxy
7	Stand. housing, bronze material, 5/16-18 UNC-2B mtg holes
8	Standard housing, bronze material
9	Switch assemblies (replacement)

1

Circuitry

1	15 A, SPDT basic switch/es
2	20 A, SPDT basic switch/es
4	10 A, DPDT basic switch/es
6	1 A, SPDT, hermetically sealed basic switch/es
8	4 mA to 20 mA output for position sensing
172	1 A, SPDT, gold-plated contacts, basic switch/es

CX

Switch Type

CX	Momentary
CX1	Maintained

2

Switches

0	4 mA to 20 mA
1	One switch
2	Two switches
3	Three switches
4	Four switches
5	Two switches, one CW oper., one CCW oper.

Additional Options

	Non-threaded thru holes
A	Side mounting, 5/16-18(8)
B	Thru mounting, 3/8-24(4)
C	Low temperature
E	ATEX/IEC Ex/ INMETRO certified with cover clamp
M	Metric, M25 x 1.5 conduit
D01	Flat shaft
00	Or other numbers, various specials

Other special configurations may be available.
For more information, contact your Honeywell representative.

CX Series

Table 4. Order Guide

When factory assembled, all basic switches operate on a clockwise and counter clockwise rotation. The actuating mechanism can be field adjusted for CW or CCW operation only. No tools are required. For listings not shown, contact your Honeywell representative.

	Cat. Listing[1]	Housing Material	Cover Size	Switch Action[2]	Basic Switch Type, Quantity, Circuitry	Electrical Rating (Page 4)
	11CX12	Epoxy-coated aluminum	Short	Maintained	BZ (2), SPDT each	A (15 A)
	11CX12E	Epoxy-coated aluminum	Short	Maintained	BZ (2), SPDT each	A (15 A)
	11CX2	Epoxy-coated aluminum	Short	Momentary	BZ (2), SPDT each	A (15 A)
	11CX2E	Epoxy-coated aluminum	Short	Momentary	BZ (2), SPDT each	A (15 A)
	1172CX2	Epoxy-coated aluminum	Short	Momentary	BZ (2), SPDT each	F (1 A)
	11CX5C	Epoxy-coated aluminum	Short	Momentary	BZ (2), SPDT each	A (15 A)
	11CX212	Epoxy-coated aluminum	Short	Maintained	BZ (2), SPDT each	A (15 A)
	12CX12	Epoxy-coated aluminum	Short	Maintained	BA (2), SPDT each	B (20 A)
	12CX12-D01	Epoxy-coated aluminum	Short	Maintained	BA (2), SPDT each	B (20 A)
	12CX15-D01	Epoxy-coated aluminum	Short	Maintained	BA (2), SPDT each	B (20 A)
	12CX2	Epoxy-coated aluminum	Short	Momentary	BA (2), SPDT each	B (20 A)
	**12CX2A**	Epoxy-coated aluminum	Short	Momentary	BA (2), SPDT each	B (20 A)
	12CX2AE	Epoxy-coated aluminum	Short	Momentary	BA (2), SPDT each	B (20 A)
	12CX5E	Epoxy-coated aluminum	Short	Momentary	BA (2), SPDT each	B (20 A)
	12CX200	Epoxy-coated aluminum	Short	Maintained	BA (2), SPDT each	B (20 A)
	14CX1E	Epoxy-coated aluminum	Short	Momentary	DT (1), DPDT	C (10 A)
	16CX1	Epoxy-coated aluminum	Short	Momentary	HS (1), SPDT	D (1 A)
	16CX1E	Epoxy-coated aluminum	Short	Momentary	HS (1), SPDT	D (1 A)
	16CX2	Epoxy-coated aluminum	Short	Momentary	HS (2), SPDT each	D (1 A)
	16CX2C	Epoxy-coated aluminum	Short	Momentary	HS (2), SPDT each	D (1 A)
	16CX12	Epoxy-coated aluminum	Short	Maintained	HS (2), SPDT each	D (1 A)
	18CX0	Epoxy-coated aluminum	Short	Momentary	–	–
	18CX10	Epoxy-coated aluminum	Short	Maintained	–	–
	21CX4	Epoxy-coated aluminum	Standard	Momentary	BZ (4), SPDT each	A (15 A)
	21CX12F	Epoxy-coated aluminum	Standard	Maintained	BZ (2), SPDT each	A (15 A)
	21CX14	Epoxy-coated aluminum	Standard	Maintained	BZ (4), SPDT each	A (15 A)
	22CX4	Epoxy-coated aluminum	Standard	Momentary	BA (4), SPDT each	B (20 A)
	24CX2	Epoxy-coated aluminum	Standard	Momentary	DT (2), DPDT each	C (10 A)
	**26CX4**	Epoxy-coated aluminum	Standard	Momentary	HS (4) SPDT each	D (1 A)
	26CX14	Epoxy-coated aluminum	Standard	Maintained	HS (4) SPDT each	D (1 A)
	26CX16	Epoxy-coated aluminum	Standard	Maintained	HS (4) SPDT each	D (1 A)
	281CX12	Epoxy-coated aluminum	Standard	Maintained	BZ (2) SPDT each	A (15 A)
	281CX12E	Epoxy-coated aluminum	Standard	Maintained	BZ (2) SPDT each	A (15 A)
	74CX2	Bronze	Standard	Momentary	DT (2) DPDT each	D (10 A)
	**81CX2**	Bronze	Standard	Momentary	BZ (2) SPDT each	A (15 A)
	82CX2A	Bronze	Standard	Momentary	BA (2) SPDT each	B (20 A)

[1] Basic switches operate nearly simultaneously in multiple switch devices

[2] Shafts of devices without spring return can be rotated through 360°

MICRO SWITCH™ Weather-Sealed, Explosion-Proof Switches

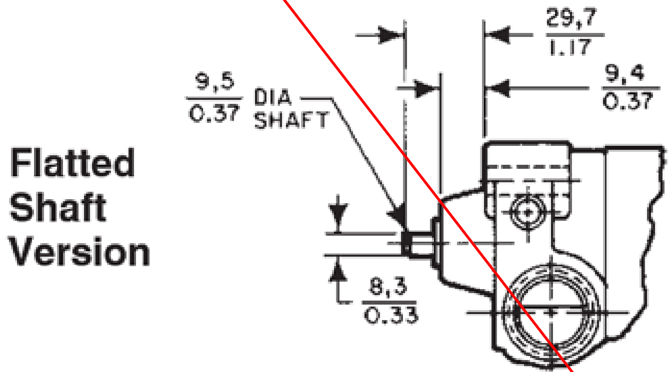
Operating Torque Nm [In-lb]	Pretravel max.	Differential Travel max.	Overtravel min.	Options	Comments
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	–
0,5 Nm [4.42 in-lb]	15°	10°	90°	ATEX/IEC Ex/INMETRO certified	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	–	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	ATEX/IEC Ex/INMETRO certified	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	–	Gold-plated switch contacts
1,25 Nm [11.1 in-lb]	15°	10°	90°	Low temperature seals	1 switch operates CW, 1 switch operates CCW
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	Cam provides ~ 30° actuation in 360° rotation for each basic switch
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	–
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	–
0,5 Nm [4.42 in-lb]	15°	10°	90°	Flat shaft for direct coupling	1 switch operates CW, 1 switch operates CCW
1,25 Nm [11.1 in-lb]	15°	10°	90°	Flat shaft for direct coupling	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	Threaded mounting holes, side (8)	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	Threaded mounting holes, side (8), ATEX/IEC Ex/INMETRO certified	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	ATEX/IEC Ex/INMETRO certified	1 switch operates CW, 1 switch operates CCW
0,5 Nm [4.42 in-lb]	–	–	–	–	Cam provides approximately 30° actuation in 360° rotation for each basic switch
1,25 Nm [11.1 in-lb]	30°	25°	75°	ATEX/IEC Ex/INMETRO certified	–
1,25 Nm [11.1 in-lb]	30°	20°	75°	–	Hermetic sealed basic switch
1,25 Nm [11.1 in-lb]	30°	20°	75°	ATEX/IEC Ex/INMETRO certified	Hermetic sealed basic switch
1,25 Nm [11.1 in-lb]	30°	20°	75°	–	Hermetic sealed basic switches
1,25 Nm [11.1 in-lb]	30°	20°	75°	Low temperature seals	Hermetic sealed basic switches
0,5 Nm [4.42 in-lb]	30°	20°	75°	–	Hermetic sealed basic switches
0,5 Nm [4.42 in-lb]	–	–	–	Analog position sensing	4 mA to 20 mA
0,5 Nm [4.42 in-lb]	–	–	–	Analog position sensing	4 mA to 20 mA
1,25 Nm [11.1 in-lb]	15°	10°	90°	–	–
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	Two basic switches. 4 sets of cams & return springs
0,5 Nm [4.42 in-lb]	15°	10°	90°	–	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	–	–
1,25 Nm [11.1 in-lb]	30°	25°	75°	–	–
1,25 Nm [11.1 in-lb]	30°	20°	75°	–	Hermetic sealed basic switches
0,5 Nm [4.42 in-lb]	30°	20°	75°	–	Hermetic sealed basic switches
0,5 Nm [4.42 in-lb]	30°	20°	75°	–	Hermetic sealed basic switches, two switches operate CW, two switches operate CCW
0,5 Nm [4.42 in-lb]	15°	10°	90°	Analog position sensing (4 mA to 20 mA)	–
0,5 Nm [4.42 in-lb]	15°	10°	90°	Analog position sensing (4 mA to 20 mA), ATEX/IEC Ex/INMETRO certified	–
1,25 Nm [11.1 in-lb]	30°	25°	75°	–	Threaded mounting holes, side (8)
1,25 Nm [11.1 in-lb]	15°	10°	90°	–	–
1,25 Nm [11.1 in-lb]	15°	10°	90°	Threaded mounting holes, side (8)	–

ASSEMBLY MODIFICATIONS

MODIFIED SHAFT ENABLES DIRECT COUPLING

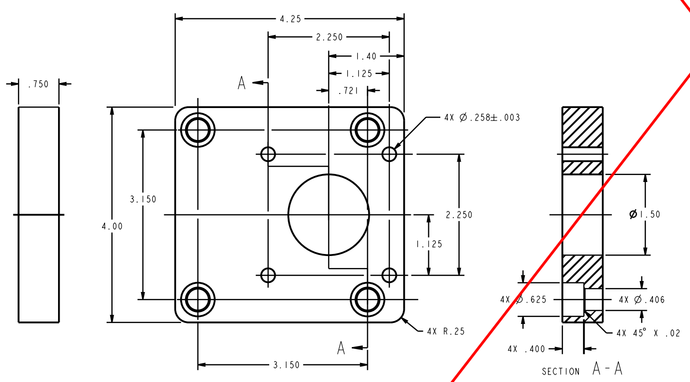
CX switches are available with a 3⁄8 inch diameter by 3⁄4 inch long flatted shaft which conforms to standard NEMA motor shaft specifications. It accepts commercially available shaft couplers, permitting easy, direct coupling to most equipment actuators.

To specify a “direct-couple” CX switch: Add-**DO1** to catalog listings shown in the order guides, i.e. 11CX12-**DO1**.



MOUNTING BRACKETS

15PA500-CX adapter bracket for mounting CX products to NAMUR footprint is available upon request.



Mounting Holes

Add the letter **A** to listings with side mounting holes tapped 5/16-18(8). Example: 11CX2**A**

Add the letter **B** to listings with thru mounting holes tapped 3/8-24(4). Example: 11CX2**B**.

CX Series Replacement Basic Switch Assemblies

These assemblies are factory-adjusted to the same operating characteristics as a new CX switch. They include components subject to mechanical or electrical wear: basic switches, cams, cam followers, and springs.

To order, change the first number in the complete switch catalog listing to **9 for rotary switches**. For example:

Rotary switch 11CX2 Replacement = **9**1CX2

Note: Basic switch assemblies for rotary actuated switches, with or without spring return, will be the same.

For example: 11CX2 and 11CX12 use **9**1CX2.

Low Temperature Switches

Add the letter **C** to listings for low temperature versions

For example: 21CX14**C** = -40 °F [-40 °C] Rotary

MICRO SWITCH™ Weather-Sealed, Explosion-Proof Switches

Table 6. Rotary Levers

Levers for use with side-rotary-actuated switches are available in a wide choice of sizes and materials. The most common listings are shown below. Rollers may be on either side of the lever to best match the external actuating mechanism.

Fixed lever, nylon roller
LSZ51A - front mount roller
LSZ51C - back mount roller

Short fixed lever, nylon roller
LSZ59A - front mount roller
LSZ59C - back mount roller

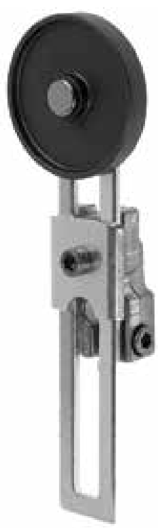
Offset lever, nylon roller
LSZ55A - back mount roller
LSZ55C - front mount roller

One-way lever, nylon roller
LSZ60A - front mount roller

Yoke lever, nylon rollers
LSZ53A - front/back mount rollers

Adj. lever, nylon roller
LSZ52A - back mount roller
LSZ52C - front mount roller

LSZ52J
adjustable lever,
nylon roller
25,4 mm [1 in]



LSZ52K
adjustable lever,
nylon roller
38,1 [1.5 in]

LSZ54M
aluminum rod
140 mm [5.5 in]

LSZ61
loop
152 mm [6 in]

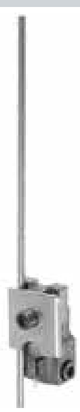
LSZ67CA**
Plastic conveyor roller

LSZ68
rod w/ spring
305 mm [12 in]

** May require orientation of switch and lever to enable gravity to help restore switch's free position.
Non-sparking rollers and actuators must be used in hazardous areas.

CX Series

Table 7. Rotary Levers Order Guide

	Catalog Listing	Material	Roller Dia. mm [in]	Roller Width mm [in]	Roller Mounting
	Fixed – 38,1 [1.5] inch radius				
	LSZ51	Rollerless	n/a	n/a	n/a
	LSZ51A	Nylon	19 [0.75]	6,35 [0.25]	Front
	LSZ51C	Nylon	19 [0.75]	6,35 [0.25]	Back
	LSZ51F	Nylon	25,4 [1.0]	12,7 [0.50]	Front
	LSZ51G	Nylon	38,1 [1.5]	6,35 [0.25]	Front
	LSZ51J	Nylon	25,4 [1.0]	12,7 [0.50]	Back
	LSZ51M	Nylon	19 [0.75]	31,7 [1.25]	Back
	LSZ51P	Nylon	19 [0.75]	12,7 [0.50]	Front
	LS2Z51A (sst)	Nylon	19 [0.75]	6,35 [0.25]	Front
	LS2Z51C (sst)	Nylon	19 [0.75]	6,35 [0.25]	Back
	LS2Z51E (sst)	Copper alloy	19 [0.75]	6,35 [0.25]	Front
	LS2Z51F (sst)	Copper alloy	19 [0.75]	6,35 [0.25]	Back
	Adjustable – 38,1 [1.5] in to 3.5 in radius				
	LSZ52	Rollerless	n/a	n/a	n/a
	LSZ52A	Nylon	19 [0.75]	6,35 [0.25]	Back
	LSZ52C	Nylon	19 [0.75]	6,35 [0.25]	Front
	LSZ52E	Nylon	19 [0.75]	33,0 [1.30]	Front
	LSZ52J	Nylon	25,4 [1.0]	12,7 [0.50]	Front
	LSZ52K	Nylon	38,1 [1.5]	6,35 [0.25]	Front
	LSZ52M	Nylon	50,8 [2.0]	6,35 [0.25]	Front
	LSZ52N	Nylon	19 [0.75]	12,7 [0.50]	Front
	LS2Z52A (sst)	Nylon	19 [0.75]	6,35 [0.25]	Front
	LS2Z52C (sst)	Nylon	19 [0.75]	6,35 [0.25]	Back
	LS2Z52E (sst)	Copper alloy	19 [0.75]	6,35 [0.25]	Front
	LS2Z52F (sst)	Copper alloy	19 [0.75]	6,35 [0.25]	Back
	Yoke – 38,1 [1.5] in radius				
	LSZ53A	Nylon	19 [0.75]	6,35 [0.25]	Front/Back
	LSZ53E	Nylon	19 [0.75]	6,35 [0.25]	Back/Front
	LSZ53M	Nylon	19 [0.75]	31,7 [1.25]	Back/Front
	LSZ53S	Nylon	19 [0.75]	6,35 [0.25]	Back/Back
	Rod				
	LSZ54	Hub only	n/a	n/a	n/a
	LSZ54M	Alum, 140 mm [5.5 in]	Ø 3,2 [Ø 0.125]	n/a	n/a
	LSZ54N	Stainless, 330 mm [13 in]	Ø 3,2 [Ø 0.125]	n/a	n/a
	LSZ54P	Plastic rod, 305 mm [12 in]	Ø6,85 [Ø 0.27]	n/a	n/a
	LSZ54W	Plastic rod, 183 mm [7.2 in]	Ø6,85 [Ø 0.27]	n/a	n/a
	Offset – 38,1 [1.5] in radius				
	LSZ55	Rollerless	n/a	n/a	n/a
	LSZ55A	Nylon	19 [0.75]	6,35 [0.25]	Back
	LSZ55C	Nylon	19 [0.75]	6,35 [0.25]	Front
	LSZ55E	Nylon	19 [0.75]	12,7 [0.50]	Front
	LSZ55K	Nylon	38,1 [1.5]	6,35 [0.25]	Front

	Catalog Listing	Material	Roller Dia. mm [in]	Roller Width mm [in]	Roller Mounting
	Short fixed – 1.3 in radius				
	LSZ59A	Nylon	19 [0.75]	6,35 [0.25]	Front
	LSZ59C	Nylon	19 [0.75]	6,35 [0.25]	Back
	One-way roller lever				
	LSZ60A	Nylon	19 [0.75]	6,35 [0.25]	Front
	Flexible loop				
	LSZ61	Ø 4,8 [Ø 0.19] Nylatron	152 mm [6 in] flexible loop		
	LSZ618	Ø 4,8 [Ø 0.19] Nylatron	241 mm [9.5 in] flexible loop		
	LSZ54	Hub only	n/a	n/a	n/a
	Spring rod				
	LSZ68	Delrin rod, 305 mm [12 in]	Ø 6,35 [0.25]	n/a	n/a
	LSZ617	Delrin rod, 406 mm [16 in]	Ø 6,35 [0.25]	n/a	n/a
	LSZ686	Delrin rod, 152 mm [6 in]	Ø 6,35 [0.25]	n/a	n/a
	Rubber roller levers				
	LSZ51Y 38,1 [1.5] radius (standard)	Rubber	50 [2.0]	12,7 [0.5]	front
	LSZ55Y 38,1 [1.5] radius (offset)	Rubber	50 [2.0]	12,7 [0.5]	front
	LSZ52Y 38,1 to 89 [1.5 to 3.5] radius (adjustable)	Rubber	50 [2.0]	12,7 [0.5]	front
	Plastic roller levers				
	LSZ67AA (conveyor)*	Plastic	38,1 [1.5]	96,5 [3.8]	n/a

* May require orientation of switch and lever to enable gravity to help restore switch to free position.

MICRO SWITCH™ Weather-Sealed, Explosion-Proof Switches

DIMENSIONS mm[in]

Figure 1. MICRO SWITCH™ CX - side rotary standard housing

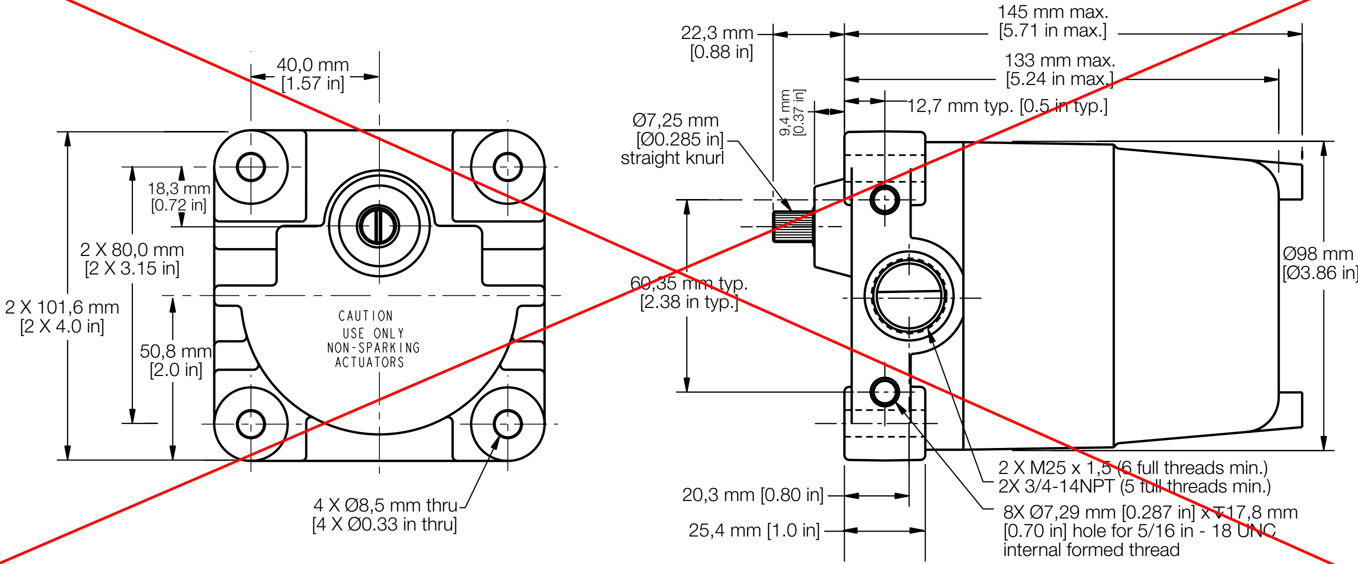


Figure 2. MICRO SWITCH™ CX - side rotary short housing

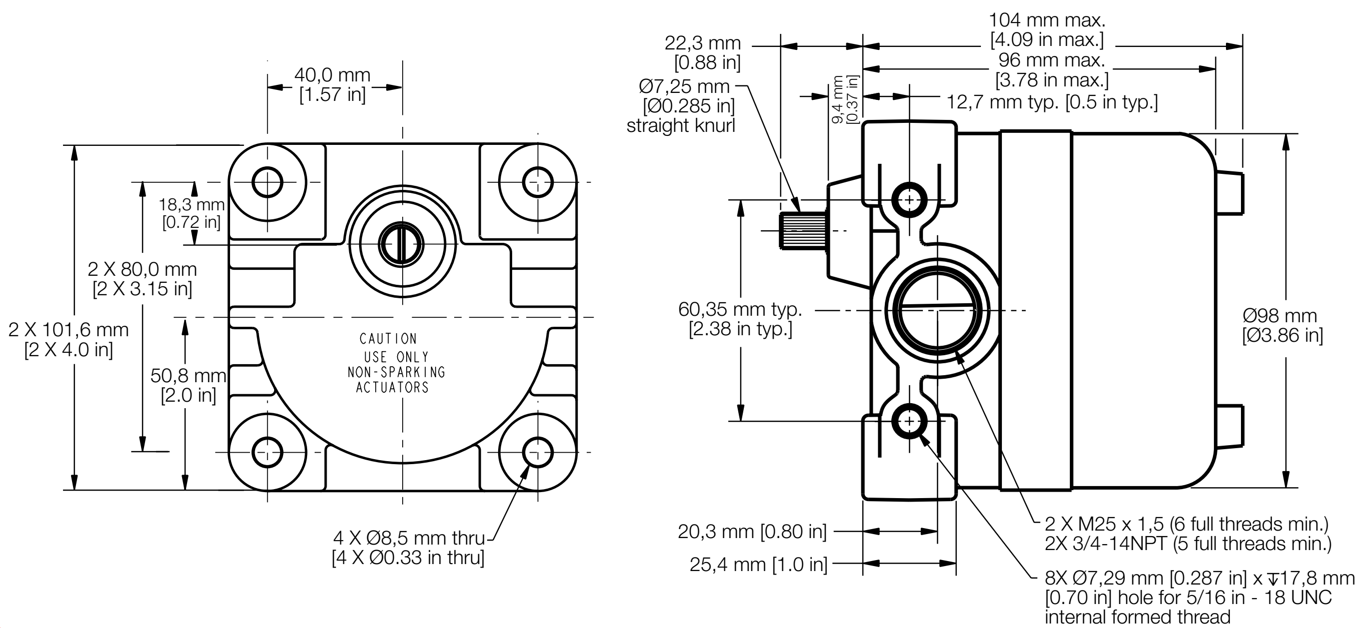
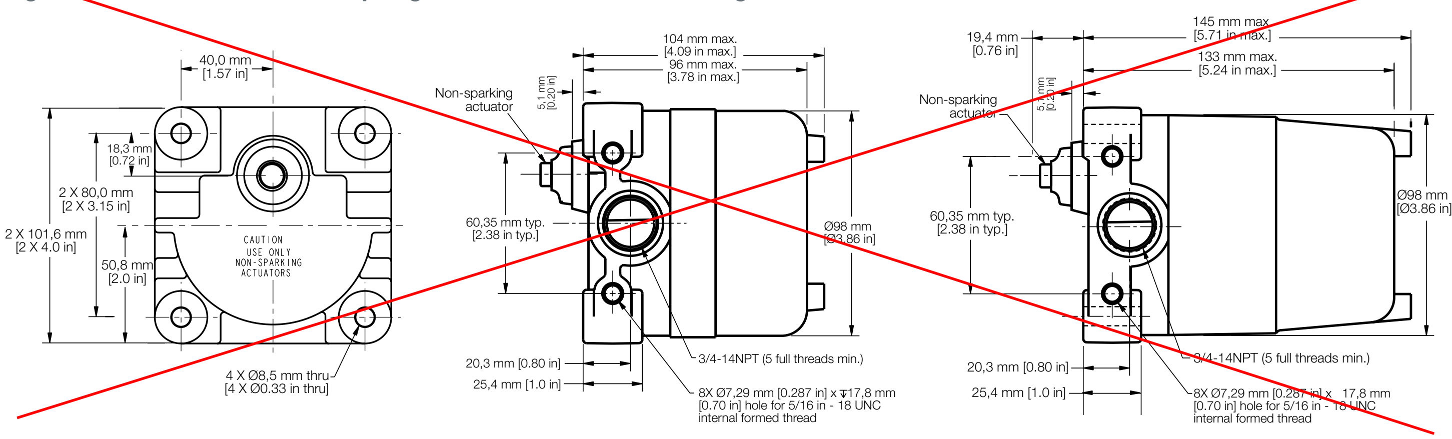


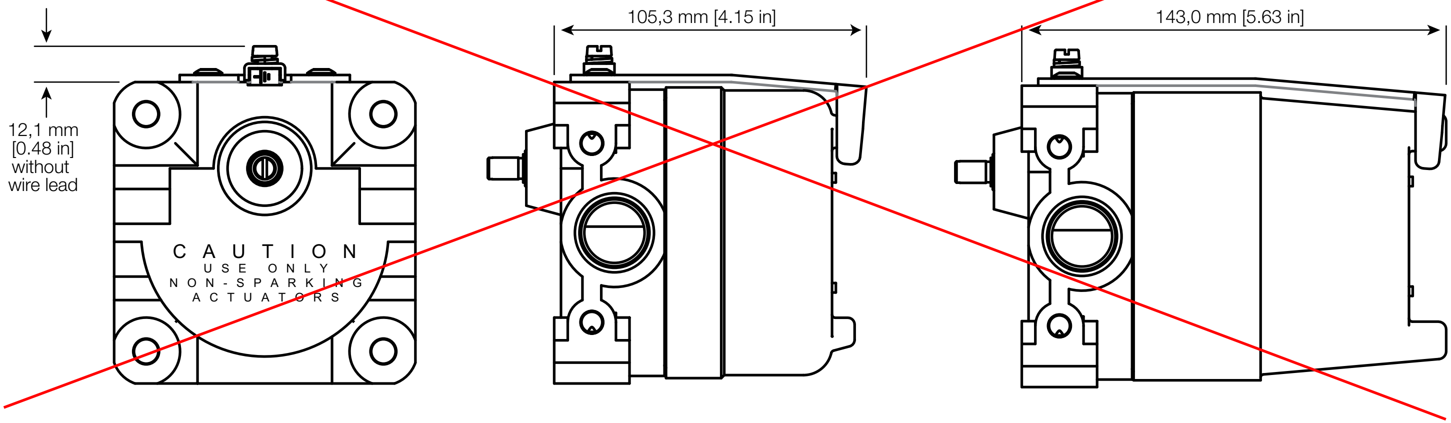
Figure 3. MICRO SWITCH™ CX - plunger standard and short housing



ATEX COVER CLAMP ASSEMBLY

FOR EUROPEAN COMPLIANCE

To specify a CX switch with ATEX, IEC Ex, or INMETRO certifications, add the letter “E” to the end of the catalog listing: 11CX2**E**.



This Honeywell datasheet supports the following MICRO SWITCH™ CX Series Hazardous Location Switch Listings

1172CX12	12CX106	16CX12B-D01	21CX14-D01	281CX12E	81CX4
1172CX2	12CX12	16CX12C	21CX14E	281CX12HM	82CX2
11CX1	12CX12-D01	16CX1C	21CX16	281CX12HM-D01	82CX2A
11CX11B-D01	12CX15	16CX1E	21CX16E	281CX12HM-D01E	84CX12
11CX12	12CX15-D01	16CX2	21CX4	281CX12HME	84CX2
11CX12C	12CX2	16CX200	21CX4C	281CX2	86CX2
11CX12-D01	12CX200	16CX2C	21CX4E	281CX2HM	9172CX4
11CX12E	12CX200E	16CX2E	21CX4HM	284CX106	91CX2
11CX12HM	12CX200ME	16CX5C	21CX6	284CX12	91CX4
11CX12HM-D01	12CX2A	18CX0	22CX4	284CX2	92CX2
11CX12HM-D01E	12CX2AE	18CX0HM	24CX12	286CX2E	92CX200
11CX15-D01	12CX2E	18CX10	24CX12HM-D01	3172CX2	92CX5
11CX1B-D01	12CX5	18CX106	24CX2	31CX1	94CX2
11CX1C	12CX5A	18CX10E	24CX200	31CX1E	96CX1
11CX1E	12CX5A-2A	18CX10HM	24CX2A-2A	36CX1	
11CX2	12CX5E	18CX10HM-D01	24CX2E	36CX1E	
11CX212	14CX1	18CX10HM-D01E	24CX5A	41CX4	
11CX2B	14CX11	2172CX14C	26CX14	61CX11-D01	
11CX2-D01E	14CX1E	21CX12	26CX16	61CX12-D01	
11CX2E	15PA148-CX	21CX12F	26CX4	64CX12-D01	
11CX2HM	15PA261-CX	21CX12F-D01	26CX4C	74CX2	
11CX5C	15PA500-CX	21CX13	27CX100	8172CX2	
11CX5CE	16CX1	21CX14	27CX100E	81CX14	
12CX1	16CX12	21CX14C	281CX12	81CX2	

ADDITIONAL INFORMATION

The following associated literature is available on the Honeywell web site at sensing.honeywell.com:

- Product installation instructions
- Product range guide
- Product nomenclature tree
- MICRO SWITCH™ Hazardous Area Switches Brochure
- Product application-specific information
  - Limit and enclosed switch reference standards
  - Application Note: Sensors and switches for industrial manual process valves
  - Application Note: Sensors and switches in oil rig applications
  - Application Note: Sensors and switches n valve actuators and valve positioners
  - Application Note: Sensors and switches in valves and flow meters

⚠WARNING
PERSONAL INJURY

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

⚠WARNING
MISUSE OF DOCUMENTATION

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell website, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

Find out more

Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office.

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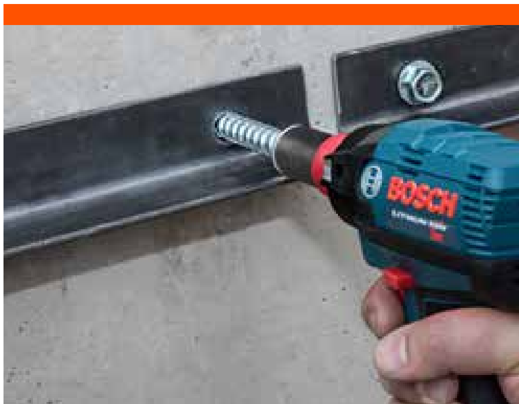
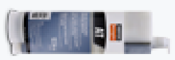
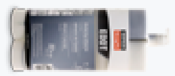
The innovative products featured in this catalog are the result of more than 40 years of research and development, and have passed the rigorous quality-assurance testing you have come to expect from Simpson Strong-Tie. With our expanding lines of high-performance anchoring products, engineering and field support, product testing and training, we are committed to giving you the power to build.



Anchor Product Selection Guide

Product			Page No.	Tested Base Materials and Code Listings							Other Listings
				Concrete		Concrete on Metal Deck	CMU		Unreinforced Clay Brick Masonry	Other	
				Cracked	Uncracked		Grout-Filled	Hollow			
Adhesive Anchors	AT-XP®		20	ER-263, RR25960, FL-16230.1		—	ER-281, RR25966, FL-16230.1	—	—	—	NSF/ANSI Std 61, DOT
Adhesive Anchors	SET-XP®		38	ESR-2508, RR25744, FL-17449.2		—	ER-265, RR25965, FL-16230.3	ER-265	—	—	NSF/ANSI Std 61, DOT
Adhesive Anchors	ET-HP®		62	ESR-3372, FL-17449.1		—	ER-241 FL-16230.2	—	ESR-3638, RR25120	—	DOT
Adhesive Anchors	AT		86	—	Non-IBC	—	Non-IBC	Non-IBC	ESR-1958	—	DOT
Adhesive Anchors	SET		102	—	Non-IBC	—	Non-IBC	Non-IBC	ESR-1772, FL-15730.5	—	NSF/ANSI Std 61, DOT
Adhesive Anchors	EDOT		122	—	Non-IBC	—	—	—	—	—	DOT
Mechanical Anchors	Torq-Cut™		138	ESR-2705, RR25946, FL-15731.3		—	—	—	—	—	—
Mechanical Anchors	Strong-Bolt® 2		144	ESR-3037, RR25891, FL-15731.2		ESR-3037 RR25891 FL-15731.2	ER-240, RR25936 FL-16230.4	—	—	—	UL, FM, DOT
Mechanical Anchors	Wedge-All®		164	—	Non-IBC	Non-IBC	ESR-1396, FL-15730.7	—	—	—	UL, FM, DOT
Mechanical Anchors	Easy-Set		179	—	Non-IBC	—	—	—	—	—	—
Mechanical Anchors	Sleeve-All®		180	—	Non-IBC	—	Non-IBC	—	—	—	UL, FM, DOT
Mechanical Anchors	Titen HD®		184	ESR-2713, RR25741, FL-15730.6			ESR-1056, RR25560, FL-15730.6	IBC	—	—	FM, DOT
Mechanical Anchors	Titen®		203	—	FL-2355.1	—	FL-2355.1		—	—	—
Mechanical Anchors	Titen HD® Rod Hanger		208	ESR-2713, RR25741, FL-15730.6		ESR-2713 RR25741	—	—	—	—	FM
Mechanical Anchors	NEW Wood Rod Hanger		212	—	—	—	—	—	—	IBC (Wood)	UL, FM

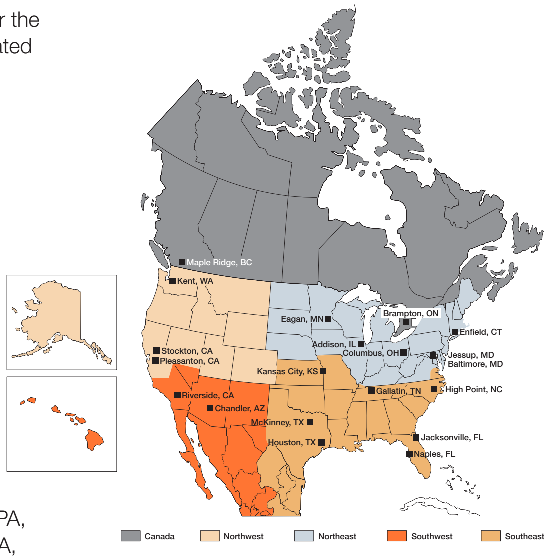
Simpson Strong-Tie Company Inc.

For nearly 60 years, Simpson Strong-Tie has focused on creating structural products that help people build safer and stronger homes and buildings. A leader in structural systems research and technology, Simpson Strong-Tie is one of the largest suppliers of structural building products in the world. The Simpson Strong-Tie commitment to product development, engineering, testing and training is evident in the consistent quality and delivery of its products and services.

For more information, visit the company's website at **www.strongtie.com**.

The Simpson Strong-Tie Company Inc. "No Equal" pledge includes:

- Quality products value-engineered for the lowest installed cost at the highest-rated performance levels
- Most thoroughly tested and evaluated products in the industry
- Strategically located manufacturing and warehouse facilities
- National code agency listings
- Largest number of patented connectors in the industry
- Global locations with an international sales team
- In-house R&D and tool and die professionals
- In-house product testing and quality control engineers
- Support of industry groups including AISI, AITC, ASTM, ASCE, AWC, AWPA, ACI, AISC, CSI, CFSEI, ICFA, NBMDA, NLBMDA, SDI, SETMA, SFA, SFIA, STAFDA, SREA, NFBA, TPI, WDSC, WIJMA, WTCA and local engineering groups.



Product Identification Key

Products and additional informationare divided into eight general categories, identified by tabs along the page's outer edge.

The Simpson Strong-Tie Quality Policy

We help people build safer structures economically. We do this by designing, engineering and manufacturing "No Equal" structural connectors and other related products that meet or exceed our customers' needs and expectations. Everyone is responsible for product quality and is committed to ensuring the effectiveness of the Quality Management System.

Karen Colonias
Chief Executive Officer

Getting Fast Technical Support

When you call for engineering technical support, we can help you quickly if you have the following information at hand. This will help us to serve you promptly and efficiently.

- Which Simpson Strong-Tie catalog are you using? (See the front cover for the form number.)
- Which Simpson Strong-Tie product are you using?
- What are the design requirements (i.e., loads, anchor diameter, base material, edge/spacing distance, etc.)?

We Are ISO 9001-2008 Registered

Simpson Strong-Tie is an ISO 9001-2008 registered company. ISO 9001-2008 is an internationally recognized quality assurance system that lets our domestic and international customers know they can count on the consistent quality of Simpson Strong-Tie® products and services.

nqa.
ISO 9001
Registered

800-999-5099 | www.strongtie.com

Using Data Tables and Load Tables

This catalog contains both strength design data tables and allowable load tables. Some allowable load tables for concrete were established under old qualification standards that are no longer valid under the IBC. The following icons indicate whether or not a given table is intended to be used under the IBC (or under other building codes that use the IBC as their basis):

IBC — Valid for International Building Code

IBC — Not Valid for International Building Code

Tables that are "not valid for International Building Code" may be used where the designer determines that other building codes or regulations permit it — for example, under AASTHO or temporary construction.

Strength Design Data Tables

Under the IBC, strength design (see page 322) must be used for cast-in-place and post-installed mechanical and adhesive anchors that are installed into concrete. The design data from these tables are to be used with the design provisions of ACI 318 Appendix D, IBC Chapter 19 and the respective ICC-ES Acceptance Criteria. Strength design data tables are watermarked with the letters "SD." Given the complexity of strength design calculations, designers may find Simpson Strong-Tie® Anchor Designer™ software (www.strongtie.com/software) to be a great time saver for computing anchor design strengths using the tabulated design data.

SET-XP® Tension Strength Design Data for Threaded Rod in Normal-Weight Concrete[1]

IBC

Characteristic			Symbol	Units	Nominal Anchor Diameter (in.)						
					⅜	½	⅝	¾	⅞	1	1¼
Steel Strength in Tension											
Threaded Rod	Minimum Tensile Stress Area		A_{se}	in²	0.078	0.142	0.226	0.334	0.462	0.606	0.969
	Tension Resistance of Steel — ASTM F1554, Grade 36		N_{sa}	lb.	4,525	8,235	13,110	19,370	26,795	35,150	56,200
	Tension Resistance of Steel — ASTM A193, Grade B7				9,750	17,750	28,250	41,750	57,750	75,750	121,125
	Tension Resistance of Steel — Type 410 Stainless (ASTM A193, Grade B6)				8,580	15,620	24,860	36,740	50,820	66,660	106,590
	Tension Resistance of Steel — Type 304 and 316 Stainless (ASTM A193, Grade B8 & B8M)				4,445	8,095	12,880	19,040	26,335	34,540	55,235
	Strength Reduction Factor — Steel Failure		ϕ	—	0.75[7]						
Concrete Breakout Strength in Tension (2,500 psi ≤ f'_c ≤ 8,000 psi)[12]											
Effectiveness Factor — Uncracked Concrete			k_{uncr}	—	24						
Effectiveness Factor — Cracked Concrete			k_{cr}	—	17						
Strength Reduction Factor — Breakout Failure			ϕ	—	0.65[8]						
Bond Strength in Tension (2,500 psi ≤ f'_c ≤ 8,000 psi)[12]											
Uncracked Concrete[2,3,4]	Characteristic Bond Strength[5,13]		$\tau_{k,uncr}$	psi	770	1,150	1,060	970	885	790	620
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	2⅜	2¾	3⅛	3½	3½	4	5
		Maximum			7½	10	12½	15	17½	20	25
Cracked Concrete[2,3,4]	Characteristic Bond Strength[5,10,11,14]		$\tau_{k,cr}$	psi	595	510	435	385	355	345	345
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	3	4	5	6	7	8	10
		Maximum			7½	10	12½	15	17½	20	25

Example Strength Design Data Table

Allowable Load Tables

Under the IBC, allowable stress design (see page 322) maybe used for cast-in-place and post-installed adhesive and mechanical anchors installed into masonry or for gas/powder-actuated fasteners installed into concrete, masonry or steel.

SET-XP® Allowable Tension and Shear Values for Threaded Rod and Rebar in the Top of Fully Grouted CMU Wall Construction[1,2,4,5,6,7,9,10,11,12]

IBC

Diameter (in.) or Rebar Size No.	Drill Bit Diameter (in.)	Minimum Embedment[3] (in.)	Allowable Load Based on Bond Strength[7] (lb.)		
			Tension Load	Shear Perp.	Shear Parallel
Threaded Rod Installed in the Top of CMU Wall					
⅜	½	4½	1,485	590	1,050
		12	2,440	665	1,625
½	⅝	5⅝	1,700	565	1,435
		15	2,960	660	1,785
⅝	¾	6½	1,610	735	1,370
		21	4,760	670	1,375
Rebar Installed in the Top of CMU Wall					
#4	⅝	4½	1,265	560	865
		12	2,715	465	1,290
#5	¾	5⅝	1,245	590	1,140
		15	3,090	590	1,235

1. Allowable load shall be the lesser of the bond values shown in this table and steel values, shown on page XX.
2. Allowable loads are for installation in the grouted CMU core opening.
3. Embedment depth shall be measured from the horizontal surface of the grouted CMU core opening on top of the masonry wall.

Example Allowable Load Table

Important Information and General Notes

Under the IBC, allowable stress design may only be used for cast-in-place and post-installed mechanical and adhesive anchors installed into concrete if the allowable loads are converted from strength design calculations. Converted allowable loads are very specific to the design assumptions described in the tables.

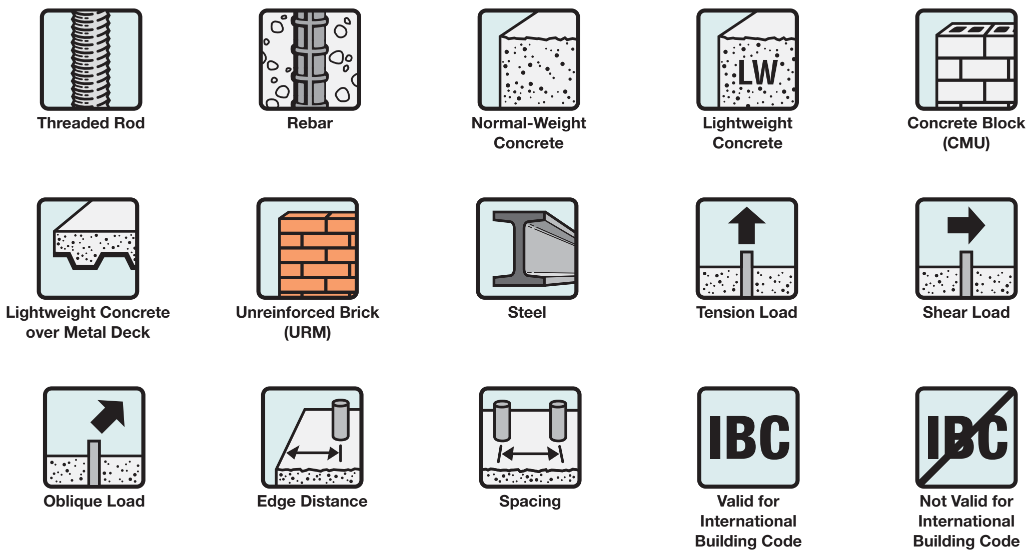
SET-XP® Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (f'_c = 2,500 psi) — Static Load

Rod Dia. (in.)	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)			
						Edge distances = c_{ac} on all sides		Edge Distances = 1¾" on one side and C_{ac} on three sides	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked
⅜	2⅜	4⅜ 5⅜	3⅝ 3⅝	—	—	845	—	480 570	—
	3	4⅜ 7¼	5 4⅝	4⅜	3⅛	1,070	820	455 630	555
	4½	6⅜ 10⅛	8⅛ 6⅜	6⅜	3⅝	1,605	1,230	420 630	830
	6	7⅞ 14⅛	11⅛ 9	7⅞	4⅜	2,140	1,645	405 630	1,110
	7½	9⅜ 18	14⅛ 11¼	9⅜	5⅛	2,675	2,055	400 630	1,390
½	2¾	5¾ 6⅝	5⅛ 5⅛	—	—	1,950	—	1,050 1,050	—
	4	6½ 9⅝	7⅜ 6	6½	5⅛	2,840	1,255	1,000 1,380	675
	6	8½ 14¼	12⅜ 9	8½	5⅛	4,255	1,880	930 1,380	1,015
	8	10½ 19¼	17½ 12	10½	5⅛	5,680	2,505	900 1,380	1,350
	10	12½ 24	22¼ 15	12½	6⅛	7,095	3,135	880 1,380	1,690
⅝	3⅛	6⅝ 7½	6⅛ 6⅛	—	—	2,555	—	1,290 1,290	—
	5	8⅛ 12	9⅜ 7½	8⅛	6⅛	4,095	1,670	1,340 1,850	840
	7½	10⅝ 18	15⅝ 11¼	10⅝	6⅛	6,140	2,500	1,245 1,850	1,260
	12½	15⅝ 30	26⅝ 18¾	15⅝	7⅛	10,230	4,165	1,180 1,850	2,105
¾	3½	7¼ 8½	7⅛ 7⅛	—	—	3,130	—	1,515 1,515	—
	6	9¾ 14⅜	11 9	9¾	7⅛	5,370	2,145	1,670 2,305	1,035
	9	12¾ 21⅜	17⅜ 13½	12¾	7⅛	8,055	3,215	1,555 2,305	1,555

Example Converted Allowable Load Table

Table Icon System

In order to facilitate easier identification of performance data, the following icon system has been incorporated into the sections of the catalog with multiple load tables. These icons will appear in the heading of the table to promote easier visual identification of the type of load, insert type and substrate addressed in the table. Icons are intended for quick identification. All specific information regarding suitability should be read from the table itself.



Important Information and General Notes

General Notes

These general notes are provided to ensure proper installation of Simpson Strong-Tie Company Inc. products and must be followed fully.

a. Simpson Strong-Tie Company Inc. reserves the right to change specifications, designs, and models without notice or liability for such changes.

b. Unless otherwise noted, dimensions are in inches and loads are in pounds.

c. Do not overload, which will jeopardize the anchorage. Service loads shall not exceed published allowable loads. Factored loads shall not exceed design strengths calculated in accordance with published design data.

d. Some hardened fasteners may experience premature failure if exposed to moisture. These fasteners are recommended to be used in dry interior applications.

e. Do not weld products listed in this catalog. Some steel types have poor weldability and a tendency to crack when welded.

General Instructions for the Installer

These general instructions for the installer are provided to ensure the proper selection and installation of Simpson Strong-Tie products and must be followed carefully. They are in addition to the specific design and installation instructions and notes provided for each particular product, all of which should be consulted prior to and during the installation of Simpson Strong-Tie products.

a. Do not modify Simpson Strong-Tie products as the performance of modified products may be substantially weakened. Simpson Strong-Tie will not warrant or guarantee the performance of such modified products.

b. Do not alter installation procedures from those set forth in this catalog.

c. Drill holes for post-installed anchors with carbide-tipped drills meeting the diameter requirements of ANSI B212.15 (shown in the table to the right). A properly sized hole is critical to the performance of post-installed anchors. Rotary-hammered drills with light, high-frequency impact are recommended for drilling holes. When holes are to be drilled in archaic or hollow base materials, the drill should be set to “rotation only” mode.

d. For mechanical anchors requiring specific installation torque: Failure to apply the recommended installation torque can result in excessive displacement of the anchor under load or premature failure of the anchor. These anchors will lose pre-tension after setting due to pre-load relaxation. See page 316 for more information.

e. Do not disturb, bolt up, or apply load to adhesive anchors prior to the full cure of the adhesive.

f. Use proper safety equipment.

Finished Diameters for Rotary and Rotary-Hammer Carbide-Tipped Concrete Drills per ANSI B212.15

Nominal Drill Bit Diameter (in.)	Tolerance Range Minimum (in.)	Tolerance Range Maximum (in.)
1/8	0.134	0.140
5/32	0.165	0.171
3/16	0.198	0.206
7/32	0.229	0.237
1/4	0.260	0.268
5/16	0.327	0.335
3/8	0.390	0.398
7/16	0.458	0.468
1/2	0.520	0.530
9/16	0.582	0.592
5/8	0.650	0.660
11/16	0.713	0.723
3/4	0.775	0.787
13/16	0.837	0.849
27/32	0.869	0.881
7/8	0.905	0.917
15/16	0.968	0.980
1	1.030	1.042
1 1/8	1.160	1.175
1 3/16	1.223	1.238
1 1/4	1.285	1.300
1 5/16	1.352	1.367
1 3/8	1.410	1.425
1 7/16	1.472	1.487
1 1/2	1.535	1.550
1 9/16	1.588	1.608
1 5/8	1.655	1.675
1 3/4	1.772	1.792
2	2.008	2.028

Additional Instructions for the Installer for Gas- and Powder-Actuated Fastening

Before operating any Simpson Strong-Tie gas- or powder-actuated tool, you must read and understand the Operator's Manual and be trained by an authorized instructor in the operation of the tool. Simpson Strong-Tie recommends you read and fully understand the safety guidelines of the tool you use. To become a Certified Operator of Simpson Strong-Tie gas- and powder-actuated tools, you must pass a test and receive a certified operator card. Test and Operator's Manual are included with each tool kit. Extra copies may be obtained by contacting Simpson Strong-Tie at (800) 999-5099.

To avoid serious injury or death:

a. Always make sure that the operators and bystanders wear safety glasses. Hearing and head protection is also recommended.

b. Always post warning signs within the area when gas- or powder-actuated tools are in use. Signs should state "Tool in Use."

c. Always store gas- and powder-actuated tools unloaded. Store tools and powder loads in a locked container out of reach of children.

d. Never place any part of your body over the front muzzle of the tool, even if no fastener is present. The fastener, pin or tool piston can cause serious injury or death in the event of accidental discharge.

e. Never attempt to bypass or circumvent any of the safety features on a gas- or powder-actuated tool.

f. Always keep the tool pointed in a safe direction.

g. Always keep your finger off the trigger.

h. Always keep the tool unloaded until ready to use.

i. Always hold the tool perpendicular (90°) to the fastening surface to prevent ricocheting fasteners. Use the spall guard whenever possible.

j. Never attempt to fasten into soft, thin, brittle or very hard materials such as drywall, light-gauge steel, glass, tile or cast iron as these materials are inappropriate. Conduct a pre-punch test to determine base material adequacy.

k. Never attempt to fasten into soft material such as drywall or wood. Fastening through soft materials into appropriate base material may be allowed if the application is appropriate.

l. Never attempt to fasten to a spalled, cracked or uneven surface.

SIMPSON Strong-Tie®

General Instructions for the Designer

These general instructions for the designer are provided to ensure the proper selection and installation of Simpson Strong-Tie® products and must be followed carefully. They are in addition to the specific design and installation instructions and notes provided for each particular product, all of which should be consulted prior to and during the design process.

a. The term "Designer" used throughout this catalog is intended to mean a licensed/certified building design professional, a licensed professional engineer or a licensed architect.

b. All connected members and related elements shall be designed by the Designer and must have sufficient strength (bending, shear, etc.) to resist the loads imposed by the anchors.

c. When the allowable allowable stress design method is used, the design service load shall not exceed the published allowable loads reduced by load-adjustment factors for temperature, spacing and edge distance. Where stated in this catalog, allowable loads may be increased 33⅓% when permitted by code. In general, this is permissible only when the alternative basic load combinations of the IBC are used.

d. When the strength design method is used, the factored loads shall not exceed the design strengths calculated in accordance with the published design data.

e. Simpson Strong-Tie strongly recommends the following addition to construction drawings and specifications: "Simpson Strong-Tie products are specifically required to meet the structural calculations of plan. Before substituting another brand, confirm load capacity based on reliable published testing data or calculations. The Engineer/Designer should evaluate and give written approval for substitution prior to installation."

f. Where used in this catalog, "IBC" refers to the 2012 International Building Code, and "ACI 318" refers to ACI 318-11 Building Code Requirements for Structural Concrete. Local and/or regional building codes may require meeting special conditions. Building codes often require special inspection of anchors. For compliance with these requirements, contact the local building authority. Except where mandated by code, Simpson Strong-Tie products do not require special inspection.

g. Allowable loads and design strengths are determined from test results, calculations and experience. These are guide values for sound base materials with known properties. Due to variation in base materials and site conditions, site-specific testing should be conducted if exact performance in a specific base material at a specific site must be known.

h. Unless stated otherwise, tests conducted to derive performance information were performed in members with minimum thickness equal to 1.5 times the anchor embedment depth. Anchoring into thinner members requires the evaluation and judgment of a qualified Designer.

i. Tests are conducted with anchors installed perpendicular (±6° from a vertical reference) from a vertical reference to the surface of the base material. Deviations can result in anchor bending stresses and reduce the load-carrying capacity of the anchor.

j. Allowable loads and design strengths do not consider bending stresses due to shear loads applied with large eccentricities.

k. Metal anchors and fasteners will corrode and may lose load-carrying capacity when installed in corrosive environments or exposed to corrosive materials. See page 316.

l. Mechanical anchors should not be installed into concrete that is less than 7 days old. The allowable loads and design strengths of mechanical anchors that are installed into concrete less than 28 days old should be based on the actual compressive strength of the concrete at the time of installation.

m. Nominal embedment depth ("embedment depth") is the distance from the surface of the base material to the installed end of the anchor and is measured prior to application of an installation torque (if applicable). Effective embedment depth is the distance from the surface of the base material to the deepest point at which the load is transferred to the base material.

n. Drill bits shall meet the diameter requirements of ANSI B212.15. For adhesive anchor installations in oversized holes, see page 318. For adhesive anchor installations into core-drilled holes, see page 319.

o. Threaded-rod inserts for adhesive anchors shall be oil-free UNC fully threaded steel. Bare steel, zinc plating, mechanical galvanizing or hot-dip galvanizing coatings are acceptable.

p. Allowable loads and design strengths are generally based on testing of adhesive anchors installed into dry holes. For installations into damp, wet and submerged environments, see page 319.

ACI 318 states that adhesive anchors should not be installed into concrete that is less than 21 days old. For information on adhesive anchors installed into concrete less than 21 days old, see page 318.

q. Adhesive anchors can be affected by elevated base material temperature. See page 319.

r. Anchors are permitted to support fire-resistant construction provided at least one of the following conditions is fulfilled: (a) anchors are used to resist wind or seismic forces only; (b) anchors that support gravity-load-bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards; or (c) anchors are used to support non-structural elements.

s. Exposure to some chemicals may degrade the bond strength of adhesive anchors. Refer to the product description for chemical resistance information or refer to see page 320.

Important Information and General Notes

SIMPSON Strong-Tie®

Limited Warranty

Simpson Strong-Tie Company Inc. warrants catalog products to be free from defects in material or manufacturing. Simpson Strong-Tie Company Inc. products are further warranted for adequacy of design when used in accordance with design limits in this catalog and when properly specified, installed and maintained. This warranty does not apply to uses not in compliance with specific applications and installations set forth in this catalog, or to non-catalog or modified products, or to deterioration due to environmental conditions.

Simpson Strong-Tie® anchors, fasteners and connectors are designed to enable structures to resist the movement, stress and loading that results from impact events such as earthquakes and high-velocity winds. Other Simpson Strong-Tie products are designed to the load capacities and uses listed in this catalog. Properly installed Simpson Strong-Tie products will perform in accordance with the specifications set forth in the applicable Simpson Strong-Tie catalog. Additional performance limitations for specific products may be listed on the applicable catalog pages.

Due to the particular characteristics of potential impact events, the specific design and location of the structure, the building materials used, the quality of construction, and the condition of the soils involved, damage may nonetheless result to a structure and its contents even if the loads resulting from the impact event do not exceed Simpson Strong-Tie catalog specifications and Simpson Strong-Tie connectors are properly installed in accordance with applicable building codes.

All warranty obligations of Simpson Strong-Tie Company Inc. shall be limited, at the discretion of Simpson Strong-Tie Company Inc., to repair or replacement of the defective part. These remedies shall constitute the sole obligation of Simpson Strong-Tie Company Inc. and the sole remedy of purchaser under this warranty. In no event will Simpson Strong-Tie Company Inc. be responsible for incidental, consequential, or special loss or damage, however caused.

This warranty is expressly in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose, all such other warranties being hereby expressly excluded. This warranty may change periodically – consult our website **www.strongtie.com** for current information.

Terms and Conditions of Sale

Product Use

Products in this catalog are designed and manufactured for the specific purposes shown, and should not be used with other connectors not approved by a qualified Designer. Modifications to products or changes in installations should only be made by a qualified Designer. The performance of such modified products or altered installations is the sole responsibility of the Designer.

Indemnity

Customers or Designers modifying products or installations, or designing non-catalog products for fabrication by Simpson Strong-Tie Company Inc. shall, regardless of specific instructions to the user, indemnify, defend and hold harmless Simpson Strong-Tie Company Inc. for any and all claimed loss or damage occasioned in whole or in part by non-catalog or modified products.

Non-Catalog And Modified Products

Consult Simpson Strong-Tie Company Inc. for applications for which there is no catalog product, or for connectors for use in hostile environments, with excessive wood shrinkage, or with abnormal loading or erection requirements.

Non-catalog products must be designed by the customer and will be fabricated by Simpson Strong-Tie in accordance with customer specifications.

Simpson Strong-Tie cannot and does not make any representations regarding the suitability of use or load-carrying capacities of non-catalog products. Simpson Strong-Tie provides no warranty, express or implied, on non-catalog products. F.O.B. Shipping Point unless otherwise specified.

Important Information and General Notes

SIMPSON Strong-Tie®

Warning

Simpson Strong-Tie Company Inc. anchors, fasteners and connectors are designed and tested to provide specified design loads. To obtain optimal performance from Simpson Strong-Tie products and to achieve maximum allowable design load, the products must be properly installed and used in accordance with the installation instructions and design limits provided by Simpson Strong-Tie. To ensure proper installation and use, designers and installers must carefully read the General Notes, General Instructions to the Installer and General Instructions to the Designer contained in this catalog, as well as consult the applicable catalog pages for specific product installation instructions and notes. Please always consult the Simpson Strong-Tie website at strongtie.com for updates regarding all Simpson Strong-Tie products.

Proper product installation requires careful attention to all notes and instructions, including the following basic rules:

1. Be familiar with the application and correct use of the anchor, connector or fastener.
2. Follow all installation instructions provided in the catalog, website, *Installer's Pocket Guide* or any other Simpson Strong-Tie publication.
3. Follow all product-related warnings provided in the catalog, website or any other Simpson Strong-Tie publication.
4. Install anchors, connectors and fasteners in accordance with their intended use.
5. Install all anchors, connectors and fasteners per installation instructions provided by Simpson Strong-Tie.
6. When using power tools to install fasteners: (a) use proper fastener type for direct fastening tool; (b) use proper powder or gas loads; and (c) follow appropriate safety precautions as outlined in this catalog, on the website or in the tool Operator's Manual.

In addition to following the basic rules provided above as well as all notes, warnings and instructions provided in the catalog, installers, designers, engineers and consumers should consult the Simpson Strong-Tie website at www.strongtie.com to obtain additional design and installation information, including:

- Instructional builder/contractor training kits containing an instructional video, an instructor guide and a student guide in both English and Spanish;
- *Installer's Pocket Guide* (form S-INSTALL; contact Simpson Strong-Tie for more information), which is designed specifically for installers and uses detailed graphics and minimal text in both English and Spanish to explain visually how to install many key products;
- Information on workshops Simpson Strong-Tie conducts at various training centers throughout the United States;
- Product-specific installation videos;
- Specialty catalogs;
- Code reports – Simpson Strong-Tie® Code Report Finder software;
- Technical fliers, bulletins and engineering letters;
- Master format specifications;
- Material safety data sheets;
- Corrosion information;
- Adhesive cartridge estimator;
- Simpson Strong-Tie Anchor Designer™ software;
- Simpson Strong-Tie AutoCAD® menu;
- Simpson Strong-Tie CFS Designer™ software;
- Simpson Strong-Tie Connector Selector™ software;
- Connector selection guides for engineered wood products (by manufacturer);
- Simpson Strong-Tie Strong-Wall® Selector software;
- Simpson Strong-Tie Strong Frame® Selector;
- Simpson Strong-Tie Fastener Finder; and
- Answers to frequently asked questions and technical topics.

Failure to fully follow all of the notes and instructions provided by Simpson Strong-Tie may result in improper installation of products. Improperly installed products may not perform to the specifications set forth in this catalog and may reduce a structure's ability to resist the movement, stress and loading that occur from gravity loads as well as impact events such as earthquakes and high-velocity winds.

Simpson Strong-Tie Company Inc. does not guarantee the performance or safety of products that are modified, improperly installed or not used in accordance with the design and load limits set forth in this catalog.

SET-XP® High-Strength Epoxy Adhesive

SET-XP® epoxy anchoring adhesive is a high-strength formula for anchoring and doweling in cracked and uncracked concrete and masonry applications. It is a two-part system with the resin and hardener being simultaneously dispensed and mixed through the mixing nozzle. When properly mixed, adhesive will be a uniform teal color for easy post-installation identification.

Features

- 1:1 two-component, high-solids, epoxy-based anchoring adhesive formula
- Passed the demanding ICC-ES AC308 adverse-condition tests pertaining to elevated temperatures and long-term sustained loads
- Code listed under the IBC/IRC for cracked and uncracked concrete per ICC-ES ESR-2508
- Code listed under the IBC/IRC for masonry per IAPMO UES ER-265
- Suitable for use under static and seismic loading conditions in cracked and uncracked concrete and masonry
- Cure times: 24 hours at 70°F, 72 hours at 50°F
- Easy hole-cleaning – no power-brushing required
- Suitable for use in dry or water-saturated concrete
- For best results, store between 45°F and 90°F
- Available in 8.5 oz., 22 oz. and 56 oz. cartridges for application versatility
- Manufactured in the USA using global materials

SET-XP® Adhesive

Applications

- Threaded rod anchoring and rebar doweling into concrete and masonry
- Suitable for horizontal, vertical and overhead applications
- Multiple DOT listings – refer to **www.strongtie.com/DOT** for current approvals

Codes: ICC-ES ESR-2508 (concrete); IAPMO UES ER-265 (masonry); City of L.A. RR25744 (concrete), RR25965 (masonry); Florida FL-17449.2 (concrete), FL-16230.3 (masonry); AASHTO M-235 and ASTM C881 (Type I and IV, Grade 3, Class C); NSF/ANSI Standard 61 (216 in.²/1,000 gal.)

Chemical Resistance

See pages 320–321.

Installation and Application Instructions

(See also pages 124–127.)

- Surfaces to receive epoxy must be clean.
- Base material temperature must be 50°F or above at the time of installation. For best results, material should be between 70°F and 80°F at time of application.
- To warm cold material, store cartridges in a warm, uniformly heated area or storage container. Do not immerse cartridges in water to facilitate warming.
- Mixed material in nozzle can harden in 30 minutes at temperatures of 70°F and above.

Design Example

See page 328.

Suggested Specifications

See **www.strongtie.com** for more information.

SET-XP® High-Strength Epoxy Adhesive

Test Criteria

Anchors installed with SET-XP® adhesive have been tested in accordance with ICC-ES *Acceptance Criteria for Post-Installed Adhesive Anchors in Masonry Elements* (AC58) and *Adhesive Anchors in Concrete Elements* (AC308).

Property	Test Method	Result*
Consistency	ASTM C881	Passed, non-sag
Glass transition temperature	ASTM E1356	155°F
Bond strength (moist cure)	ASTM C882	3,742 psi at 2 days
Water absorption	ASTM D570	0.10%
Compressive yield strength	ASTM D695	14,830 psi
Compressive modulus	ASTM D695	644,000 psi
Shore D Durometer	ASTM D2240	84
Gel time	ASTM C881	49 minutes
Volatile Organic Compound (VOC)	—	3 g/L

*Material and curing conditions: 73 ± 2˚F, unless otherwise noted.

SET-XP® Cartridge System

Model No.	Capacity (ounces)	Cartridge Type	Carton Quantity	Dispensing Tool(s)	Mixing Nozzle
SET-XP10[4]	8.5	Single	12	CDT10S	EMN22i
SET-XP22-N[5]	22	Side-by-Side	10	EDT22S, EDTA22P, EDTA22CKT	
SET-XP56	56	Side-by-Side	6	EDTA56P	

1. Cartridge estimation guidelines are available at www.strongtie.com/apps.
2. Detailed information on dispensing tools, mixing nozzles and other adhesive accessories is available on pages 128 through 135, or at www.strongtie.com.
3. Use only Simpson Strong-Tie® mixing nozzles in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair SET-XP adhesive performance.
4. Two EMN22i mixing nozzles and two nozzle extensions are supplied with each cartridge.
5. One EMN22i mixing nozzle and one nozzle extension are provided with each cartridge.

Cure Schedule

Base Material Temperature		Cure Time (hrs.)
°F	°C	
50	10	72
60	16	48
70	21	24
90	32	24
110	43	24

For water-saturated concrete, the cure times must be doubled.

SET-XP® Design Information — Concrete

SET-XP® Installation Information and Additional Data for Threaded Rod and Rebar in Normal-Weight Concrete[1]

Characteristic		Symbol	Units	Nominal Anchor Diameter (in.) / Rebar Size						
				⅜ / #3	½ / #4	⅝ / #5	¾ / #6	⅞ / #7	1 / #8	1¼ / #10
Installation Information										
Drill Bit Diameter		d_{hole}	in.	½	⅝	¾	⅞	1	1⅛	1⅜
Maximum Tightening Torque		T_{inst}	ft.-lb.	10	20	30	45	60	80	125
Permitted Embedment Depth Range	Minimum	h_{ef}	in.	2⅜	2¾	3⅛	3½	3¾	4	5
	Maximum	h_{ef}	in.	7½	10	12½	15	17½	20	25
Minimum Concrete Thickness		h_{min}	in.	$h_{ef} + 5d_o$						
Critical Edge Distance[2]		c_{ac}	in.	See footnote 2						
Minimum Edge Distance		c_{min}	in.	1¾						2¾
Minimum Anchor Spacing		s_{min}	in.	3						6

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-11.
2. $c_{ac} = h_{ef} (\tau_{k,uncr}/1160)^{0.4} \times [3.1 - 0.7(h/h_{ef})]$, where:

   $[h/h_{ef}] \le 2.4$

   $\tau_{k,uncr}$ = the characteristic bond strength in uncracked concrete, given in the tables that follow $\le k_{uncr} ((h_{ef} \times f'_c)^{0.5}/(\pi \times d_a))$

   h = the member thickness (inches)

   h_{ef} = the embedment depth (inches)

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Tension Strength Design Data for Threaded Rod in Normal-Weight Concrete[1]

IBC *

Characteristic			Symbol	Units	Nominal Anchor Diameter (in.)						
					3/8	1/2	5/8	3/4	7/8	1	1 1/4
Steel Strength in Tension											
Threaded Rod	Minimum Tensile Stress Area		A_{se}	in²	0.078	0.142	0.226	0.334	0.462	0.606	0.969
	Tension Resistance of Steel — ASTM F1554, Grade 36		N_{sa}	lb.	4,525	8,235	13,110	19,370	26,795	35,150	56,200
	Tension Resistance of Steel — ASTM A193, Grade B7				9,750	17,750	28,250	41,750	57,750	75,750	121,125
	Tension Resistance of Steel — Type 410 Stainless (ASTM A193, Grade B6)				8,580	15,620	24,860	36,740	50,820	66,660	106,590
	Tension Resistance of Steel — Type 304 and 316 Stainless (ASTM A193, Grade B8 & B8M)				4,445	8,095	12,880	19,040	26,335	34,540	55,235
	Strength Reduction Factor — Steel Failure		ϕ	—	0.75[7]						
Concrete Breakout Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)[12]											
Effectiveness Factor — Uncracked Concrete			k_{uncr}	—	24						
Effectiveness Factor — Cracked Concrete			k_{cr}	—	17						
Strength Reduction Factor — Breakout Failure			ϕ	—	0.65[9]						
Bond Strength in Tension (2,500 psi ≤ f'c ≤ 8,000 psi)[12]											
Uncracked Concrete[2,3,4]	Characteristic Bond Strength[5,13]		$\tau_{k,uncr}$	psi	770	1,150	1,060	970	885	790	620
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	2 3/8	2 3/4	3 1/8	3 1/2	3 3/4	4	5
		Maximum			7 1/2	10	12 1/2	15	17 1/2	20	25
Cracked Concrete[2,3,4]	Characteristic Bond Strength[5,10,11,13]		$\tau_{k,cr}$	psi	595	510	435	385	355	345	345
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	3	4	5	6	7	8	10
		Maximum			7 1/2	10	12 1/2	15	17 1/2	20	25
Bond Strength in Tension — Bond Strength Reduction Factors for Continuous Special Inspection											
Strength Reduction Factor — Dry Concrete			$\phi_{dry,ci}$	—	0.65[8]						
Strength Reduction Factor — Water-saturated Concrete — $h_{ef} \leq 12d_a$			$\phi_{sat,ci}$	—	0.55[8]		0.45[8]				
Additional Factor for Water-saturated Concrete — $h_{ef} \leq 12d_a$			$K_{sat,ci}$[6]	—	N/A		1			0.84	
Strength Reduction Factor — Water-saturated Concrete — $h_{ef} > 12d_a$			$\phi_{sat,ci}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete — $h_{ef} > 12d_a$			$K_{sat,ci}$[6]	—	0.57						
Bond Strength in Tension — Bond Strength Reduction Factors for Periodic Special Inspection											
Strength Reduction Factor — Dry Concrete			$\phi_{dry,pi}$	—	0.55[8]						
Strength Reduction Factor — Water-saturated Concrete — $h_{ef} \leq 12d_a$			$\phi_{sat,pi}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete — $h_{ef} \leq 12d_a$			$K_{sat,pi}$[6]	—	1		0.93			0.71	
Strength Reduction Factor — Water-saturated Concrete — $h_{ef} > 12d_a$			$\phi_{sat,pi}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete — $h_{ef} > 12d_a$			$K_{sat,pi}$[6]	—	0.48						

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-11.
2. Temperature Range: Maximum short-term temperature of 150°F. Maximum long-term temperature of 110°F.
3. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling).
4. Long-term concrete temperatures are constant temperatures over a significant time period.
5. For anchors that only resist wind or seismic loads, bond strengths may be increased b 72%.
6. In water-saturated concrete, multiply $\tau_{k,uncr}$ and $\tau_{k,cr}$ by K_{sat}.
7. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
8. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
9. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition A are met, refer to Section D.4.4 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.5 to determine the appropriate value of ϕ.
10. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values for 7/8" anchors must be multiplied by $\alpha_{N,seis}$ = 0.80.
11. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, the bond strength values for 1" anchors must be multiplied by $\alpha_{N,seis}$ = 0.92.
12. The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa) for uncracked concrete. The value of f'_c used for calculation purposes must not exceed 2,500 psi (17.2 MPa) for tension resistance in cracked concrete.
13. For applications where maximum short-term temperature is 110ºF (43ºC) and the maximum long-term temperature is 75ºF (24ºC), bond strengths may be increased 93%. No additional increase is permitted for anchors that only resist wind or seismic loads.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Tension Strength Design Data for Rebar in Normal-Weight Concrete[1]

IBC *

Characteristic			Symbol	Units	Rebar Size						
					#3	#4	#5	#6	#7	#8	#10
Steel Strength in Tension											
Rebar	Minimum Tensile Stress Area		A_{se}	in^2	0.11	0.2	0.31	0.44	0.6	0.79	1.23
	Tension Resistance of Steel — Rebar (ASTM A615 Grade 60)		N_{sa}	lb.	9,900	18,000	27,900	39,600	54,000	71,100	110,700
	Strength Reduction Factor – Steel Failure		ϕ	—	0.65[7]						
Concrete Breakout Strength in Tension (2,500 psi ≤ f'_c ≤ 8,000 psi)[10]											
Effectiveness Factor — Uncracked Concrete			k_{uncr}	—	24						
Effectiveness Factor — Cracked Concrete			k_{cr}	—	17						
Strength Reduction Factor — Breakout Failure			ϕ	—	0.65[9]						
Bond Strength in Tension (2,500 psi ≤ f'_c ≤ 8,000 psi)[10]											
Uncracked Concrete [2,3,4]	Characteristic Bond Strength[5,11]		$\tau_{k,uncr}$	psi	895	870	845	820	795	770	720
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	2⅜	2¾	3⅛	3½	3¾	4	5
		Maximum			7½	10	12½	15	17½	20	25
Cracked Concrete [2,3,4]	Characteristic Bond Strength[5,11]		$\tau_{k,cr}$	psi	365	735	660	590	515	440	275
	Permitted Embedment Depth Range	Minimum	h_{ef}	in.	3	4	5	6	7	8	10
		Maximum			7½	10	12½	15	17½	20	25
Bond Strength in Tension — Bond Strength Reduction Factors for Continuous Special Inspection											
Strength Reduction Factor – Dry Concrete			$\phi_{dry,ci}$	—	0.65[8]						
Strength Reduction Factor – Water-saturated Concrete - $h_{ef} \leq 12d_a$			$\phi_{sat,ci}$	—	0.55[8]		0.45[8]				
Additional Factor for Water-saturated Concrete - $h_{ef} \leq 12d_a$			$K_{sat,ci}$[6]	—	N/A		1			0.84	
Strength Reduction Factor – Water-saturated Concrete - $h_{ef} > 12d_a$			$\phi_{sat,ci}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete - $h_{ef} > 12d_a$			$K_{sat,ci}$[6]	—	0.57						
Bond Strength in Tension — Bond Strength Reduction Factors for Periodic Special Inspection											
Strength Reduction Factor – Dry Concrete			$\phi_{dry,pi}$	—	0.55[8]						
Strength Reduction Factor – Water-saturated Concrete - $h_{ef} \leq 12d_a$			$\phi_{sat,pi}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete - $h_{ef} \leq 12d_a$			$K_{sat,pi}$[6]	—	1		0.93			0.71	
Strength Reduction Factor – Water-saturated Concrete - $h_{ef} > 12d_a$			$\phi_{sat,pi}$	—	0.45[8]						
Additional Factor for Water-saturated Concrete - $h_{ef} > 12d_a$			$K_{sat,pi}$[6]	—	0.48						

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-11.
2. Temperature Range: Maximum short-term temperature of 150°F. Maximum long-term temperature of 110°F.
3. Short-term concrete temperatures are those that occur over short intervals (diurnal cycling).
4. Long-term concrete temperatures are constant temperatures over a significant time period.
5. For anchors that only resist wind or seismic loads, bond strengths may be increased b 72%.
6. In water-saturated concrete, multiply $\tau_{k,uncr}$ and $\tau_{k,cr}$ by K_{sat}.
7. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.5 to determine the appropriate value of ϕ.
8. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.5 to determine the appropriate value of ϕ.
9. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.4 (c) for Condition A are met, refer to Section D.4.4 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.5 to determine the appropriate value of ϕ.
10. The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa) for uncracked concrete. The value of f'_c used for calculation purposes must not exceed 2,500 psi (17.2 MPa) for tension resistance in cracked concrete.
11. For applications where maximum short-term temperature is 110°F (43°C) and the maximum long-term temperature is 75°F (24°C), bond strengths may be increased 93%. No additional increase is permitted for anchors that only resist wind or seismic loads.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Shear Strength Design Data for Threaded Rod in Normal-Weight Concrete[1]

IBC *

Characteristic		Symbol	Units	Nominal Anchor Diameter (in.)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Steel Strength in Shear										
Threaded Rod	Minimum Shear Stress Area	A_{se}	$in.^2$	0.078	0.142	0.226	0.334	0.462	0.606	0.969
	Shear Resistance of Steel — ASTM F1554, Grade 36	V_{sa}	lb.	2,260	4,940	7,865	11,625	16,080	21,090	33,720
	Shear Resistance of Steel — ASTM A193, Grade B7			4,875	10,650	16,950	25,050	34,650	45,450	72,675
	Shear Resistance of Steel — Type 410 Stainless (ASTM A193, Grade B6)			4,290	9,370	14,910	22,040	30,490	40,000	63,955
	Shear Resistance of Steel — Type 304 and 316 Stainless (ASTM A193, Grade B8 & B8M)			2,225	4,855	7,730	11,420	15,800	20,725	33,140
	Reduction for Seismic Shear — ASTM F1554, Grade 36	$\alpha_{V,seis}$[5]	—	0.87	0.78	0.68				0.65
	Reduction for Seismic Shear — ASTM A193, Grade B7			0.87	0.78	0.68				0.65
	Reduction for Seismic Shear — Stainless (ASTM A193, Grade B6)			0.69	0.82	0.75			0.83	0.72
	Reduction for Seismic Shear — Stainless (ASTM A193, Grade B8 & B8M)			0.69	0.82	0.75			0.83	0.72
	Strength Reduction Factor — Steel Failure	ϕ	—	0.65[2]						
Concrete Breakout Strength in Shear										
Outside Diameter of Anchor		d_o	in.	0.375	0.5	0.625	0.75	0.875	1	1.25
Load Bearing Length of Anchor in Shear		ℓ_e	in.	h_{ef}						
Strength Reduction Factor — Breakout Failure		ϕ	—	0.70[3]						
Concrete Pryout Strength in Shear										
Coefficient for Pryout Strength		k_{cp}	—	1.0 for $h_{ef} < 2.50$"; 2.0 for $h_{ef} \geq 2.50$"						
Strength Reduction Factor — Pryout Failure		ϕ	—	0.70[4]						

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-11.
2. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
3. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition A are met, refer to Section D.4.3 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
4. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
5. The values of V_{sa} are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, V_{sa} must be multiplied by $\alpha_{V,seis}$ for the corresponding anchor steel type.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SIMPSON Strong-Tie®

IBC *

SET-XP® Shear Strength Design Data for Rebar in Normal-Weight Concrete[1]

Characteristic		Symbol	Units	Rebar Size						
				#3	#4	#5	#6	#7	#8	#10
Steel Strength in Shear										
Rebar	Minimum Shear Stress Area	A_{se}	in²	0.11	0.2	0.31	0.44	0.6	0.79	1.23
	Shear Resistance of Steel — Rebar (ASTM A615 Grade 60)	V_{sa}	lb.	4,950	10,800	16,740	23,760	32,400	42,660	66,420
	Reduction for Seismic Shear — Rebar (ASTM A615 Grade 60)	$\alpha_{V,seis}$[5]	—	0.85	0.88	0.84		0.77		0.59
	Strength Reduction Factor — Steel Failure	ϕ	—	0.60[2]						
Concrete Breakout Strength in Shear										
Outside Diameter of Anchor		d_o	in.	0.375	0.5	0.625	0.75	0.875	1	1.25
Load-Bearing Length of Anchor in Shear		ℓ_e	in.	h_{ef}						
Strength Reduction Factor — Breakout Failure		ϕ	—	0.70[3]						
Concrete Pryout Strength in Shear										
Coefficient for Pryout Strength		k_{cp}	—	1.0 for $h_{ef} < 2.50$"; 2.0 for $h_{ef} \geq 2.50$"						
Strength Reduction Factor — Pryout Failure		ϕ	—	0.70[4]						

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-11.
2. The value of ϕ applies when the load combinations of ACI 318 Section 9.2 are used. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
3. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition B are met. If the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition A are met, refer to Section D.4.3 to determine the appropriate value of ϕ. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
4. The value of ϕ applies when both the load combinations of ACI 318 Section 9.2 are used and the requirements of Section D.4.3 (c) for Condition B are met. If the load combinations of ACI 318 Appendix C are used, refer to Section D.4.4 to determine the appropriate value of ϕ.
5. The values of V_{sa} are applicable for both cracked concrete and uncracked concrete. For anchors installed in regions assigned to Seismic Design Category C, D, E or F, V_{sa} must be multiplied by $\alpha_{V,seis}$.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Development Length for Rebar Dowels in Normal-Weight Concrete[1,2,3,4,5,6]

IBC *

Rebar Size	Top Cover in. (mm)	Development Length, in. (mm)				
		f'_c = 2,500 psi (17.2 MPa) Concrete	f'_c = 3,000 psi (20.7 MPa) Concrete	f'_c = 4,000 psi (27.6 MPa) Concrete	f'_c = 6,000 psi (41.4 MPa) Concrete	f'_c = 8,000 psi (55.2 MPa) Concrete
#3 (9.5)	1½ (38)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)
#4 (12.7)	1½ (38)	15 (381)	14 (356)	12 (305)	12 (305)	12 (305)
#5 (15.9)	1½ (38)	18 (457)	17 (432)	15 (381)	12 (305)	12 (305)
#6 (19.1)	1½ (38)	22 (559)	20 (508)	18 (457)	14 (356)	13 (330)
#7 (22.2)	3 (76)	32 (813)	29 (737)	25 (635)	21 (533)	18 (457)
#8 (25.4)	3 (76)	36 (914)	33 (838)	29 (737)	24 (610)	21 (533)
#9 (28.7)	3 (76)	41 (1041)	38 (965)	33 (838)	27 (686)	23 (584)
#10 (32.3)	3 (76)	46 (1168)	42 (1067)	37 (940)	30 (762)	26 (660)
#11 (35.8)	3 (76)	51 (1295)	47 (1194)	41 (1041)	33 (838)	29 (737)

1. Tabulated development lengths are for static, wind and seismic load cases in Seismic Design Category A and B.
2. Rebar is assumed to be ASTM A615 Grade 60 or A706 (f_y = 60,000 psi). For rebar with a higher yield strength, multiply tabulated values by f_y / 60,000 psi.
3. Concrete is assumed to be normal-weight concrete. For lightweight concrete, multiply tabulated values by 1.33.
4. Tabulated values assume bottom cover of less than 12 inches cast below rebars (Ψ_t = 1.0).
5. Uncoated rebar must be used.
6. The value of K_{tr} is assumed to be 0. Refer to ACI 318 Section 12.2.3.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SIMPSON Strong-Tie®

SET-XP® Tension Design Strength for Threaded Rod Anchors in Normal-Weight Concrete (f'_c = 2,500 psi)

IBC *

Rod Dia. (in.)	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Tension Design Strength Based on Concrete or Bond (lb.)							
						Edge Distances = c_{ac} on all sides				Edge Distances = 1¾" on one side and C_{ac} on three sides			
						SDC A-B[6]		SDC C-F[7,8]		SDC A-B[6]		SDC C-F[7,8]	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked
⅜	2⅜	4¼ 5¾	3¾ 3⅝	—	—	1,185	—	890	—	675 800	—	505 600	—
	3	4⅞ 7¼	5 4½	4⅞	3¼	1,500	1,150	1,125	865	635 880	775	475 660	585
	4½	6⅜ 10⅞	8⅛ 6¾	6⅜	3¼	2,250	1,725	1,685	1,295	590 880	1,165	445 660	875
	6	7⅞ 14½	11⅛ 9	7⅞	4⅜	2,995	2,300	**2,250**	1,725	570 880	1,555	430 660	1,165
	7½	9⅜ 18	14¼ 11¼	9⅜	5⅜	3,745	2,875	**2,810**	2,160	560 880	1,945	420 660	1,455
½	2¾	5¼ 6⅝	5⅛ 5⅛	—	—	2,730	—	2,050	—	1,470 1,470	—	1,105 1,105	—
	4	6½ 9⅝	7⅞ 6	6½	5⅛	3,975	1,755	2,980	1,315	1,400 1,935	945	1,050 1,450	710
	6	8½ 14½	12⅝ 9	8½	5⅛	5,960	2,635	**4,470**	1,975	1,300 1,935	1,420	975 1,450	1,065
	8	10½ 19¼	17½ 12	10½	5¼	7,950	3,510	**5,960**	2,635	1,260 1,935	1,890	945 1,450	1,420
	10	12½ 24	22¼ 15	12½	6⅜	9,935	4,390	**7,450**	3,290	1,235 1,935	2,365	925 1,450	1,775
⅝	3⅛	6¼ 7½	6¼ 6¼	—	—	3,580	—	2,685	—	1,805 1,805	—	1,355 1,355	—
	5	8⅛ 12	9½ 7½	8⅛	6¼	5,730	2,335	4,295	1,750	1,875 2,590	1,175	1,405 1,945	885
	7½	10⅝ 18	15⅜ 11¼	10⅝	6¼	8,595	3,500	6,445	2,625	1,745 2,590	1,765	1,310 1,945	1,325
	12½	15⅝ 30	26⅞ 18¾	15⅝	7⅝	14,320	5,830	**10,740**	4,375	1,655 2,590	2,945	1,240 1,945	2,210
¾	3½	7¼ 8½	7⅛ 7⅛	—	—	4,385	—	3,290	—	2,120 2,120	—	1,590 1,590	—
	6	9¾ 14½	11 9	9¾	7⅛	7,520	3,000	5,640	2,250	2,335 3,230	1,450	1,750 2,420	1,090
	9	12¾ 21⅝	17¾ 13½	12¾	7⅛	11,280	4,500	8,460	3,375	2,175 3,230	2,180	1,630 2,420	1,635
	15	18¾ 36	31⅛ 22½	18¾	9	18,795	7,505	**14,100**	5,625	2,060 3,230	3,630	1,545 2,420	2,720
⅞	3¾	8⅛ 9	7⅞ 7⅞	—	—	5,020	—	3,010	—	2,355 2,355	—	1,410 1,410	—
	7	11⅜ 16⅞	12⅜ 10½	11⅜	7⅞	9,365	3,745	5,620	2,250	2,795 3,865	1,755	1,680 2,320	1,055
	10½	14⅞ 25¼	19⅞ 15¾	14⅞	7⅞	14,050	5,620	8,430	3,370	2,605 3,865	2,635	1,560 2,320	1,580
	17½	21⅞ 42	35 26¼	21⅞	10	23,415	9,365	**14,050**	5,620	2,465 3,865	4,390	1,480 2,320	2,635
1	4	9 9⅝	8½ 8½	—	—	5,455	—	3,765	—	2,505 2,505	—	1,730 1,730	—
	8	13 19¼	13½ 12	13	8½	10,905	4,755	7,525	3,280	3,155 4,360	2,185	2,175 3,010	1,510
	12	17 28⅞	21¾ 18	17	8½	16,360	7,135	11,290	4,920	2,935 4,360	3,280	2,025 3,010	2,265
	20	25 48	38¼ 30	25	12¼	27,265	11,890	**18,815**	8,205	2,785 4,360	5,465	1,920 3,010	3,770
1¼	5	11¼ 12	9½ 9½	—	—	6,705	—	5,030	—	—	—	—	—
	10	16¼ 24	15⅜ 15	16¼	9½	13,415	7,430	10,060	5,570	—	—	—	—
	15	21¼ 36	24¾ 22½	21¼	11⅛	20,120	11,145	15,090	8,360	—	—	—	—
	25	31¼ 60	43⅜ 37½	31¼	15⅝	33,530	18,575	25,150	13,930	—	—	—	—

Threaded Rod Dia. (in.)	Tension Design Strength of Threaded Rod Steel (lb)					
	ASTM F1554, GR 36	ASTM F1554, GR 55	ASTM F1554, GR 105	ASTM A193, B6	ASTM A193, B7	ASTM A193, B8/B8M
⅜	3,370	4,360	7,270	6,395	7,270	3,310
½	6,175	7,990	13,315	11,715	13,315	6,070
⅝	9,835	12,715	21,190	18,645	21,190	9,660
¾	14,530	18,790	31,315	27,555	31,315	14,280
⅞	20,095	25,990	43,315	38,115	43,315	19,750
1	26,365	34,090	56,815	49,995	56,815	25,905
1¼	42,150	54,505	90,845	79,945	90,845	41,425

1. Tension design strength must be the lesser of the concrete, bond or threaded rod steel design strength.
2. Tension design strengths are based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.
5. Strength reduction factor, ϕ, is based on using a load combination from ACI 318-11 Section 9.2.

* See page 12 for an explanation of the load table icons.

6. The tension design strength listed for SDC (Seismic Design Category) A-B may also be used in SDC C-F when the tension component of the strength-level seismic design load on the anchor does not exceed 20% of the total factored tension load on the anchor associated with the same load combination.
7. When designing anchorages in SDC C-F, the Designer shall consider the ductility requirements of ACI 318-11 Section D.3.3. Design strengths in **Bold** indicate that the anchor ductility requirements of D.3.3.4.3 (a)1 to 3 are satisfied when using ASTM F1554 Grade 36 threaded rod. Any other ductility requirements must be satisfied.
8. Tension design strengths in SDC C-F have been adjusted by 0.75 factor in accordance with ACI 318-11 Section D.3.3.4.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (f'_c = 2,500 psi) — Static Load

IBC *

Rod Dia. (in.)	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)			
						Edge distances = c_{ac} on all sides		Edge Distances = 1¾" on one side and C_{ac} on three sides	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked
⅜	2⅜	4¼	3¾	—	—	845	—	480	—
		5¾	3⅝					570	
	3	4⅞	5	4⅞	3¼	1,070	820	455	555
		7¼	4½					630	
	4½	6⅜	8⅛	6⅜	3¼	1,605	1,230	420	830
		10⅞	6¾					630	
	6	7⅞	11⅛	7⅞	4⅜	2,140	1,645	405	1,110
		14½	9					630	
	7½	9⅜	14¼	9⅜	5⅜	2,675	2,055	400	1,390
		18	11¼					630	
½	2¾	5¼	5⅛	—	—	1,950	—	1,050	—
		6⅝	5⅛					1,050	
	4	6½	7⅞	6½	5⅛	2,840	1,255	1,000	675
		9⅝	6					1,380	
	6	8½	12⅝	8½	5⅛	4,255	1,880	930	1,015
		14½	9					1,380	
	8	10½	17½	10½	5¼	5,680	2,505	900	1,350
		19¼	12					1,380	
	10	12½	22¼	12½	6⅜	7,095	3,135	880	1,690
		24	15					1,380	
⅝	3⅛	6¼	6¼	—	—	2,555	—	1,290	—
		7½	6¼					1,290	
	5	8⅛	9½	8⅛	6¼	4,095	1,670	1,340	840
		12	7½					1,850	
	7½	10⅝	15⅜	10⅝	6¼	6,140	2,500	1,245	1,260
		18	11¼					1,850	
	12½	15⅝	26⅞	15⅝	7⅝	10,230	4,165	1,180	2,105
		30	18¾					1,850	
¾	3½	7¼	7⅛	—	—	3,130	—	1,515	—
		8½	7⅛					1,515	
	6	9¾	11	9¾	7⅛	5,370	2,145	1,670	1,035
		14½	9					2,305	
	9	12¾	17¾	12¾	7⅛	8,055	3,215	1,555	1,555
		21⅝	13½					2,305	
	15	18¾	31⅛	18¾	9	13,425	5,360	1,470	2,595
		36	22½					2,305	
⅞	3¾	8⅛	7⅞	—	—	3,585	—	1,680	—
		9	7⅞					1,680	
	7	11⅜	12⅜	11⅜	7⅞	6,690	2,675	1,995	1,255
		16⅞	10½					2,760	
	10½	14⅞	19⅞	14⅞	7⅞	10,035	4,015	1,860	1,880
		25¼	15¾					2,760	
	17½	21⅞	35	21⅞	10	16,725	6,690	1,760	3,135
		42	26¼					2,760	
1	4	9	8½	—	—	3,895	—	1,790	—
		9⅝	8½					1,790	
	8	13	13½	13	8½	7,790	3,395	2,255	1,560
		19¼	12					3,115	
	12	17	21¾	17	8½	11,685	5,095	2,095	2,345
		28⅞	18					3,115	
	20	25	38¼	25	12¼	19,475	8,495	1,990	3,905
		48	30					3,115	
1¼	5	11¼	9½	—	—	4,790	—	—	—
		12	9½						
	10	16¼	15⅜	16¼	9½	9,580	5,305	—	—
		24	15						
	15	21¼	24¾	21¼	11⅛	14,370	7,960	—	—
		36	22½						
	25	31¼	43⅜	31¼	15⅝	23,950	13,270	—	—
		60	37½						

Threaded Rod Dia. (in.)	Allowable Tension Load of Threaded Rod Steel (lb.)					
	ASTM F1554, GR 36	ASTM F1554, GR 55	ASTM F1554, GR 105	ASTM A193, B6	ASTM A193, B7	ASTM A193, B8/B8M
⅜	2,405	3,115	5,195	4,570	5,195	2,365
½	4,410	5,705	9,510	8,370	9,510	4,335
⅝	7,025	9,080	15,135	13,320	15,135	6,900
¾	10,380	13,420	22,370	19,680	22,370	10,200
⅞	14,355	18,565	30,940	27,225	30,940	14,105
1	18,830	24,350	40,580	35,710	40,580	18,505
1¼	30,105	38,930	64,890	57,105	64,890	29,590

1. Allowable tension load must be the lesser of the concrete, bond or threaded rod steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using a conversion factor of a = 1.4. The conversion factor a is based on the load combination 1.2D + 1.6L assuming 50% dead load and 50% live load: 1.2(0.5) + 1.6(0.5) = 1.4.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (f'_c = 2,500 psi) — Wind Load

IBC *

Rod Dia. (in.)	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)			
						Edge distances = c_{ac} on all sides		Edge Distances = 1¾" on one side and c_{ac} on three sides	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked
⅜	2⅜	4¼	3¾	—	—	710	—	405	—
		5¾	3⅝					480	
	3	4⅞	5	4⅞	3¼	900	690	380	465
		7¼	4½					530	
	4½	6⅜	8⅛	6⅜	3¼	1,350	1,035	355	700
		10⅞	6¾					530	
	6	7⅞	11⅛	7⅞	4⅜	1,795	1,380	340	935
		14½	9					530	
	7½	9⅜	14¼	9⅜	5⅜	2,245	1,725	335	1,165
		18	11¼					530	
½	2¾	5¼	5⅛	—	—	1,640	—	880	—
		6⅝	5⅛					880	
	4	6½	7⅞	6½	5⅛	2,385	1,055	840	565
		9⅝	6					1160	
	6	8½	12⅝	8½	5⅛	3,575	1,580	780	850
		14½	9					1,160	
	8	10½	17½	10½	5¼	4,770	2,105	755	1,135
		19¼	12					1,160	
	10	12½	22¼	12½	6⅜	5,960	2,635	740	1,420
		24	15					1,160	
⅝	3⅛	6¼	6¼	—	—	2,150	—	1,085	—
		7½	6¼					1,085	
	5	8⅛	9½	8⅛	6¼	3,440	1,400	1,125	705
		12	7½					1,555	
	7½	10⅝	15⅜	10⅝	6¼	5,155	2,100	1,045	1,060
		18	11¼					1,555	
	12½	15⅝	26⅞	15⅝	7⅝	8,590	3,500	995	1,765
		30	18¾					1,555	
¾	3½	7¼	7⅛	—	—	2,630	—	1,270	—
		8½	7⅛					1,270	
	6	9¾	11	9¾	7⅛	4,510	1,800	1,400	870
		14½	9					1,940	
	9	12¾	17¾	12¾	7⅛	6,770	2,700	1,305	1,310
		21⅝	13½					1,940	
	15	18¾	31⅛	18¾	9	11,275	4,505	1,235	2,180
		36	22½					1,940	
⅞	3¾	8⅛	7⅞	—	—	3,010	—	1,415	—
		9	7⅞					1,415	
	7	11⅜	12⅜	11⅜	7⅞	5,620	2,245	1,675	1,055
		16⅞	10½					2,320	
	10½	14⅞	19⅞	14⅞	7⅞	8,430	3,370	1,565	1,580
		25¼	15¾					2,320	
	17½	21⅞	35	21⅞	10	14,050	5,620	1,480	2,635
		42	26¼					2,320	
1	4	9	8½	—	—	3,275	—	1,505	—
		9⅝	8½					1,505	
	8	13	13½	13	8½	6,545	2,855	1,895	1,310
		19¼	12					2,615	
	12	17	21¾	17	8½	9,815	4,280	1,760	1,970
		28⅞	18					2,615	
	20	25	38¼	25	12¼	16,360	7,135	1,670	3,280
		48	30					2,615	
1¼	5	11¼	9½	—	—	4,025	—	—	—
		12	9½						
	10	16¼	15⅜	16¼	9½	8,050	4,460	—	—
		24	15						
	15	21¼	24¾	21¼	11⅛	12,070	6,685	—	—
		36	22½						
	25	31¼	43⅜	31¼	15⅝	20,120	11,145	—	—
		60	37½						

Threaded Rod Dia. (in.)	Allowable Tension Load of Threaded Rod Steel (lb.)					
	ASTM F1554 GR 36	ASTM F1554 GR 55	ASTM F1554 GR 105	ASTM A193 B6	ASTM A193 B7	ASTM A193 B8/B8M
⅜	2,020	2,615	4,360	3,835	4,360	1,985
½	3,705	4,795	7,990	7,030	7,990	3,640
⅝	5,900	7,630	12,715	11,185	12,715	5,795
¾	8,720	11,275	18,790	16,535	18,790	8,570
⅞	12,055	15,595	25,990	22,870	25,990	11,850
1	15,820	20,455	34,090	29,995	34,090	15,545
1¼	25,290	32,705	54,505	47,965	54,505	24,855

1. Allowable tension load must be the lesser of the concrete, bond or threaded rod steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using a conversion factor of $\alpha = 1/0.6 = 1.67$. The conversion factor α is based on the load combination assuming 100% wind load.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (f'_c = 2,500 psi) — Seismic Load

IBC *

Nom. Insert Diam. (in.)	Embed. Depth, h_{ef} (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)							
						Edge Distances = c_{ac} on all sides				Edge Distances = 1¾" on one side and c_{ac} on three sides			
						SDC A-B[5]		SDC C-F[6,7]		SDC A-B[5]		SDC C-F[6,7]	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked
⅜	2⅜	4¼ 5¾	3¾ 3⅝	—	—	830	—	625	—	475 560	—	355 420	—
	3	4⅞ 7¼	5 4½	4⅞	3¼	1,050	805	790	605	445 615	545	335 460	410
	4½	6⅜ 10⅞	8⅛ 6¾	6⅜	3¼	1,575	1,210	1,180	905	415 615	815	310 460	615
	6	7⅞ 14½	11⅛ 9	7⅞	4⅜	2,095	1,610	**1,575**	1,210	400 615	1,090	300 460	815
	7½	9⅜ 18	14¼ 11¼	9⅜	5⅜	2,620	2,015	**1,965**	1,510	390 615	1,360	295 460	1,020
½	2¾	5¼ 6⅝	5⅛ 5⅛	—	—	1,910	—	1,435	—	1,030 1,030	—	775 775	—
	4	6½ 9⅝	7⅞ 6	6½	5⅛	2,785	1,230	2,085	920	980 1,355	660	735 1,015	495
	6	8½ 14½	12⅝ 9	8½	5⅛	4,170	1,845	**3,130**	1,385	910 1,355	995	685 1,015	745
	8	10½ 19¼	17½ 12	10½	5¼	5,565	2,455	**4,170**	1,845	880 1,355	1,325	660 1,015	995
	10	12½ 24	22¼ 15	12½	6⅜	6,955	3,075	**5,215**	2,305	865 1,355	1,655	650 1,015	1,245
⅝	3⅛	6¼ 7½	6¼ 6¼	—	—	2,505	—	1,880	—	1,265 1,265	—	950 950	—
	5	8⅛ 12	9½ 7½	8⅛	6¼	4,010	1,635	3,005	1,225	1,315 1,815	825	985 1,360	620
	7½	10⅝ 18	15⅜ 11¼	10⅝	6¼	6,015	2,450	4,510	1,840	1,220 1,815	1,235	915 1,360	930
	12½	15⅝ 30	26⅞ 18¾	15⅝	7⅝	10,025	4,080	**7,520**	3,065	1,160 1,815	2,060	870 1,360	1,545
¾	3½	7¼ 8½	7⅛ 7⅛	—	—	3,070	—	2,305	—	1,485 1,485	—	1,115 1,115	—
	6	9¾ 14½	11 9	9¾	7⅛	5,265	2,100	3,950	1,575	1,635 2,260	1,015	1,225 1,695	765
	9	12¾ 21⅝	17¾ 13½	12¾	7⅛	7,895	3,150	5,920	2,365	1,525 2,260	1,525	1,140 1,695	1,145
	15	18¾ 36	31⅛ 22½	18¾	9	13,155	5,255	**9,870**	3,940	1,440 2,260	2,540	1,080 1,695	1,905
⅞	3¾	8⅛ 9	7⅞ 7⅞	—	—	3,515	—	2,105	—	1,650 1,650	—	985 985	—
	7	11⅜ 16⅞	12⅜ 10½	11⅜	7⅞	6,555	2,620	3,935	1,575	1,955 2,705	1,230	1,175 1,625	740
	10½	14⅞ 25¼	19⅞ 15¾	14⅞	7⅞	9,835	3,935	5,900	2,360	1,825 2,705	1,845	1,090 1,625	1,105
	17½	21⅞ 42	35 26¼	21⅞	10	16,390	6,555	**9,835**	3,935	1,725 2,705	3,075	1,035 1,625	1,845
1	4	9 9⅝	8½ 8½	—	—	3,820	—	2,635	—	1,755 1,755	—	1,210 1,210	—
	8	13 19¼	13½ 12	13	8½	7,635	3,330	5,270	2,295	2,210 3,050	1,530	1,525 2,105	1,055
	12	17 28⅞	21¾ 18	17	8½	11,450	4,995	7,905	3,445	2,055 3,050	2,295	1,420 2,105	1,585
	20	25 48	38¼ 30	25	12¼	19,085	8,325	**13,170**	5,745	1,950 3,050	3,825	1,345 2,105	2,640
1¼	5	11¼ 12	9½ 9½	—	—	4,695	—	3,520	—	—	—	—	—
	10	16¼ 24	15⅜ 15	16¼	9½	9,390	5,200	7,040	3,900	—	—	—	—
	15	21¼ 36	24¾ 22½	21¼	11⅛	14,085	7,800	10,565	5,850	—	—	—	—
	25	31¼ 60	43⅜ 37½	31¼	15⅝	23,470	13,005	17,605	9,750	—	—	—	—

Threaded Rod Dia. (in.)	Allowable Tension Load of Threaded Rod Steel (lb.)					
	ASTM F1554 GR 36	ASTM F1554 GR 55	ASTM F1554 GR 105	ASTM A193 B6	ASTM A193 B7	ASTM A193 B8/B8M
⅜	2,360	3,050	5,090	4,475	5,090	2,315
½	4,325	5,595	9,320	8,200	9,320	4,250
⅝	6,885	8,900	14,835	13,050	14,835	6,760
¾	10,170	13,155	21,920	19,290	21,920	9,995
⅞	14,065	18,195	30,320	26,680	30,320	13,825
1	18,455	23,865	39,770	34,995	39,770	18,135
1¼	29,505	38,155	63,590	55,960	63,590	29,000

1. Allowable tension load must be the lesser of the concrete, bond or threaded rod steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using a conversion factor of $\alpha = 1/0.7 = 1.43$. The conversion factor α is based on the load combination assuming 100% seismic load.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.

* See page 12 for an explanation of the load table icons.

5. The allowable tension load listed for SDC (Seismic Design Category) A-B may also be used in SDC C-F when the tension component of the strength-level seismic design load on the anchor does not exceed 20% of the total factored tension load on the anchor associated with the same load combination.
6. When designing anchorages in SDC C-F, the Designer shall consider the ductility requirements of ACI 318-11 Section D.3.3. Design strengths in **Bold** indicate that the anchor ductility requirements of D.3.3.4.3 (a)1 to 3 are satisfied when using ASTM F1554 Grade 36 threaded rod. Any other ductility requirements must be satisfied.
7. Allowable tension loads in SDC C-F have been adjusted by 0.75 factor in accordance with ACI 318-11 Section D.3.3.4.4.

SIMPSON Strong-Tie®

SET-XP® Design Information — Concrete

IBC *

SET-XP® Tension Design Strength for Rebar in Normal-Weight Concrete (f'_c = 2,500 psi)

Rebar Size	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Tension Design Strength Based on Concrete or Bond (lb.)							
						Edge Distances = c_{ac} on all sides				Edge Distances = 1¾" on one side and C_{ac} on three sides			
						SDC A-B[6]		SDC C-F[7,8]		SDC A-B[6]		SDC C-F[7,8]	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked
#3	2⅜	4¼	4	—	—	1,380	—	1,035	—	765	—	575	—
		5¾	3⅝							895		670	
	3	4⅞	5⅝	4⅞	3½	1,740	700	1,305	525	720	455	540	340
		7¼	4½							995		745	
	4½	6⅜	8⅝	6⅜	3½	2,615	1,055	1,960	790	670	685	505	510
		10⅞	6¾							995		745	
	6	7⅞	11⅞	7⅞	3½	3,485	1,405	2,615	1,055	650	910	485	685
		14½	9							995		745	
	7½	9⅜	15⅛	9⅜	3½	4,355	1,755	3,265	1,315	635	1,140	475	855
		18	11¼							995		745	
#4	2¾	5¼	4½	—	—	2,065	—	1,550	—	1,180	—	885	—
		6⅝	4½							1,180		885	
	4	6½	7	6½	4½	3,005	2,525	2,255	1,895	1,090	1,440	815	1,080
		9⅝	6							1,505		1,130	
	6	8½	11⅜	8½	5½	4,510	3,790	3,380	2,840	1,015	2,035	760	1,525
		14½	9							1,505		1,130	
	8	10½	15⅝	10½	6⅝	6,015	5,050	4,510	3,790	980	2,525	735	1,895
		19¼	12							1,505		1,130	
	10	12½	19⅞	12½	7⅝	7,515	6,315	5,635	4,735	960	2,995	720	2,245
		24	15							1,505		1,130	
#5	3⅛	6¼	5½	—	—	2,860	—	2,145	—	1,500	—	1,125	—
		7½	5½							1,500		1,125	
	5	8⅛	8¾	8⅛	5½	4,575	3,560	3,430	2,670	1,520	1,865	1,140	1,400
		12	7½							2,105		1,575	
	7½	10⅝	14	10⅝	6⅞	6,860	5,340	5,145	4,005	1,415	2,640	1,060	1,980
		18	11¼							2,105		1,575	
	12½	15⅝	24⅜	15⅝	9⅝	11,435	8,895	8,575	6,670	1,340	4,005	1,005	3,005
		30	18¾							2,105		1,575	
#6	3½	7¼	6½	—	—	3,725	—	2,795	—	1,845	—	1,385	—
		8½	6½							1,845		1,385	
	6	9¾	10⅜	9¾	6½	6,385	4,555	4,790	3,415	2,000	2,260	1,500	1,695
		14½	9							2,765		2,075	
	9	12¾	16⅝	12¾	8⅛	9,575	6,835	7,180	5,125	1,860	3,235	1,395	2,425
		21⅝	13½							2,765		2,075	
	15	18¾	29⅛	18¾	11⅜	15,960	11,390	11,970	8,545	1,765	4,965	1,325	3,725
		36	22½							2,765		2,075	
#7	3¾	8⅛	7½	—	—	4,505	—	3,380	—	2,145	—	1,610	—
		9	7½							2,145		1,610	
	7	11⅜	11⅞	11⅜	7½	8,415	5,430	6,310	4,070	2,525	2,585	1,890	1,940
		16⅞	10½							3,485		2,615	
	10½	14⅞	19⅛	14⅞	9⅛	12,620	8,145	9,465	6,110	2,350	3,740	1,760	2,805
		25¼	15¾							3,485		2,615	
	17½	21⅞	33½	21⅞	12¾	21,035	13,575	15,775	10,180	2,225	5,770	1,670	4,330
		42	26¼							3,485		2,615	
#8	4	9	8⅜	—	—	5,330	—	3,995	—	2,455	—	1,845	—
		9⅝	8⅜							2,455		1,845	
	8	13	13⅜	13	8⅜	10,660	6,095	7,995	4,570	3,085	2,810	2,315	2,110
		19¼	12							4,265		3,200	
	12	17	21½	17	9¾	15,985	9,145	11,990	6,860	2,870	4,070	2,155	3,055
		28⅞	18							4,265		3,200	
	20	25	37⅞	25	13¾	26,645	15,240	19,985	11,430	2,720	6,380	2,040	4,785
		48	30							4,265		3,200	
#10	5	11¼	10⅛	—	—	7,765	—	5,825	—	—	—	—	—
		12	10⅛										
	10	16¼	16¼	16¼	10⅛	15,530	5,940	11,645	4,455	—	—	—	—
		24	15										
	15	21¼	26⅛	21¼	10⅛	23,295	8,910	17,470	6,680	—	—	—	—
		36	22½										
	25	31¼	46	31¼	13½	38,825	14,850	29,115	11,135	—	—	—	—
		60	37½										

Rebar Size	Tension Design Strength of Rebar Steel (lb.)	
	ASTM A615 GR 60	ASTM A706 GR 60
#3	6,435	5,720
#4	11,700	10,400
#5	18,135	16,120
#6	25,740	22,880
#7	35,100	31,200
#8	46,215	41,080
#10	74,100	66,040

1. Tension design strength must be the lesser of the concrete, bond or rebar steel design strength.
2. Tension design strengths are based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.
5. Strength reduction factor, ϕ, is based on using a load combination from ACI 318-11 Section 9.2.
6. The tension design strength listed for SDC (Seismic Design Category) A-B may also be used in SDC C-F when the tension component of the strength-level seismic design load on the anchor does not exceed 20% of the total factored tension load on the anchor associated with the same load combination.
7. When designing anchorages in SDC C-F, the Designer shall consider the ductility requirements of ACI 318-11 Section D.3.3.
8. Tension design strengths in SDC C-F have been adjusted by 0.75 factor in accordance with ACI 318-11 Section D.3.3.4.4.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Rebar in Normal-Weight Concrete (f'_c = 2,500 psi) — Static Load

IBC *

Rebar Size	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)			
						Edge Distances = c_{ac} on all sides		Edge Distances = 1¾" on one side and c_{ac} on three sides	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked
#3	2⅜	4¼	4	—	—	985	—	545	—
		5¾	3⅝					640	
	3	4⅞	5⅜	4⅞	3½	1,245	500	515	325
		7¼	4½					710	
	4½	6⅜	8⅝	6⅜	3½	1,870	755	480	490
		10⅞	6¾					710	
	6	7⅞	11⅞	7⅞	3½	2,490	1,005	465	650
		14½	9					710	
	7½	9⅜	15⅛	9⅜	3½	3,110	1,255	455	815
		18	11¼					710	
#4	2¾	5¼	4½	—	—	1,475	—	845	—
		6⅝	4½					845	
	4	6½	7	6½	4½	2,145	1,805	780	1,030
		9⅝	6					1,075	
	6	8½	11⅜	8½	5½	3,220	2,705	725	1,455
		14½	9					1,075	
	8	10½	15⅝	10½	6⅝	4,295	3,605	700	1,805
		19¼	12					1,075	
	10	12½	19⅞	12½	7⅝	5,370	4,510	685	2,140
		24	15					1,075	
#5	3⅛	6¼	5½	—	—	2,045	—	1,070	—
		7½	5½					1,070	
	5	8⅛	8¾	8⅛	5½	3,270	2,545	1,085	1,330
		12	7½					1,505	
	7½	10⅝	14	10⅝	6⅞	4,900	3,815	1,010	1,885
		18	11¼					1,505	
	12½	15⅝	24⅝	15⅝	9⅝	8,170	6,355	955	2,860
		30	18¾					1,505	
#6	3½	7¼	6½	—	—	2,660	—	1,320	—
		8½	6½					1,320	
	6	9¾	10⅜	9¾	6½	4,560	3,255	1,430	1,615
		14½	9					1,975	
	9	12¾	16⅝	12¾	8⅛	6,840	4,880	1,330	2,310
		21⅝	13½					1,975	
	15	18¾	29⅛	18¾	11⅜	11,400	8,135	1,260	3,545
		36	22½					1,975	
#7	3¾	8⅛	7½	—	—	3,220	—	1,530	—
		9	7½					1,530	
	7	11⅜	11⅞	11⅜	7½	6,010	3,880	1,805	1,845
		16⅞	10½					2,490	
	10½	14⅞	19⅛	14⅞	9⅛	9,015	5,820	1,680	2,670
		25¼	15¾					2,490	
	17½	21⅞	33½	21⅞	12¾	15,025	9,695	1,590	4,120
		42	26¼					2,490	
#8	4	9	8⅜	—	—	3,805	—	1,755	—
		9⅝	8⅜					1,755	
	8	13	13⅜	13	8⅜	7,615	4,355	2,205	2,005
		19¼	12					3,045	
	12	17	21½	17	9¾	11,420	6,530	2,050	2,905
		28⅞	18					3,045	
	20	25	37⅞	25	13¾	19,030	10,885	1,945	4,555
		48	30					3,045	
#10	5	11¼	10⅛	—	—	5,545	—	—	—
		12	10⅛						
	10	16¼	16¼	16¼	10⅛	11,095	4,245	—	—
		24	15						
	15	21¼	26⅛	21¼	10⅛	16,640	6,365	—	—
		36	22½						
	25	31¼	46	31¼	13½	27,730	10,605	—	—
		60	37½						

Rebar Size	Allowable Tension Load of Rebar Steel (lb.)	
	ASTM A615 GR 60	ASTM A706 GR 60
#3	4,595	4,085
#4	8,355	7,430
#5	12,955	11,515
#6	18,385	16,345
#7	25,070	22,285
#8	33,010	29,345
#10	52,930	47,170

1. Allowable tension load must be the lesser of the concrete, bond or rebar steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using a conversion factor of α = 1.4. The conversion factor α is based on the load combination 1.2D + 1.6L assuming 50% dead load and 50% live load: 1.2(0.5) + 1.6(0.5) = 1.4.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Rebar in Normal-Weight Concrete (f'_c = 2,500 psi) — Wind Load

IBC *

Rebar Size	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)			
						Edge Distances = c_{ac} on all sides		Edge Distances = 1¾" on one side and c_{ac} on three sides	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked
#3	2⅜	4¼	4	—	—	830	—	460	—
		5¾	3⅝					535	
	3	4⅞	5⅜	4⅞	3½	1,045	420	430	275
		7¼	4½					595	
	4½	6⅜	8⅝	6⅜	3½	1,570	635	400	410
		10⅞	6¾					595	
	6	7⅞	11⅞	7⅞	3½	2,090	845	390	545
		14½	9					595	
	7½	9⅜	15⅛	9⅜	3½	2,615	1,055	380	685
		18	11¼					595	
#4	2¾	5¼	4½	—	—	1,240	—	710	—
		6⅝	4½					710	
	4	6½	7	6½	4½	1,805	1,515	655	865
		9⅝	6					905	
	6	8½	11⅜	8½	5½	2,705	2,275	610	1,220
		14½	9					905	
	8	10½	15⅝	10½	6⅝	3,610	3,030	590	1,515
		19¼	12					905	
	10	12½	19⅞	12½	7⅝	4,510	3,790	575	1,795
		24	15					905	
#5	3⅛	6¼	5½	—	—	1,715	—	900	—
		7½	5½					900	
	5	8⅛	8¾	8⅛	5½	2,745	2,135	910	1,120
		12	7½					1,265	
	7½	10⅝	14	10⅝	6⅞	4,115	3,205	850	1,585
		18	11¼					1,265	
	12½	15⅝	24⅝	15⅝	9⅝	6,860	5,335	805	2,405
		30	18¾					1,265	
#6	3½	7¼	6½	—	—	2,235	—	1,105	—
		8½	6½					1,105	
	6	9¾	10⅜	9¾	6½	3,830	2,735	1,200	1,355
		14½	9					1,660	
	9	12¾	16⅝	12¾	8⅛	5,745	4,100	1,115	1,940
		21⅝	13½					1,660	
	15	18¾	29⅛	18¾	11⅜	9,575	6,835	1,060	2,980
		36	22½					1,660	
#7	3¾	8⅛	7½	—	—	2,705	—	1,285	—
		9	7½					1,285	
	7	11⅜	11⅞	11⅜	7½	5,050	3,260	1,515	1,550
		16⅞	10½					2,090	
	10½	14⅞	19⅛	14⅞	9⅛	7,570	4,885	1,410	2,245
		25¼	15¾					2,090	
	17½	21⅞	33½	21⅞	12¾	12,620	8,145	1,335	3,460
		42	26¼					2,090	
#8	4	9	8⅜	—	—	3,200	—	1,475	—
		9⅝	8⅜					1,475	
	8	13	13⅜	13	8⅜	6,395	3,655	1,850	1,685
		19¼	12					2,560	
	12	17	21½	17	9¾	9,590	5,485	1,720	2,440
		28⅞	18					2,560	
	20	25	37⅞	25	13¾	15,985	9,145	1,630	3,830
		48	30					2,560	
#10	5	11¼	10⅛	—	—	4,660	—	—	—
		12	10⅛						
	10	16¼	16¼	16¼	10⅛	9,320	3,565	—	—
		24	15						
	15	21¼	26⅛	21¼	10⅛	13,975	5,345	—	—
		36	22½						
	25	31¼	46	31¼	13½	23,295	8,910	—	—
		60	37½						

Rebar Size	Allowable Tension Load of Rebar Steel (lb.)	
	ASTM A615 GR 60	ASTM A706 GR 60
#3	3,860	3,430
#4	7,020	6,240
#5	10,880	9,670
#6	15,445	13,730
#7	21,060	18,720
#8	27,730	24,650
#10	44,460	39,625

1. Allowable tension load must be the lesser of the concrete, bond or rebar steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using α conversion factor of $\alpha = 1/0.6 = 1.67$. The conversion factor α is based on the load combination assuming 100% wind load.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.

* See page 12 for an explanation of the load table icons.

SET-XP® Design Information — Concrete

SET-XP® Allowable Tension Loads for Rebar in Normal-Weight Concrete (f'_c = 2,500 psi) — Seismic Load

IBC *

Rebar Size	Nominal Embed. Depth (in.)	Minimum Dimensions for Uncracked (in.)		Minimum Dimensions for Cracked (in.)		Allowable Tension Load Based on Concrete or Bond (lb.)							
						Edge Distances = c_{ac} on all sides				Edge Distances = 1¾" on one side and c_{ac} on three sides			
						SDC A-B[5]		SDC C-F[6,7]		SDC A-B[5]		SDC C-F[6,7]	
		h_a	c_{ac}	h_a	c_{ac}	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked	Uncracked	Cracked
#3	2⅜	4¼ 5¾	4 3⅝	—	—	965	—	725	—	535 625	—	405 470	—
	3	4⅞ 7¼	5⅜ 4½	4⅞	3½	1,220	490	915	370	505 695	320	380 520	240
	4½	6⅜ 10⅞	8⅝ 6¾	6⅜	3½	1,830	740	1,370	555	470 695	480	355 520	355
	6	7⅞ 14½	11⅞ 9	7⅞	3½	2,440	985	1,830	740	455 695	635	340 520	480
	7½	9⅜ 18	15⅛ 11¼	9⅜	3½	3,050	1,230	2,285	920	445 695	800	335 520	600
#4	2¾	5¼ 6⅝	4½ 4½	—	—	1,445	—	1,085	—	825 825	—	620 620	—
	4	6½ 9⅝	7 6	6½	4½	2,105	1,770	1,580	1,325	765 1,055	1,010	570 790	755
	6	8½ 14½	11⅜ 9	8½	5½	3,155	2,655	2,365	1,990	710 1,055	1,425	530 790	1,070
	8	10½ 19¼	15⅝ 12	10½	6⅝	4,210	3,535	3,155	2,655	685 1,055	1,770	515 790	1,325
	10	12½ 24	19⅞ 15	12½	7⅝	5,260	4,420	3,945	3,315	670 1,055	2,095	505 790	1,570
#5	3⅛	6¼ 7½	5½ 5½	—	—	2,000	—	1,500	—	1,050 1,050	—	790 790	—
	5	8⅛ 12	8¾ 7½	8⅛	5½	3,205	2,490	2,400	1,870	1,065 1,475	1,305	800 1,105	980
	7½	10⅝ 18	14 11¼	10⅝	6⅞	4,800	3,740	3,600	2,805	990 1,475	1,850	740 1,105	1,385
	12½	15⅝ 30	24⅝ 18¾	15⅝	9⅝	8,005	6,225	6,005	4,670	940 1,475	2,805	705 1,105	2,105
#6	3½	7¼ 8½	6½ 6½	—	—	2,610	—	1,955	—	1,290 1,290	—	970 970	—
	6	9¾ 14½	10⅜ 9	9¾	6½	4,470	3,190	3,355	2,390	1,400 1,935	1,580	1,050 1,455	1,185
	9	12¾ 21⅝	16⅝ 13½	12¾	8⅛	6,705	4,785	5,025	3,590	1,300 1,935	2,265	975 1,455	1,700
	15	18¾ 36	29⅛ 22½	18¾	11⅜	11,170	7,975	8,380	5,980	1,235 1,935	3,475	930 1,455	2,610
#7	3¾	8⅛ 9	7½ 7½	—	—	3,155	—	2,365	—	1,500 1,500	—	1,125 1,125	—
	7	11⅜ 16⅞	11⅞ 10½	11⅜	7½	5,890	3,800	4,415	2,850	1,770 2,440	1,810	1,325 1,830	1,360
	10½	14⅞ 25¼	19⅛ 15¾	14⅞	9⅛	8,835	5,700	6,625	4,275	1,645 2,440	2,620	1,230 1,830	1,965
	17½	21⅞ 42	33½ 26¼	21⅞	12¾	14,725	9,505	11,045	7,125	1,560 2,440	4,040	1,170 1,830	3,030
#8	4	9 9⅝	8⅜ 8⅜	—	—	3,730	—	2,795	—	1,720 1,720	—	1,290 1,290	—
	8	13 19¼	13⅜ 12	13	8⅜	7,460	4,265	5,595	3,200	2,160 2,985	1,965	1,620 2,240	1,475
	12	17 28⅞	21½ 18	17	9¾	11,190	6,400	8,395	4,800	2,010 2,985	2,850	1,510 2,240	2,140
	20	25 48	37⅞ 30	25	13¾	18,650	10,670	13,990	8,000	1,905 2,985	4,465	1,430 2,240	3,350
#10	5	11¼ 12	10⅛ 10⅛	—	—	5,435	—	4,080	—	—	—	—	—
	10	16¼ 24	16¼ 15	16¼	10⅛	10,870	4,160	8,150	3,120	—	—	—	—
	15	21¼ 36	26⅛ 22½	21¼	10⅛	16,305	6,235	12,230	4,675	—	—	—	—
	25	31¼ 60	46 37½	31¼	13½	27,180	10,395	20,380	7,795	—	—	—	—

Rebar Size	Allowable Tension Load of Rebar Steel (lb.)	
	ASTM A615 GR 60	ASTM A706 GR 60
#3	4,505	4,005
#4	8,190	7,280
#5	12,695	11,285
#6	18,020	16,015
#7	24,570	21,840
#8	32,350	28,755
#10	51,870	46,230

1. Allowable tension load must be the lesser of the concrete, bond or rebar steel load.
2. Allowable tension loads are calculated based on the strength design provisions of ACI 318-11 Appendix D assuming dry concrete, periodic inspection, short-term temperature of 150°F and long-term temperature of 110°F. Tension design strengths are converted to allowable tension loads using α conversion factor of $\alpha = 1/0.7 = 1.43$. The conversion factor α is based on the load combination assuming 100% seismic load.
3. Tabulated values are for a single anchor with no influence of another anchor.
4. Interpolation between embedment depths is not permitted.
5. The allowable tension load listed for SDC (Seismic Design Category) A-B may also be used in SDC C-F when the tension component of the strength-level seismic design load on the anchor does not exceed 20% of the total factored tension load on the anchor associated with the same load combination.
6. When designing anchorages in SDC C-F, the Designer shall consider the ductility requirements of ACI 318-11 Section D.3.3.
7. Allowable tension loads in SDC C-F have been adjusted by 0.75 factor in accordance with ACI 318-11 Section D.3.3.4.4.

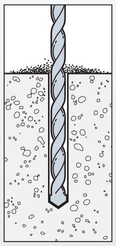
* See page 12 for an explanation of the load table icons.

Adhesive Anchoring Installation Instructions

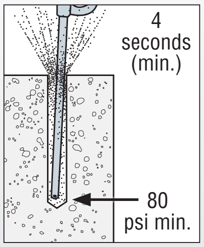
NOTE: Always check expiration date on product label. Do not use expired product.

WARNING: When drilling and cleaning hole, use eye and lung protection. When installing adhesive, use eye and skin protection.

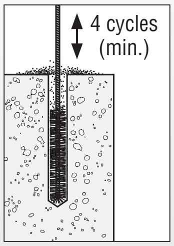
1 Hole Preparation – Horizontal, Vertical and Overhead Applications



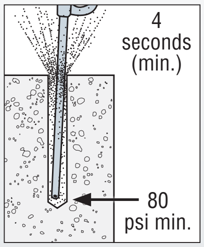
1. Drill. Drill hole to specified diameter and depth.



2. Blow. Remove dust from hole with oil-free compressed air for a minimum of 4 seconds. Compressed air nozzle must reach the bottom of the hole.



3. Brush. Clean with a nylon brush for a minimum of 4 cycles. Brush should provide resistance to insertion. If no resistance is felt, the brush is worn and must be replaced.



4. Blow. Remove dust from hole with oil-free compressed air for a minimum of 4 seconds. Compressed air nozzle must reach the bottom of the hole.

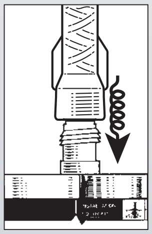
Refer to page 135 or vist www.strongtie.com for proper brush part number.

2 Cartridge Preparation

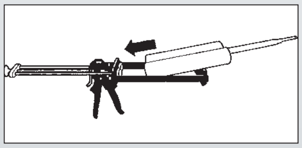
1. Check. Check expiration date on product label. **Do not use expired product.** Product is usable until end of printed expiration month.

Refer to www.strongtie.com for proper mixing nozzle and dispensing tool part number.

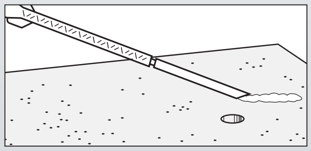
2. Open. Open cartridge per package instructions.



3. Attach. Attach proper Simpson Strong-Tie® nozzle and extension to cartridge. Do not modify nozzle.



4. Insert. Insert cartridge into dispensing tool.



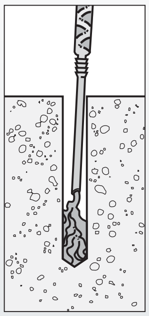
5. Dispense. Dispense adhesive to the side until properly mixed (uniform color).

FOR SOLID BASE MATERIALS

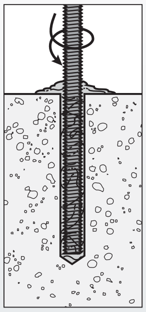
3A Filling the Hole – Vertical Anchorage

Prepare the hole per “Hole Preparation” instructions on product label.

DRY AND DAMP HOLES:

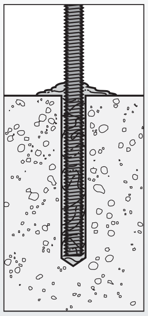


1. Fill. Fill hole ½ to ⅔ full, starting from bottom of hole to prevent air pockets. Withdraw nozzle as hole fills up.



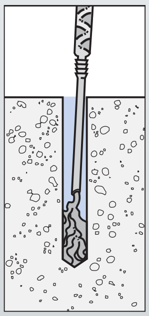
2. Insert. Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the hole.

Threaded rod or rebar

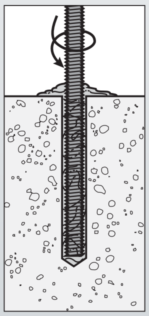


3. Do not disturb. Do not disturb anchor until fully cured.(See cure schedule for specific adhesive.)

WATER-FILLED HOLES:

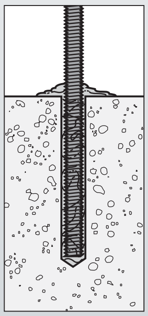


1. Fill. Fill hole completely full, starting from bottom of hole to prevent water pockets. Withdraw nozzle as hole fills up.



2. Insert. Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the hole.

Threaded rod or rebar



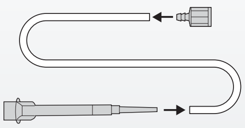
3. Do not disturb. Do not disturb anchor until fully cured. (See cure schedule.)

Note: Nozzle extensions may be needed for deep holes.

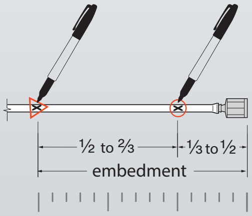
Adhesive Anchoring Installation Instructions

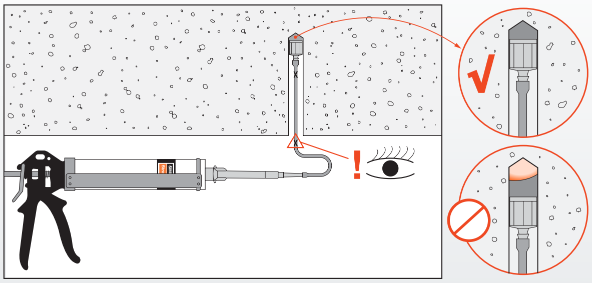
3B Filling the Hole – Piston Plug Delivery System

Prepare the hole per "Hole Preparation" instructions on product label

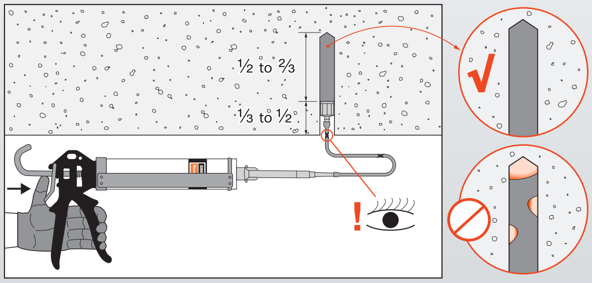


Step 1:
- Attach the piston plug to one end of the flexible tubing (PPFT25)
- Cut tubing to the length needed for the application, mark tubing as noted below and attach other end of tubing to the mixing nozzle
- If using a pneumatic dispensing tool, regulate air pressure to 80–100 psi

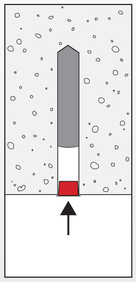




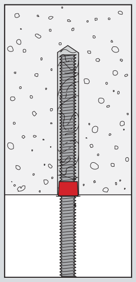
Step 2:
- Insert the piston plug to the back of the drilled hole and dispense adhesive



Step 3:
- Fill the hole ½ to ⅔ full
- **Note:** as adhesive is dispensed into the drilled hole, the piston plug will slowly displace out of the hole due to back pressure, preventing air gaps



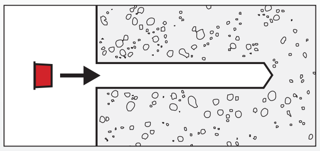
Step 4:
- Install the appropriate Simpson Strong-Tie adhesive retaining cap



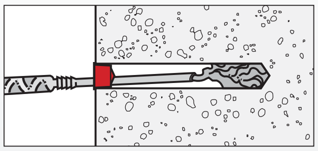
Step 5:
- Place either threaded rod or rebar through the adhesive retaining cap and into adhesive-filled hole
- Turn rod/rebar slowly until the insert bottoms out
- Do not disturb until fully cured

3C Filling the Hole – Horizontal and Overhead Anchorage with Adhesive Retaining Caps

Prepare the hole per "Hole Preparation" instructions on product label.

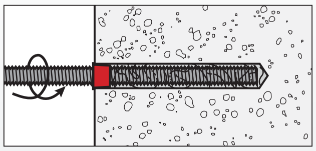


1. Install.
Install Simpson Strong-Tie® ARC adhesive retaining cap. Refer to page 132 or visit www.strongtie.com for proper ARC size.



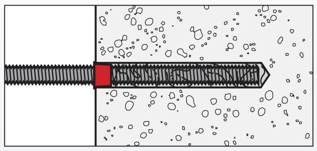
2. Fill.
Fill hole ½–⅔ full, starting from bottom of hole to prevent air pockets. Withdraw nozzle as hole fills up.

Threaded rod or rebar



3. Insert.
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the hole.

Threaded rod or rebar



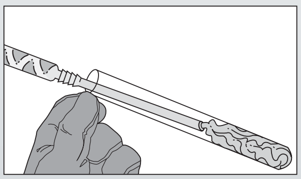
4. Do not disturb.
Do not disturb anchor until fully cured (see cure schedule).

Note: Nozzle extensions may be needed for deep holes.

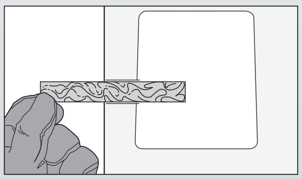
FOR HOLLOW BASE MATERIALS

3D Filling the Hole – When Anchoring with Screens: For AT, ET-HP®, SET-XP® and SET Adhesives (except SET1.7KTA)

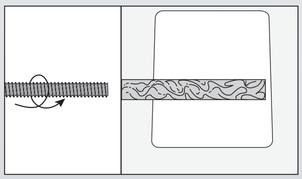
Prepare the hole per instructions on "Hole Preparation."



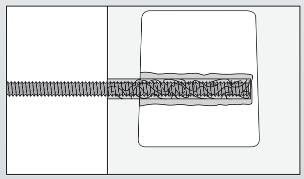
1. Fill.
Fill screen completely. Fill from the bottom of the screen and withdraw the nozzle as the screen fills to prevent air pockets. (Opti-Mesh screens: Close integral cap after filling.)



2. Insert.
Insert adhesive-filled screen into hole.



3. Insert.
Insert clean, oil-free anchor, turning slowly until the anchor contacts the bottom of the screen.



4. Do not disturb.
Do not disturb anchor until fully cured. (See cure schedule for specific adhesive.)

Installation instructions continued on page 126.

Section 6
Reference Forms

43 05 21-A. MOTOR DATA FORM

Equipment Name: JVWTP Sed. Equip. Equipment No(s): Flocculation / Sedimentation Basin No. 3
Flocculation / Sedimentation Basin No. 4
Flocculation / Sedimentation Basin No. 5
Flocculation / Sedimentation Basin No. 6

Project Site Location: Jordan Valley WTP; Herriman, UT

Nameplate Markings

Mfr: Baldor		Mfr Model: Custom		Frame: 56C		Horsepower: 0.50	
Volts:	460	Phase:	3	RPM:	1800	Service Factor:	1.00
FLA:	0.7	LRA:	5.79	Frequency:	60	Amb Temp Rating: 40	°C

Time rating:	Continuous (NEMA MG1-10.35)	Design Letter:	B (NEMA MG-1.16)
KVA Code Letter:	L	Insulation Class:	F

The following information is required for explosion-proof motors only:

A. Approved by UL for installation in Class 1, Div 2, Group A,B,C,D
B. UL frame temperature code T3C (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency 84%

(Section 43 05 21-2.02D Motor Efficiency)

B. Nameplate or nominal efficiency 84%

Data Not Necessarily Marked on Nameplate

Type of Enclosure: TEFC			Enclosure Material: Cast Iron		
Temp Rise:	19	°C (NEMA MG1-12.41,42)			
Space Heater included?	☒ Yes	☐ No	If Yes:	Watts 30	Volts 120
Type of motor winding over-temperature protection, if specified:				3 Contacts @ 150 deg C	

Provide information on other motor features specified:

Chain and Scraper Passivation Proposal

All fabricated 316SS components (i.e., support brackets, motor base plate and wall bearing housings):

2.03.A.2 Source Quality Control, Stainless Steel Components:

FABRICATIONS (Motor Base Plate, Track supports and wall bearing housings):

Stainless steel components shall be protected from carbon steel contamination during fabrication and assembly as defined in Paragraph 8 of ASTM A380. Surfaces shall be cleaned and descaled in accordance with ASTM A380 and passivated in accordance with ASTM A967. Testing to ensure proper passivation and cleaning has occurred shall be in accordance with ASTM A967. Components will be passivated, tested and report provided by a third-party supplier. Parts shall be packaged to minimize potential for recontamination.

Shafting and J-Track components:

Stainless steel components shall be protected from carbon steel contamination during fabrication as defined in Paragraph 8 of ASTM A380. Surfaces shall be cleaned and descaled in accordance with ASTM A380. Five percent of parts will be tested for free iron be Water Wetting and Drying (distilled water spray every eight hours for twenty-four hours to inspect for signs of corrosion). Five percent of parts will be Copper sulphate Tested (solution of copper sulphate applied for six minutes to test for iron oxides. Parts shall be packaged to minimize potential for recontamination.

Failure of parts from either tests would result in passivated in accordance with ASTM A380. Testing to ensure proper passivation and cleaning has occurred shall be in accordance with ASTM A967. Components will be passivated, tested and report provided by a third-party supplier. Parts shall be packaged to minimize potential for recontamination.

Section 7
Drawings

JORDAN VALLEY WATER
TREATMENT PLANT
HERRIMAN, UTAH

EVOQUA WATER TECHNOLOGIES
(12) FORE BAY PRIMARY CHAIN AND SCRAPER SLUDGE COLLECTORS,
(12) AFT BAY PRIMARY CHAIN AND SCRAPER SLUDGE COLLECTORS &
(4) CROSS COLLECTORS

DRAWING NO	REV	DESCRIPTION
419383-100	C	GENERAL ARRANGEMENT - COVER SHEET & DWG LIST
419383-101	B	GENERAL ARRANGEMENT - SPECIFICATIONS CHAIN & SCRAPER SLUDGE COLLECTORS
419383-102	C	GENERAL ARRANGEMENT - PLAN VIEW CSSC
419383-103 (SHT 1 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 2 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 3 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-103 (SHT 4 OF 4)	B	GENERAL ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEWS CSSC
419383-104 (SHT 1 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 2 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 3 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-104 (SHT 4 OF 4)	B	GENERAL ARRANGEMENT - FORE BAY LONGITUDINAL ELEVATION VIEW CSSC
419383-105	B	GENERAL ARRANGEMENT - CROSS COLLECTOR ELEVATION VIEW CSSC
419383-106 (SHT 1 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 2 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 3 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-106 (SHT 4 OF 4)	C	GENERAL ARRANGEMENT - SHAFT SECTIONS & DETAILS CSSC
419383-107 (SHT 1 OF 2)	B	GENERAL ARRANGEMENT - INSTALLATION DETAILS CSSC
419383-107 (SHT 2 OF 2)	B	GENERAL ARRANGEMENT - INSTALLATION DETAILS CSSC
419383-108	B	GENERAL ARRANGEMENT - DRIVE ARRANGEMENT, AFT BAY LONG CSSC
419383-109	B	GENERAL ARRANGEMENT - DRIVE ARRANGEMENT, FORE BAY LONG & CROSS CSSC
419383-110	A	GENERAL ARRANGEMENT - WEAR STRIP INSTALLATION DETAILS

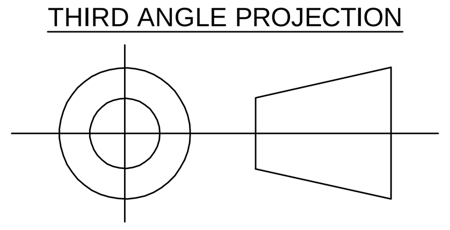
GENERAL ARRANGEMENT DRAWING NOTES:

1. ORIGINAL SUBMITTAL DRAWINGS WILL INCLUDE A STAMP DESIGNATING DRAWINGS AS "FOR APPROVAL ONLY". UPON APPROVAL, DRAWINGS WILL BE REISSUED AS REVISION 0, "ISSUED FOR CONSTRUCTION".
2. ITEM BALLOONS LEFT BLANK ON SUBMITTAL DRAWINGS WILL BE FILLED IN WITH THE APPROPRIATE NUMBERS UPON APPROVAL AND COMPLETION OF THE BILL OF MATERIALS FOR THE PROJECT.
3. TWO & THREE DIGIT ITEM NUMBERS (1 THROUGH 199) CORRESPOND WITH NUMBERED ITEMS ON THE BILL OF MATERIALS. THREE DIGIT ITEM NUMBERS (200 AND ABOVE) CORRESPOND WITH NUMBERED ITEMS ON THE FIELD HARDWARE DRAWING.

17 FIELD HARDWARE DRAWING

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION



REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED DRAWING SET	4/8/22	GLH	AJK	SW	
B	REVISED DRAWING SET	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	11/5/21	GLH	AJK	JMM	

DWN BY: G.HALASE	DATE 11/5/21	TITLE: GEN. ARRANGEMENT - COVER SHEET & DRAWING LIST (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES
MGD BY: J.MCDOND	SCALE NTS	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-100	1 OF 1	C

BAR = 1" AT PLOT SCALE

STD:22x34_D v4.0

CHAIN AND SCRAPER SLUDGE COLLECTOR

COLLECTOR CHAIN

THE COLLECTOR CARRYING CHAIN WILL BE HS730 POLYMERIC TYPE, HAVING 6" PITCH LINKS WITH AN AVERAGE WEIGHT OF 1.6 LBS/FT. THE CHAIN WILL HAVE A MINIMUM PUBLISHED WORKING LOAD OF 4,500 LBS BASED UPON STRENGTH, FATIGUE AND WEAR CONSIDERATIONS, AND A MINIMUM ULTIMATE TENSILE STRENGTH OF 20,000 LBS.

CHAIN SIDE BARS WILL BE OF FIBERGLASS COMPOSITE CONSTRUCTION HAVING CONTINUOUS FIBERGLASS FILAMENTS ORIENTED PARALLEL WITH THE SIDE BARS. THE SIDE BARS WILL BE OF A LOOP CONFIGURATION TO MINIMIZE STRESS CONCENTRATIONS WITHIN THE MEMBER AND SHALL INCLUDE PROVISIONS TO MAINTAIN PIN ORIENTATION. THE CHAIN PINS WILL NOT BE LESS THAN 1" DIAMETER PULTRUDED FIBERGLASS ROD HAVING NOT LESS THAN 70% UNIDIRECTIONAL GLASS CONTENT. THE PIN WILL INCLUDE A POLYMERIC SLEEVE WHICH WILL ROTATE WITHIN POLYMERIC BUSHINGS FITTED INTO THE SIDE BARS TO ISOLATE THE ROTATING MEMBERS FROM THE GLASS CONTAINING COMPONENTS. THE POLYMERIC CHAIN BARREL WILL ROTATE ON THE PIN SLEEVE TO DISTRIBUTE WEAR FROM SPROCKET TOOTH CONTACT AROUND THE FULL PERIPHERY OF THE BARREL. CHAIN PINS WILL BE HELD IN PLACE BY TYPE 316 STAINLESS STEEL COTTERS.

THE HIGH STRENGTH LINKS WILL BE CONTINUOUS FOR THE FULL LENGTH OF THE CHAIN STRAND WITH NO INTERSPERSED ATTACHMENT LINKS. THE SCRAPER FLIGHTS WILL BE BOLTED TO POLYMERIC FLIGHT BRACKETS MOUNTED ON EXTENDED CHAIN PINS AND SECURED WITH TYPE 316 STAINLESS STEEL COTTERS. THE ATTACHMENT MOUNTING HOLE SPACING WILL CONFORM TO ANSI STANDARD B29.21M96 AND WILL ACCOMMODATE FOUR (4) 1/2" DIAMETER TYPE 316 STAINLESS STEEL HEX HEAD ATTACHMENT BOLTS. THE BOLTS WILL BE FASTENED WITH BRASS "NYLOCK" HEX LOCKNUTS AND TYPE 316 STAINLESS STEEL FLAT WASHERS.

EACH STRAND FOR THE AFT BAY LONGITUDINAL COLLECTORS WILL BE 483'-0" LONG, MADE UP OF (45) 10'-0" LONG SECTIONS & (3) 11'-0" LONG SECTION.

EACH STRAND FOR THE FORE BAY LONGITUDINAL COLLECTORS WILL BE 242'-0" LONG, MADE UP OF (22) 10'-0" LONG SECTIONS & (2) 11'-0" LONG SECTION.

EACH STRAND FOR THE CROSS COLLECTORS WILL BE 119'-0" LONG, MADE UP OF (12) 10'-0" LONG SECTIONS.

FLIGHTS (DIAMOND TYPE)

THE SLUDGE COLLECTOR LONGITUDINAL & CROSS FLIGHTS WILL BE 3" X 8" NOMINAL SIZE FIBERGLASS CONSTRUCTION, ESSENTIALLY RECTANGULAR IN CROSS SECTION. THE MEMBER WILL HAVE A PRODUCT OF THE MODULUS OF ELASTICITY (E, PSI) AND THE MOMENT OF INERTIA (I, IN^4) OF NOT LESS THAN 12.13 X 10^6 LBS-IN^2 ABOUT ITS MINOR AXIS (PARALLEL TO THE DIRECTION OF FLOW). THE FLIGHTS ARE OF PULTRUDED ISOPTHALIC POLYESTER COMPOSITE CONSTRUCTION WITH A MINIMUM FIBERGLASS CONTENT OF 60% BUT NO GREATER THAN 70%, TO INSURE MEMBER STRENGTH AND TOTAL ENCAPSULATION OF THE GLASS FIBERS TO PREVENT WICKING.

MAXIMUM WATER ABSORPTION IS NO GREATER THAN 0.6% AFTER IMMERSION FOR 48 HRS AT 23 DEGREES C (73.4 DEGREES F) IN ACCORDANCE WITH ASTM D-570. THE FLIGHT SECTION WILL INCLUDE A SCRAPER LIP ON THE LEADING EDGE OF THE FLIGHT TO OPTIMIZE CLEANING OF THE TANK FLOOR. POLYPROPYLENE FILLER BLOCKS WILL BE FURNISHED TO ALLOW THE FLIGHT TO BE SECURELY BOLTED TO THE CHAIN ATTACHMENT. THE BLOCKS WILL PROVIDE AN INTERFERENCE FIT WITH THE FLIGHT TO MAINTAIN PROPER POSITIONING DURING ASSEMBLY. THE FLIGHT SPACING WILL BE APPROXIMATELY 10'-0" FOR THE LONGITUDINAL COLLECTOR. THE FLIGHTS WILL BE ACCURATELY DRILLED AND NOTCHED AT THE FACTORY AND BANDED TOGETHER FOR SHIPMENT.

WEARING SHOES

ALL FLIGHT WILL BE PROVIDED WITH 1/2" THICK WEAR SHOES TO RUN ON THE EXISTING TANK FLOOR WEAR STRIPS AND THE NEW RETURN TRACKS. THE SHOES WILL BE MOLDED OF UHMW-POLYETHYLENE. THE WEAR SHOES RUNNING ON THE FLOOR WILL BE LOCATED CENTRAL TO THE CHAIN ATTACHMENT. THE RETURN RUN WEARING SHOES WILL INCLUDE A GUIDE LUG TO INSURE PROPER TRACKING OF THE FLIGHT ON THE RETURN TRACK. ALL WEARING SHOES WILL BE REVERSIBLE PROVIDING TWO (2) USABLE WEARING SURFACES.

COLLECTOR SPROCKETS

ALL SPROCKETS FOR THE SLUDGE COLLECTOR CARRYING CHAINS WILL BE MOLDED TOTALLY OF POLYURETHANE HAVING A WATER ABSORPTION RATE NOT TO EXCEED 1.3% AT THE SATURATION IN ACCORDANCE WITH ASTM D-570. THE SPROCKETS WILL BE OF SPLIT CONSTRUCTION. THE SPROCKET HALVES WILL BE ASSEMBLED ON THE SHAFTING WITH TWO (2) TYPE 316 STAINLESS STEEL CLAMPING BANDS WHICH EXERT COMPRESSIVE FORCE AROUND THE FULL PERIPHERY OF THE HUB, THEREBY CLAMPING THE SPROCKET TO THE SHAFT. THE CLAMPING BANDS WILL INCLUDE PROVISIONS TO RESTRICT THEIR LATERAL MOVEMENT ON THE HUB. TYPE 316 STAINLESS STEEL BOLTS OR WEDGE DOGS WILL BE LOCATED ALONG THE SPLIT LINE NEAR THE PERIPHERY TO DRAW THE SPROCKET HALVES TOGETHER IN LATERAL ALIGNMENT.

THE HEADSHAFT SPROCKETS WILL HAVE A KEYWAY MACHINED INTO THE HUB IN SUCH A WAY AS TO RESTRICT LATERAL MOVMENT OF THE KEY AND TO ENSURE CHAIN ALIGNMENT. THE HEADSHAFT SPROCKETS WILL NOT BE LESS THAN 23.18" PITCH DIAMETER AND HAVE 12 TEETH.

THE CORNERSHAFT SPROCKETS WILL NOT BE LESS THAN 16.61" PITCH DIAMETER AND HAVE 17 TEETH. THE CORNERSHAFT SPROCKETS WILL BE CLAMPED FIRMLY TO THE SHAFTING.

HEADSHAFT

ALL HEADSHAFT WILL BE SOLID 316 STAINLESS STEEL, STRAIGHT AND TRUE, HELD IN ALIGNMENT WITH SPLIT UHMW-POLYETHYLENE SET COLLARS. THE HEADSHAFT WILL CONTAIN KEYWAYS WITH FITTED KEYS AND WILL BE SIZED TO TRANSMIT THE POWER REQUIRED. THE HEADSHAFT WILL EXTEND ACROSS THE FULL WIDTH OF THE TANK AND TURN IN BEARINGS MOUNTED ON THE TANK WALLS. THE SHAFTING AND SPROCKETS WILL BE SHIPPED UNASSEMBLED TO PREVENT DAMAGE TO THE SPROCKETS DURING SHIPPING AND HANDLING.

ALL LONGITUDINAL HEADSHAFTS WILL BE 4.50" DIAMETER.
THE CROSS COLLECTOR HEADSHAFT WILL BE 2.50" DIAMETER.

CORNER SHAFTING

ALL CORNERSHAFTS IN THE LONGITUDINALS AND CROSS WILL BE SOLID 316 STAINLESS STEEL, STRAIGHT AND TRUE, HELD IN ALIGNMENT WITH SPLIT UHMW-POLYETHYLENE SET COLLARS. THE CORNERSHAFTS WILL EXTEND ACROSS THE FULL WIDTH OF THE TANK AND TURN IN BEARINGS MOUNTED ON THE TANK WALLS.

AFT BAY LOWER INFLUENT SHAFT SHALL BE 4.50"
ALL OTHER CORNERSHAFTS WILL BE 4" DIAMETER.
THE CROSS COLLECTOR CORNERSHAFT WILL BE 2.50" DIAMETER.

SHAFTING SET COLLARS

SHAFTING SET COLLARS FOR THE HEADSHAFTS WILL BE MOLDED OF UHMW-POLYETHYLENE. THE COLLARS WILL BE OF A SPLIT CONSTRUCTION AND SHALL INCLUDE A SHOULDER AT EACH END TO CONTAIN THE CLAMPING BANDS.

BEARINGS

ALL SHAFT BEARINGS IN THE LONGITUDINALS AND CROSS SHALL BE OF A CAST TYPE 316 STAINLESS STEEL CONSTRUCTION PER ASTM A744, GRADE CF8M, WATER LUBRICATED, SELF ALIGNING TYPE, HAVING A POLYURETHANE BALL. THE HOUSING WILL BE OF A SPLIT DESIGN AND SPECIALLY DESIGNED TO PREVENT THE ACCUMULATION OF SETTLED SOLIDS ON ITS SURFACES. ALL BEARING HOUSINGS WILL HAVE 316 STAINLESS STEEL GREASE LINE TUBING ATTACHED TO THEM AND WILL BE RUN TO THE OPERATING FLOOR.

RETURN TRACKS

THE LONGITUDINAL COLLECTOR RETURN TRACKS WILL BE 12 GAUGE TYPE 316 STAINLESS STEEL, FORMED IN THE SHAPE OF AN INVERTED CAPITAL LETTER J. THE RETURN TRACK WILL HAVE A 2B POLISHED FINISH TO ALLOW THE SMOOTH TRAVEL OF THE FLIGHT WEAR SHOE WITHOUT THE NEED FOR ANY ADDITIONAL WEARING STRIPS. EACH J-TRACK SECTION WILL BE APPROXIMATELY 20 FEET LONG AND WILL HAVE MOUNTING HOLES SPACED APPROXIMATELY EVERY 24-INCHES TO ALLOW FOR VARYING WALL BRACKET SPACING. THE END SECTION IN EACH LINE WILL BE REQUIRED TO BE FIELD CUT TO THE PROPER LENGTH. THE J-TRACK SECTIONS ENDS WILL BE FIELD WELDED TOGETHER AND GROUND FOR A SMOOTH TRANSION FROM ONE SECTION TO THE NEXT. THE J-TRACK WILL BE SUPPORTED BY FABRICATED 1/4" THICK TYPE 316SS BRACKETS FROM THE TANK WALLS.

WEAR STRIPS

REPLACEABLE WEAR STRIPS WILL BE PROVIDED FOR THE COLLECTOR TANK FLOORS. THE WEAR STRIPS WILL BE 3/8" THICK 316 STAINLESS STEEL MATERIAL IN 10'-0" LONG SECTIONS WITH EACH SECTION HAVING (5) COUNTERSUNK HOLES. ALL WEAR STRIP SPLICES WILL BE MITERED AT 45 DEGREES TO ALLOW FOR A SMOOTH TRANSITION OF THE WEAR SHOES IN THE DIRECTION OF THE FLIGHT TRAVEL.

THE LONGITUDINAL & CROSS COLLECTOR WEAR STRIPS WILL BE ATTACHED TO THE TANK FLOOR USING TYPE 316 STAINLESS STEEL CONVEX WASHERS SPECIALLY DESIGNED FOR USE WITH 1/4" DIAMETER TYPE 316 STAINLESS STEEL FLAT HEAD SCREWS AND TYPE 316 STAINLESS STEEL DROP IN TYPE ANCHOR. THE ANCHORS WILL BE SET INTO PRE-DRILLED HOLES IN THE CONCRETE.

ALL ATTACHMENT HARDWARE WILL BE FURNISHED BY Evoqua Water Technologies, TO BE INSTALLED BY THE CLIENT'S CONTRACTOR.

DRIVE UNIT

THE SPEED REDUCER AND MOTOR WILL BE FACTORY ASSEMBLED AND WILL SHIP AS A COMPLETE UNIT TO ENSURE PROPER ASSEMBLY OF ALL COMPONENTS. EACH DRIVE UNIT WILL BE FIELD ASSEMBLED TO A FABRICATED 316 STAINLESS STEEL DRIVE BASE.

THE DRIVE UNIT SPEED REDUCERS IN THE LONGITUDINALS WILL BE A VARIABLE SPEED RIGHT ANGLE HORIZONTALLY MOUNTED HELICAL BEVEL GEAR TYPE, FULLY HOUSED, RUNNING IN OIL, WITH ANTI FRICTION BEARINGS THROUGHOUT.

THE MOTOR WILL CONFORM TO NEMA STANDARDS AND BE SUITABLE FOR OPERATION ON 460/230 VOLT, 3 PHASE, 60 HERTZ CURRENT. MOTORS WILL BE RATED FOR SEVERE DUTY IN A CLASS I, DIVISION 2, GROUP A, B, C, D ENVIRONMENT, AND WILL INCLUDE A 120 VOLT SPACE HEATER.

AFT BAY DUAL OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9053.1
RATIO	2953.98 : 1
OUTPUT SPEED	0.59 RPM (AT 1700 INPUT)
OUTPUT TORQUE	42,480 IN-LBS (AT 1.0 SF)

AFT BAY SINGLE OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9033.1
RATIO	2428.14 : 1
OUTPUT SPEED	0.72 RPM (AT 1700 INPUT)
OUTPUT TORQUE	13,718 IN-LBS (AT 1.0 SF)

FORE BAY DUAL OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9043.1
RATIO	3026.98 : 1
OUTPUT SPEED	0.58 RPM (AT 1700 INPUT)
OUTPUT TORQUE	24,780 IN-LBS (AT 1.0 SF)

FORE BAY SINGLE OUTPUT GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9033.1
RATIO	2428.14 : 1
OUTPUT SPEED	0.72 RPM (AT 1700 INPUT)
OUTPUT TORQUE	13,718 IN-LBS (AT 1.0 SF)

CROSS COLLECTOR GEAR REDUCER

MANUFACTURER	NORD CONSTANT SPEED DRIVE
MODEL	SK9023.1
RATIO	1504.07 : 1
OUTPUT SPEED	1.2 RPM (AT 1700 INPUT)
OUTPUT TORQUE	7,611 IN-LBS (AT 1.0 SF)

MOTOR FOR ALL DRIVES

MANUFACTURER	BALDOR
MODEL	CUSTOM
HORSEPOWER	1/2
R.P.M.	1800
VOLTAGE	460/230V, 3 PH, 60 HZ
ENCLOSURE	TEFC
SPACE HEATER	120V / 1PH. /60 HERTZ

DRIVE CHAIN

THE SLUDGE COLLECTOR DRIVE CHAIN FOR THE FORE BAY LONGITUDINAL COLLECTORS AND CROSS COLLECTORS WILL BE NH78 NON-METALLIC TYPE, HAVING 2.609" PITCH LINKS WITH AN AVERAGE WEIGHT OF 1.4 LBS/FT. THE CHAIN WILL HAVE A PUBLISHED WORKING LOAD OF NOT LESS THAN 1,750 LBS, BASED UPON STRENGTH AND FATIGUE CONSIDERATIONS. THE CHAIN LINKS WILL BE MANUFACTURED OF ACETAL RESIN AND CONNECTED WITH 7/16" DIAMETER STAINLESS STEEL PINS. THE PINS WILL BE CONSTRUCTED TO PREVENT ROTATION AND WILL BE HELD IN PLACE WITHOUT THE USE OF PINS OR COTTERS.

THE SLUDGE COLLECTOR DRIVE CHAIN FOR THE AFT BAY LONGITUDINAL COLLECTORS WILL BE ENV78B METALLIC TYPE, HAVING 2.609" PITCH LINKS WITH AN AVERAGE WEIGHT OF 3.9 LBS/FT. THE CHAIN WILL HAVE A PUBLISHED WORKING LOAD OF NOT LESS THAN 3,300 LBS, BASED UPON STRENGTH AND FATIGUE CONSIDERATIONS. THE CHAIN LINKS WILL BE MANUFACTURED OF TYPE 403 STAINLESS STEEL AND CONNECTED WITH 7/16" DIAMETER TYPE 403 STAINLESS STEEL PINS. THE CHAIN PINS WILL BE HELD IN PLACE BY TYPE 304 STAINLESS STEEL COTTERS.

DRIVE SPROCKET

EACH DRIVE SPROCKET ASSEMBLY WILL CONSIST OF A CAST IRON SHEAR PIN HUB/TORQUE LIMITER COMBINATION. THE SPROCKET ASSEMBLY WILL INCLUDE A POLYMERIC PLATE SECTION BOLTED TO A CAST IRON RIM AND MOUNTED ON A CAST IRON SHEAR PIN HUB. THE SPROCKET PLATE SECTION WILL BE MOLDED TOTALLY OF POLYURETHANE. THE SPROCKET WILL NOT BE LESS THAN 9.26" PITCH DIAMETER AND HAVE 11 TEETH.

THE DRIVE SPROCKETS WILL BE FURNISHED WITH A SHEAR PIN DEVICE TO PROVIDE FOR PROTECTION OF THE DRIVE EQUIPMENT IN THE EVENT OF EXCESSIVE LOADING. ALUMINUM SHEAR PINS WILL BE FURNISHED TO TRANSMIT TORQUE FROM THE DRIVING HUB TO THE SPROCKET RIM AND WILL INCLUDE POLYMERIC SEPARATORS BETWEEN THE SHEAR FACES TO PREVENT SEIZING. THE SHEAR PINS WILL BE SHIPPED LOOSE AND ARE TO BE INSTALLED BY THE PURCHASER. NOTE THAT THE SHEAR PIN HUB WILL BE A SECONDARY PROTECTION FOR THE EQUIPMENT, THE TORQUE LIMITER, AS DESCRIBED BELOW, WILL BE THE PRIMARY OVERLOAD DEVICE.

THE TORQUE LIMITER FOR THE LONGITUDINALS AND CROSS WILL BE A BRUNEL BIBBIGARD SERIES JSE1-0200 BALL DETENT TYPE. THE TORQUE LIMITER WILL BE MANUFACTURED OF TYPE 316 STAINLESS STEEL AND WILL INCLUDE O-RING SEALS, SAFETY ELEMENT RELUBE PROVISIONS, GREASE FITTINGS AND GREASE RELIEF VALVES. THE TORQUE LIMITER IN THE LONGITUDINAL FORE BAY WILL BE FACTORY PRE-SET TO RELEASE AT 6100 IN-LBS. THE TORQUE LIMITER IN THE LONGITUDINAL AFT BAY WILL BE FACTORY PRE-SET TO RELEASE AT 6100 IN-LBS. THE TORQUE LIMITER IN THE CROSS COLLECTORS WILL BE FACTORY PRE-SET TO RELEASE AT 4000 IN-LBS. THE TORQUE LIMITERS WILL BE EXTERNALLY ADJUSTABLE & DISCONNECTABLE.

EACH TORQUE LIMITER INCLUDES A SAFETY ELEMENT THAT, UPON TORQUE OVERLOAD, WILL EXTEND AND CONTACT THE ACTUATOR ARM OF A DOUBLE THROW LIMIT SWITCH WHICH, IN TURN, WILL SHUT OFF THE MOTOR AND ENERGIZE AN ALARM CIRCUIT. THE LIMIT SWITCH WILL HAVE A NEMA 4/4X ENCLOSURE AND WILL BE PROVIDED WITH A TYPE 316 STAINLESS STEEL SUPPORT BRACKET FOR POSITIONING ADJACENT TO THE TORQUE LIMITER. ANY WIRING AND/OR ALARMS ARE NOT FURNISHED BY Evoqua Water Technologies.

DRIVEN SPROCKET

THE DRIVEN SPROCKET WILL CONSIST OF A POLYMERIC TOOTHED RIM BOLTED TO A SPLIT POLYMERIC DISHED BODY. THE RIM AND BODY WILL BE MOLDED OF POLYURETHANE. THE BODY WILL HAVE A MACHINED KEYWAY DESIGNED TO RESTRICT THE LATERAL MOVEMENT OF THE KEY.

THE SPROCKET RIM WILL NOT BE LESS THAN 33.25" PITCH DIAMETER AND HAVE 40 TEETH.

DRIVE CHAIN TIGHTENER

THE DRIVE CHAIN ARRANGEMENT WILL INCLUDE A CHAIN TIGHTENER TO TAKE UP EXCESSIVE SLACK IN THE DRIVE CHAIN. THE TIGHTENER ASSEMBLY WILL INCLUDE A TYPE 316 STAINLESS STEEL SLIDE BASE AND MOUNTING BRACKET WITH A SELF-CENTERING AND SELF-LUBRICATED POLYURETHANE IDLER SPROCKET.

CHAIN GUARD

THE DRIVE CHAIN AND SPROCKETS LOCATED ABOVE THE OPERATING FLOOR WILL BE COVERED WITH A REMOVABLE METAL GUARD OF 14GA TYPE 316 STAINLESS STEEL.

EQUIPMENT FASTENERS

ALL ASSEMBLY HARDWARE WILL BE TYPE 316 STAINLESS STEEL.

ANCHOR BOLTS

ALL ANCHOR BOLTS SUPPLIED WILL BE TYPE 316 STAINLESS STEEL THREADED ROD AND WILL BE SET USING SIMPSON STRONG-TIE AT-XP ADHESIVE. THEY WILL BE FURNISHED BY EVOQUA WATER TECHNOLOGIES AND WILL BE OF AMPLE SIZE AND STRENGTH FOR THE PURPOSE INTENDED. ALL ANCHOR BOLTS WILL BE SET IN PLACE BY THE CLIENT'S CONTRACTOR IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

PAINT NOTE

NO PAINTING REQUIRED ON THIS PROJECT.

NON-FERROUS MATERIAL, STAINLESS STEEL AND GALVANIZED SURFACES PROVIDED BY EVOQUA WATER TECHNOLOGIES TO REMAIN UNPAINTED.

DRIVE UNIT SPEED REDUCERS, MOTORS AND CONTROLS TO REMAIN MANUFACTURER'S STANDARD FINISH.

SAFETY HAZARD WARNING LABELS

LABELS ARE AFFIXED ON Evoqua Water Technologies EQUIPMENT WHEN A VISUAL WARNING IS APPROPRIATE. THE EQUIPMENT OWNER IS RESPONSIBLE FOR KEEPING THESE LABELS VISIBLE AND IN GOOD CONDITION. REPLACEMENT LABELS ARE AVAILABLE FROM THE EVOQUA WATER TECHNOLOGIES PARTS DEPARTMENT.

ERECTION INFORMATION

EVOQUA WATER TECHNOLOGIES IS NOT RESPONSIBLE FOR ENLARGING OR CLOSING CONCRETE OPENINGS, REMOVAL AND/OR CUTTING BACK EXISTING ANCHORS FLUSH WITH CONCRETE, REMOVING CONCRETE OBSTRUCTIONS, OR FILLING CONCRETE RECESSES TO ALLOW INSTALLATION OF NEW EQUIPMENT.

SPARE PARTS

SPARE PARTS FOR THE LONGITUDINAL COLLECTORS WILL BE FURNISHED BY EVOQUA WATER TECHNOLOGIES, IN ACCORDANCE WITH SECTION 46 43 11, 1.09B

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	20	W3T543034	FLIGHT; 3 X 8 DIAMOND (LONGS, STANDARD WIDTH)
2	8	W3T543035	FLIGHT; 3 X 8 DIAMOND (CROSS)
3	10	W2T319512	COLLECTOR CHAIN STRAND; HS730; 10'-0" LG.
4	18'	W2T119925	DRIVE CHAIN; NH78
5	18'	W3T472529	DRIVE CHAIN; ENV78B
6	1	W3T377627	12T SPROCKET; 4-1/2" BORE (LONG)
7	1	W3T425729	12T SPROCKET; 2-1/2" BORE (CROSS)
8	1	W3T331972	17T SPROCKET; 4-1/2" BORE (LONG)
9	1	W2T331969	17T SPROCKET; 4" BORE (LONG)
10	1	W2T331975	17T SPROCKET; 2-1/2" BORE (CROSS)
11	2	W3T373650	WALL BEARING HUB BALL; (4-1/2" DIA. FOR LONGS)
12	2	W3T366756	WALL BEARING HUB BALL; (4" DIA. FOR LONGS)
13	2	W3T380536	WALL BEARING HUB BALL; (2-1/2" DIA. FOR CROSS)
14	4	W3T555911	FLIGHT; 3 X 8 DIAMOND (LONGS, SHORTER WIDTH)
15	1	W3T368960	DRIVEN SPROCKET ASSEMBLY (LONG)
16	1	W3T307740	DRIVEN SPROCKET ASSEMBLY (CROSS)
17	34	W2T______	SHEAR PIN FOR SK9053.1
18	34	W2T______	SHEAR PIN FOR SK9043.1
19	34	W2T______	SHEAR PIN FOR SK9033.1
20	50	W2T	SHEAR PIN FOR SK9023.1

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

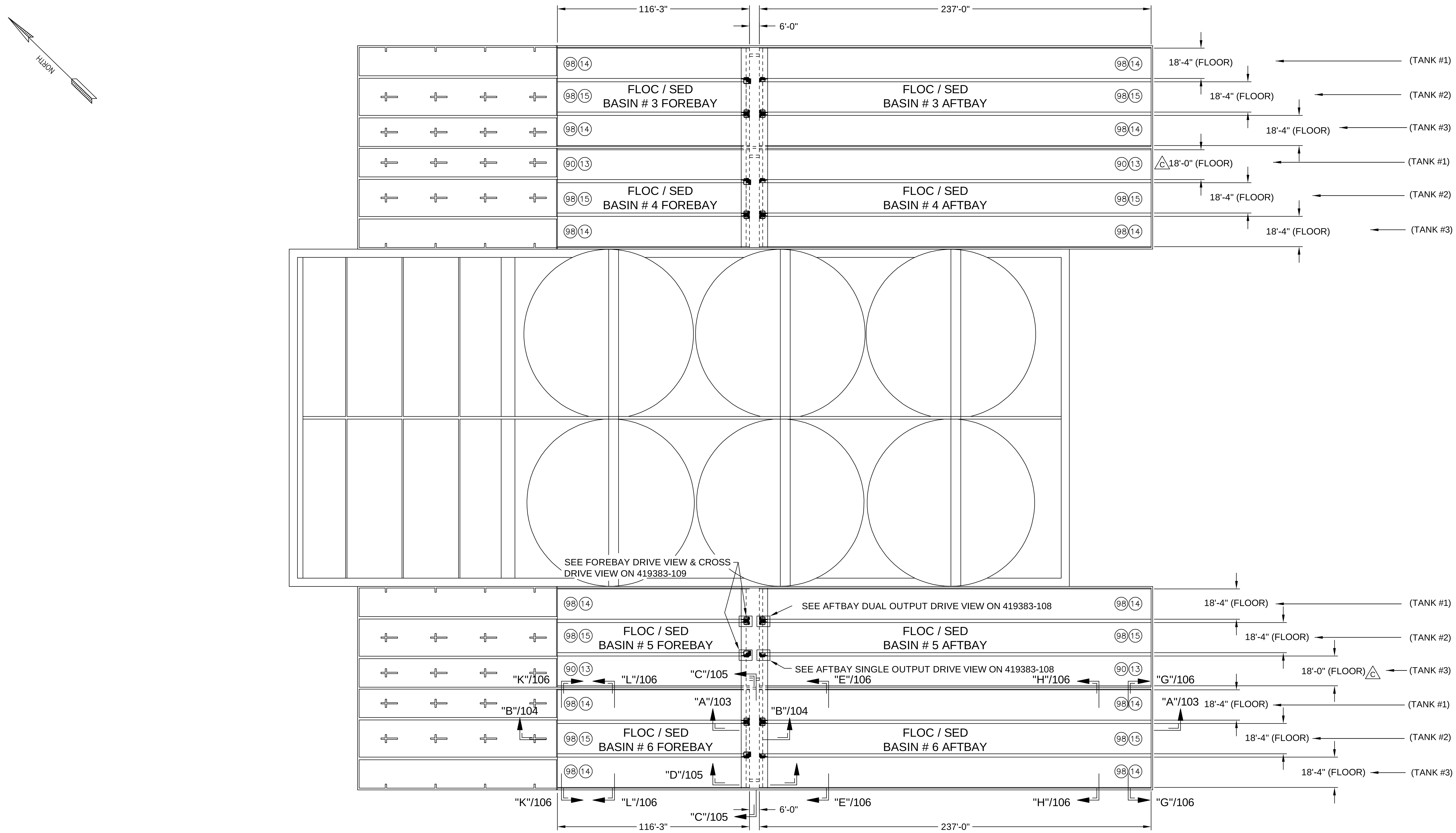
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES, REV'D CORNERSHAFTS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	11/5/21	GLH	AJK	JMM	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - SPECIFICATIONS CSSC (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-101	1 OF 1	B

BAR = 1" AT PLOT SCALE

STD 24x36_D v4.0



PLAN VIEW
PRIMARY SEDIMENTATION BASINS

SCALE: 1/16" = 1'-0"

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REV'D TANK WIDTHS IN #4 & 5, CHGING FLIGHTS, HEADSHAFTS & CORNERSHAFTS		GLH	AJK	SW	
B	REVISED DRIVES FROM EURODRIVE TO NORD ADDED DUAL LIMIT SWITCHES	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY:	DATE
G.HALASE	11/5/21
CKD BY: G.HALASE	11/5/21
APPD BY: A.KLUESS	11/5/21
MGD BY: J.MCDOND	SCALE: NTS

TITLE: GEN. ARRANGEMENT - PLAN VIEW CSSC
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-102	1 OF 1	C

STD 22x34_D v4.0
BAR = 1" AT PLOT SCALE

SECTION "A-A"/102 (TYP AFTBAY CENTER TANKS #2 NORTH WALLS SHOWN)
SECTION "A-A"/102 (TYP AFTBAY CENTER TANKS #2 SOUTH WALLS OPPOSITE SHOWN)

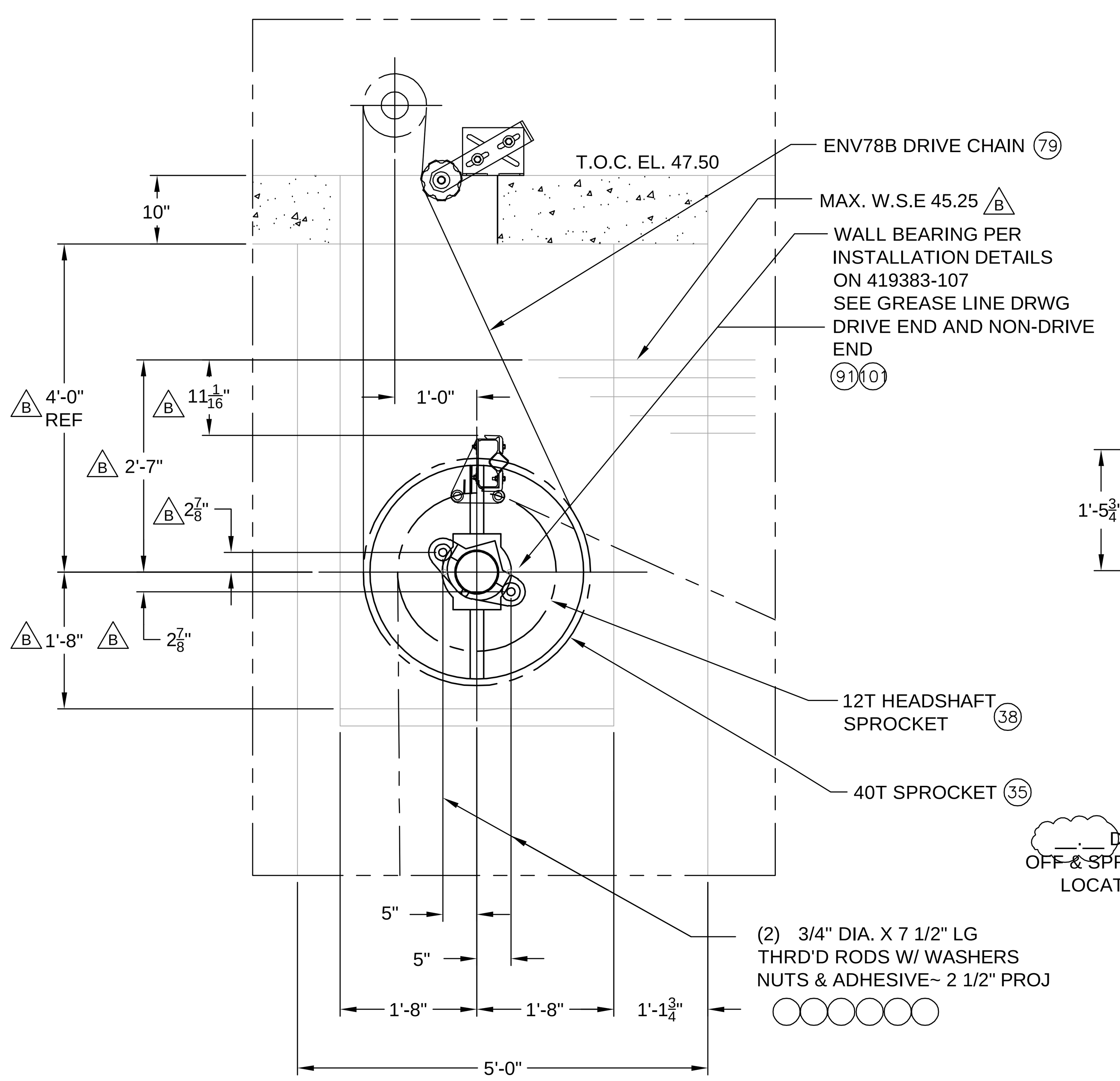
B * EVOQUA'S STANDARD LOCATION OF SLOTS FOR MOUNTING RETURN TRACK BRACKETS

SCALE: 1/8" = 1'-0"

SECTION "A-A"/102 (AFTBAY TANK #3 NORTH WALLS BASINS #3, 4, 5 & 6 SHOWN)
SECTION "A-A"/102 (AFTBAY TANKS #1 SOUTH WALLS BASINS 3,4,5 & 6 OPPOSITE SHOWN)

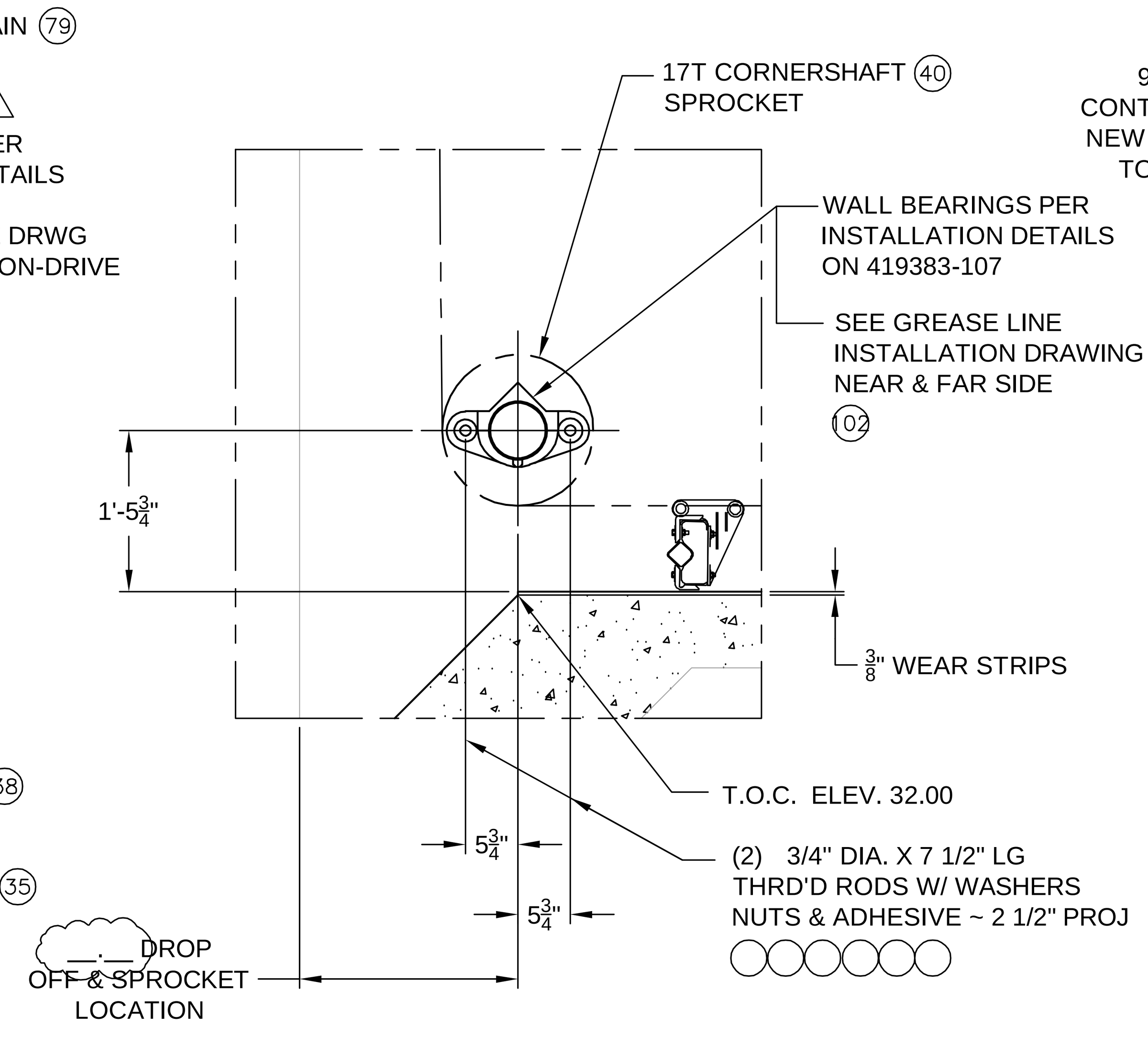
B * EVOQUA'S STANDARD LOCATION OF SLOTS FOR MOUNTING RETURN TRACK BRACKETS

SCALE: 1/8" = 1'-0"



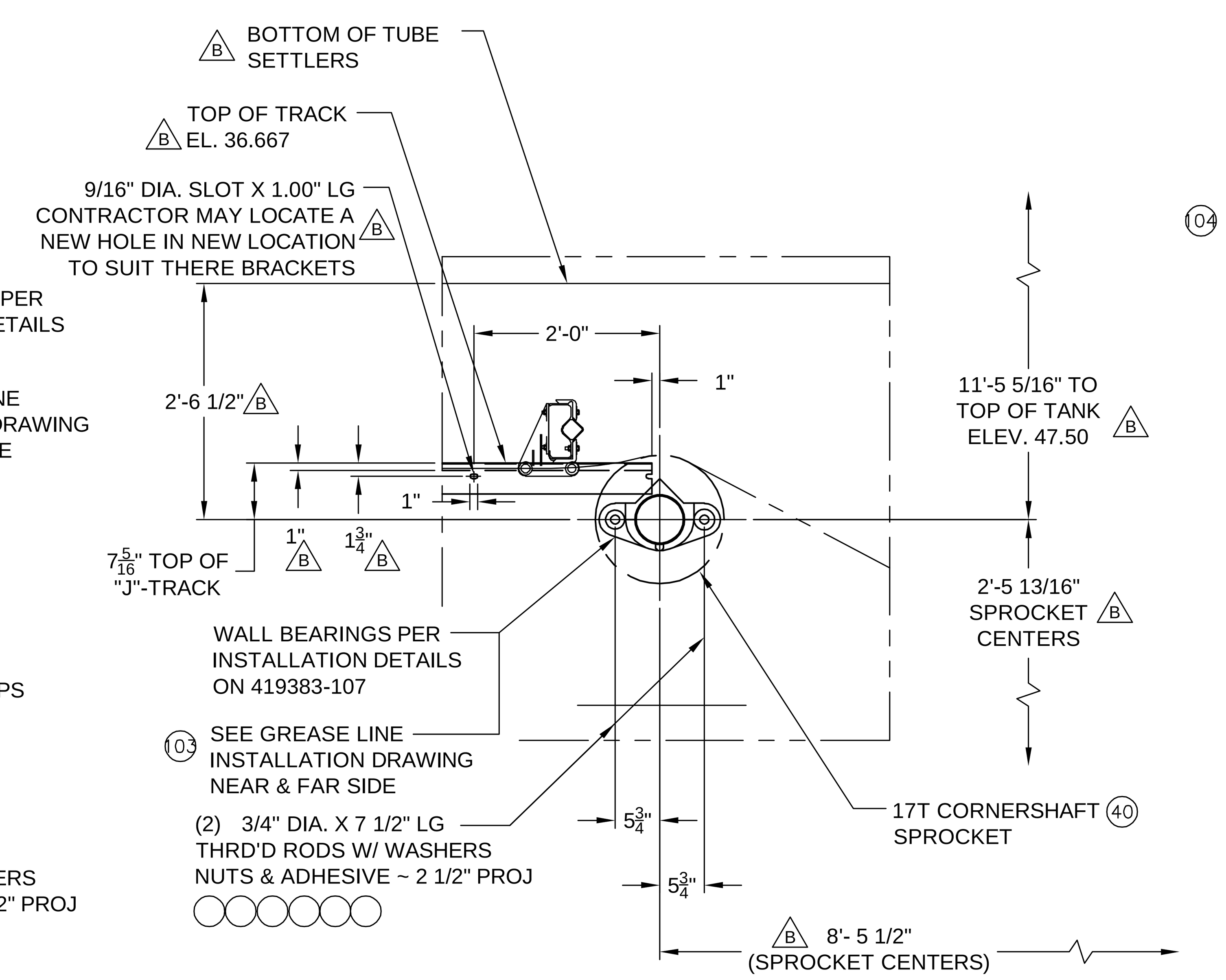
HEADSHAFT DETAIL

SCALE: 3/4" = 1'-0"



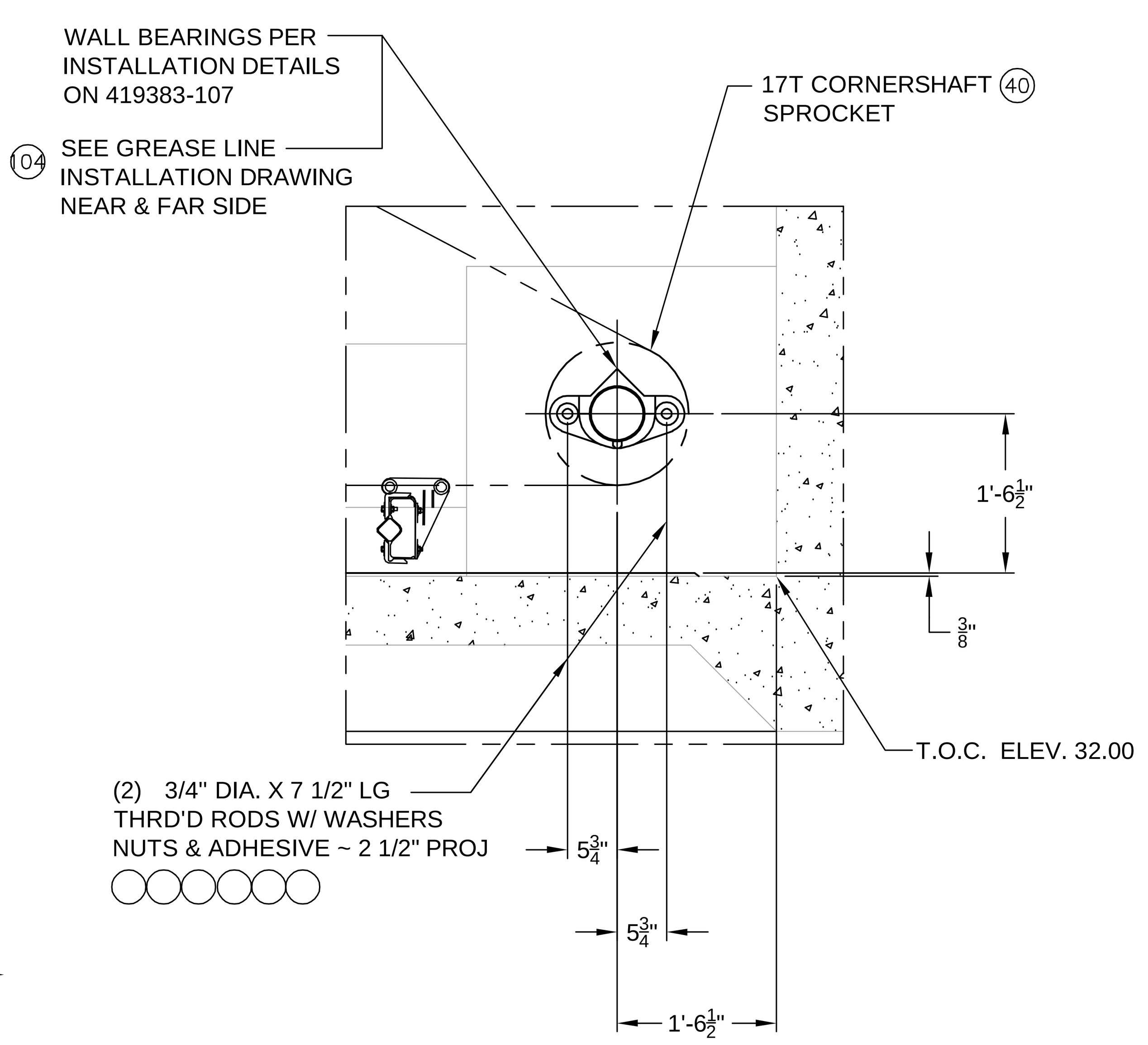
LOWER INFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



UPPER EFFLUENT CORNERSHAFT DETAIL

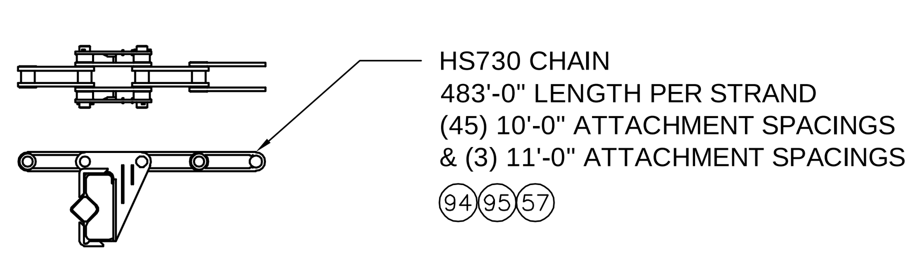
SCALE: 3/4" = 1'-0"



LOWER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"

TRAVEL



COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES ALL WEIGHTS ARE POUNDS AND EACH DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, .XXX ± .005, X/X ± 1/16, ANG ± 0.50°

MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS. REV'D HEADSHAFT LOCATION. ADDED TUBE SETTLER DIM'S. ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	
CKD BY: G.HALASE	DATE 11/5/21	
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDONOND	SCALE NTS	

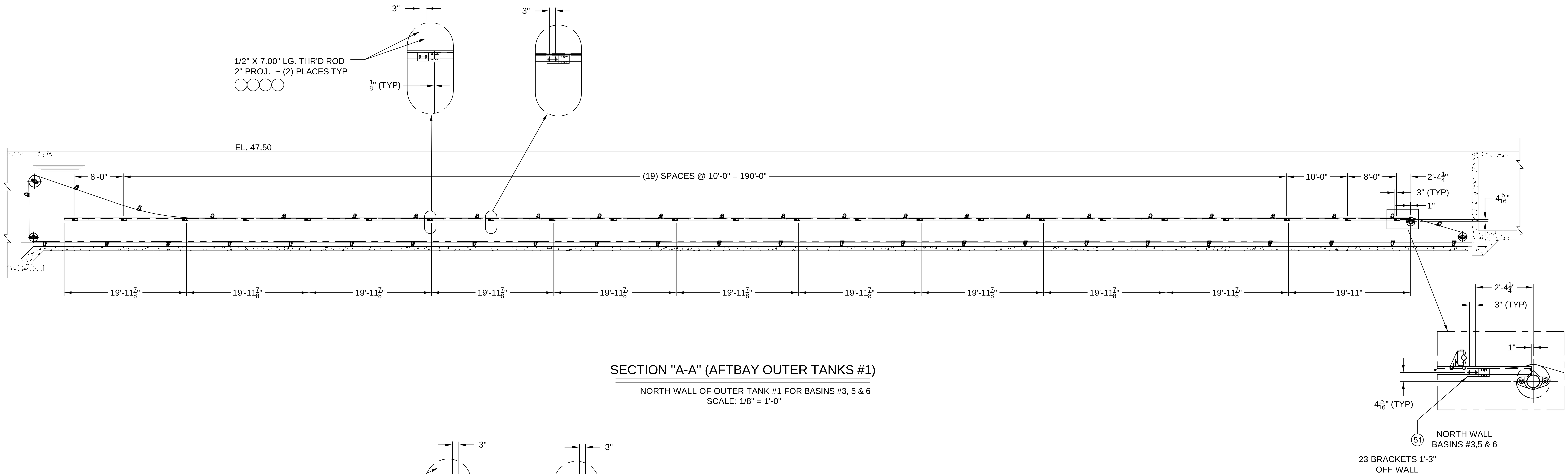
TITLE: GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

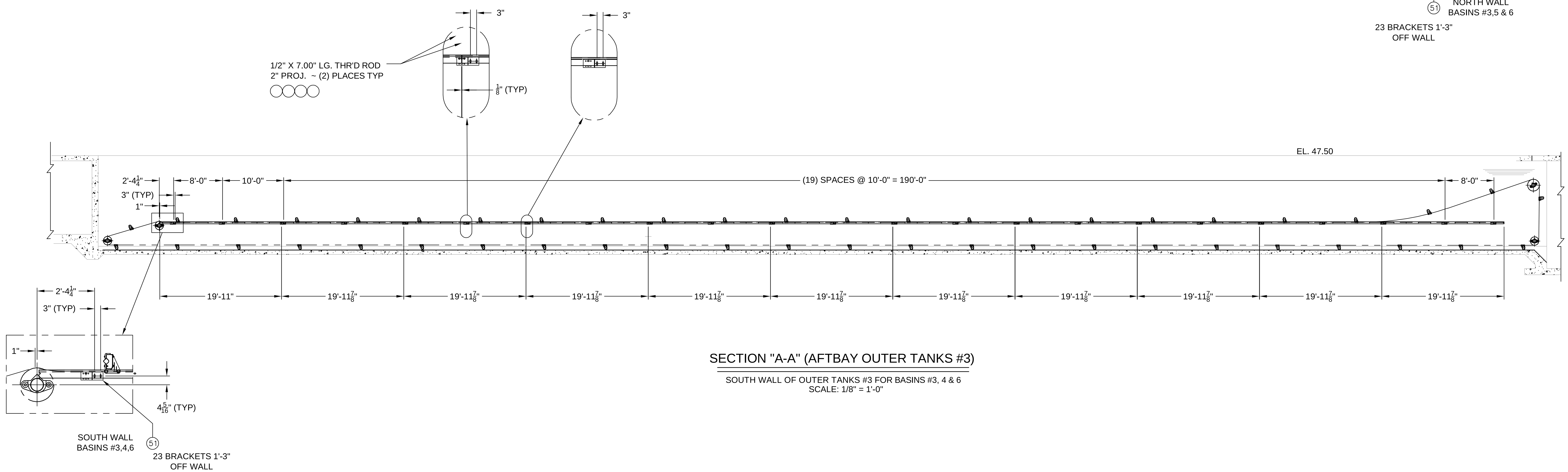
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-103	1 OF 4	B

STD-22x34_D v4.0 BAR = 1" AT PLOT SCALE



SECTION "A-A" (AFTBAY OUTER TANKS #1)

NORTH WALL OF OUTER TANK #1 FOR BASINS #3, 5 & 6
SCALE: 1/8" = 1'-0"



SECTION "A-A" (AFTBAY OUTER TANKS #3)

SOUTH WALL OF OUTER TANKS #3 FOR BASINS #3, 4 & 6
SCALE: 1/8" = 1'-0"

BAR = 1" AT PLOT SCALE

STD 22x34_D v4.0

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06; .XXX ± .005; X/X ± 1/16; ANG ± 0.50°
MACHINED SURFACES: 250

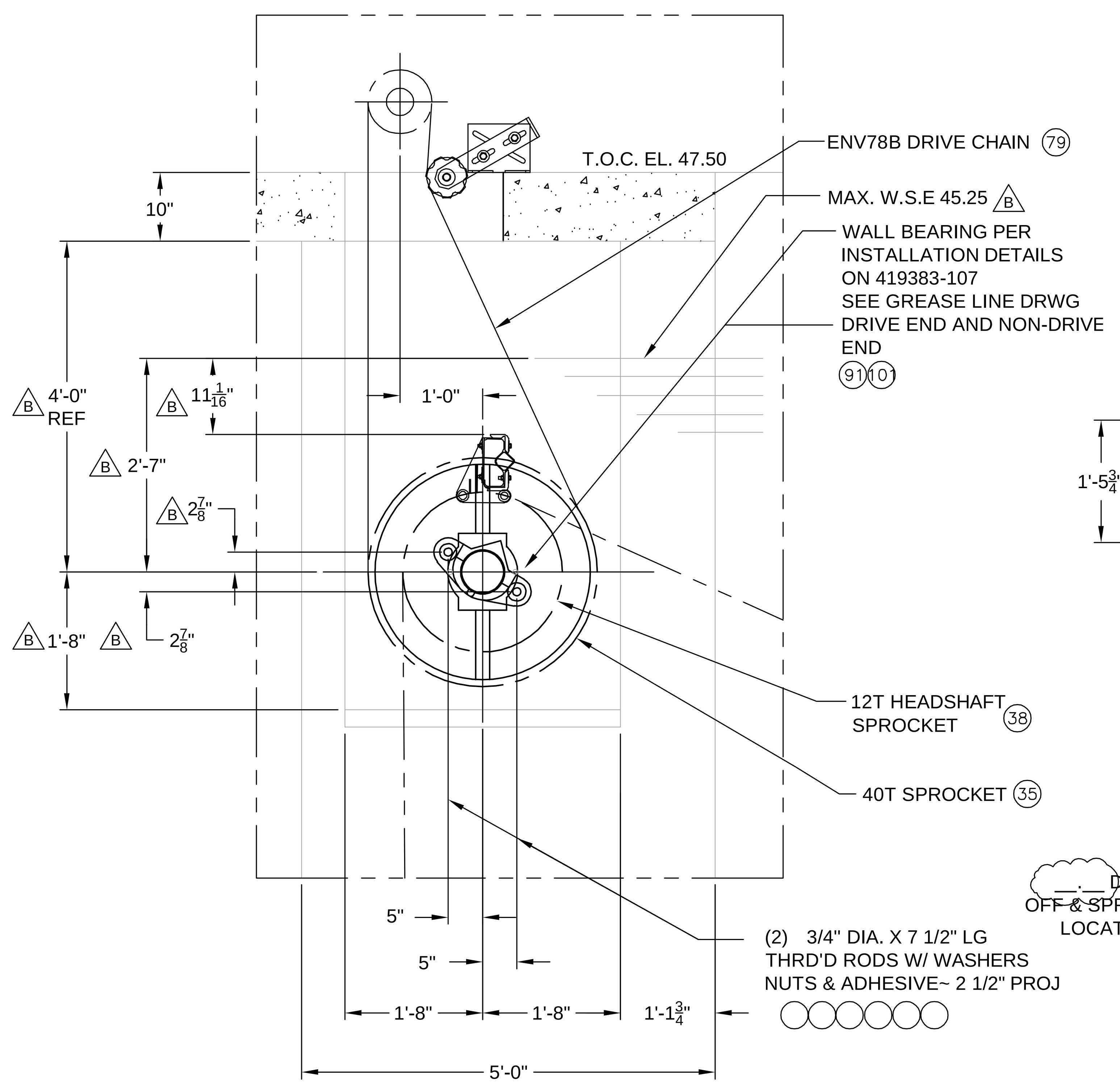
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS. REV'D HEADSHAFT LOCATION. ADDED TUBE SETTLER DIM'S. ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	TITLE: GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES — EVOQUA WATER TECHNOLOGIES, WAUKESHA WI USA, +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-103	2 OF 4	B

SECTION "A-A"/102 (AFTBAY NORTH WALL TANK #3 BASIN #5 SHOWN)
SECTION "A-A"/102 (AFTBAY SOUTH WALL TANK #1 BASIN #4 OPPOSITE SHOWN)

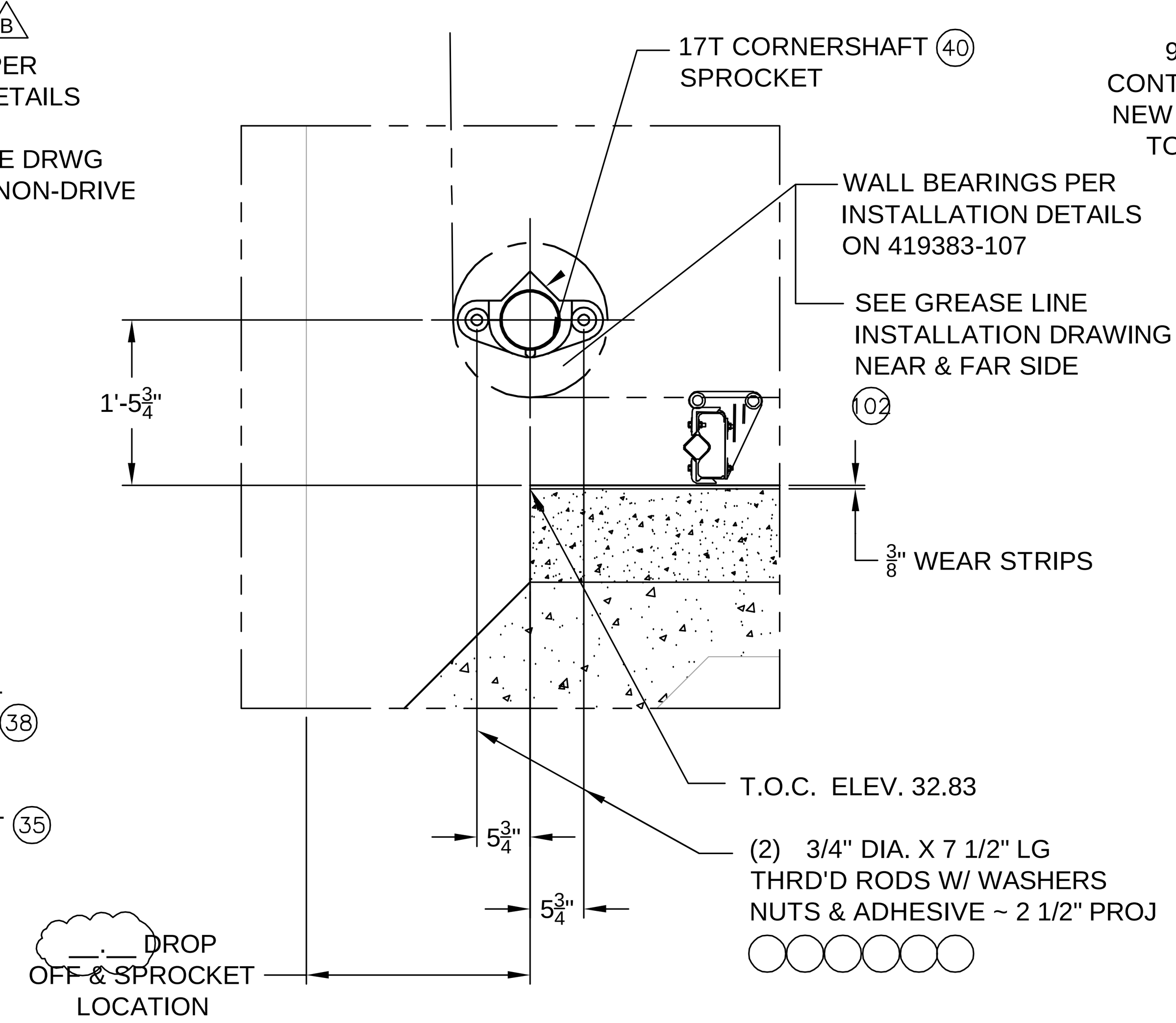
B * EVOQUA'S STANDARD LOCATION OF SLOTS FOR MOUNTING RETURN TRACK BRACKETS



HEADSHAFT DETAIL

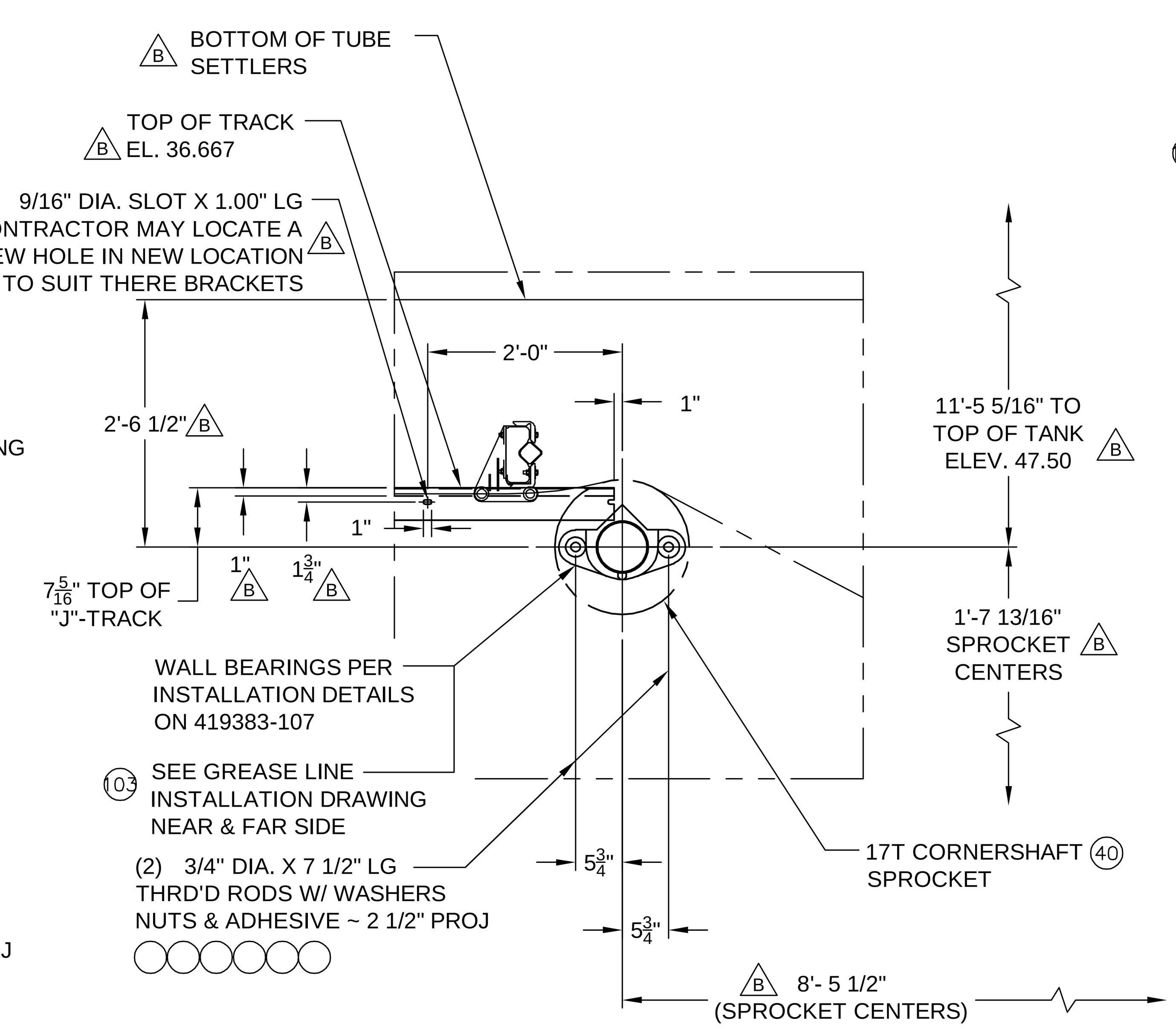
SCALE: 3/4" = 1'-0"

TRAVEL



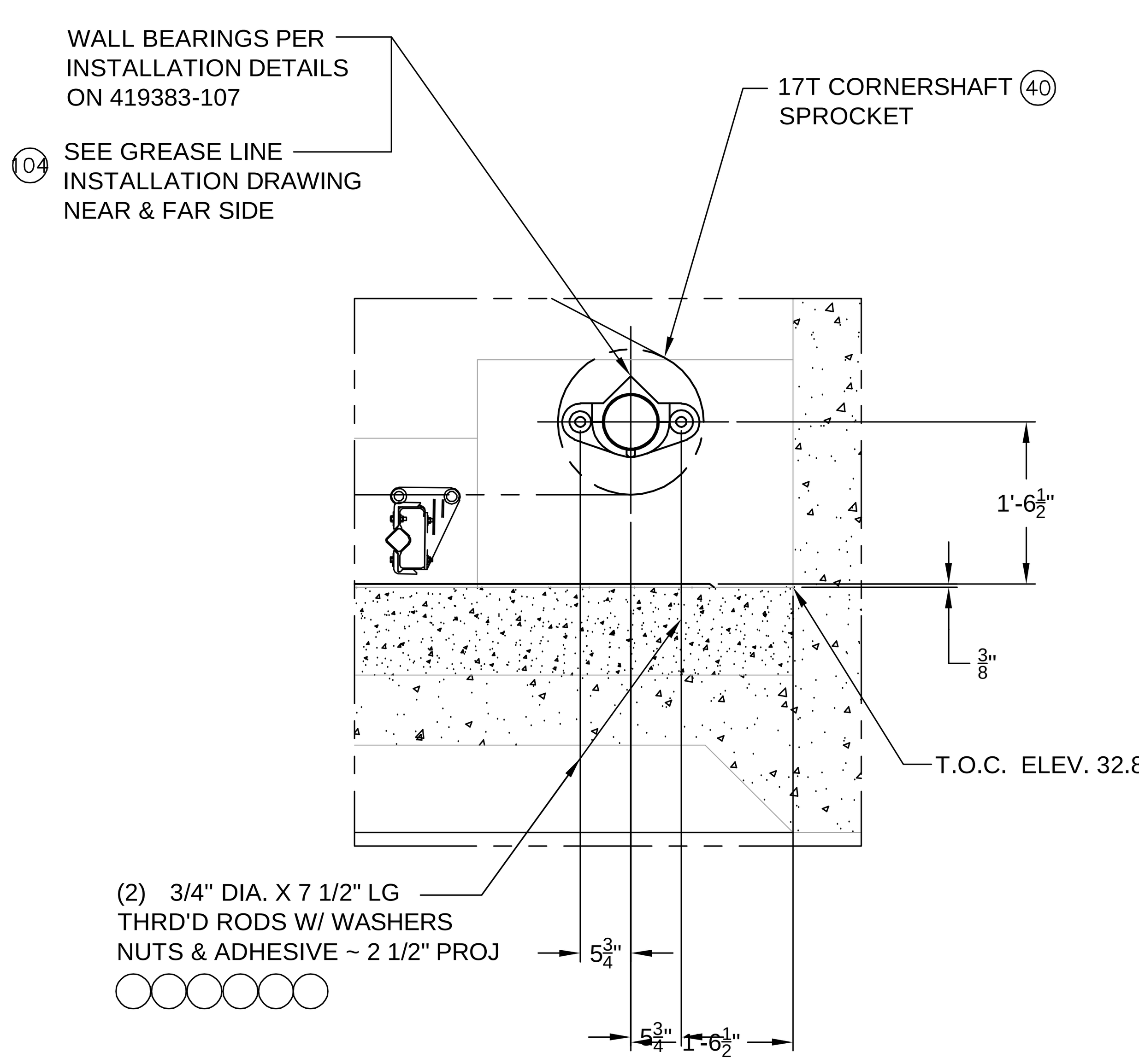
LOWER INFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



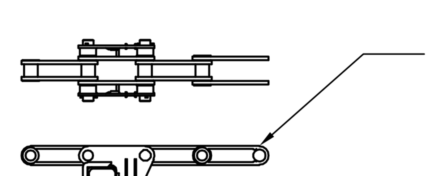
UPPER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



LOWER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"

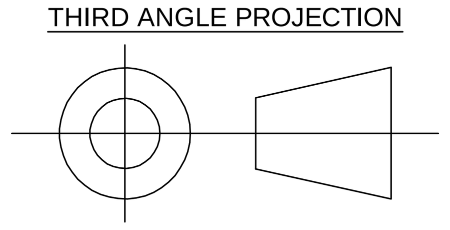


HS730 CHAIN
483'-0" LENGTH PER STRAND
(45) 10'-0" ATTACHMENT SPACINGS
& (3) 11'-0" ATTACHMENT SPACINGS
94 95 57

COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS. REV'D HEADSHAFT LOCATION. ADDED TUBE SETTLER DIM'S. ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	
CKD BY: G.HALASE	DATE 11/5/21	
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDOND	SCALE NTS	

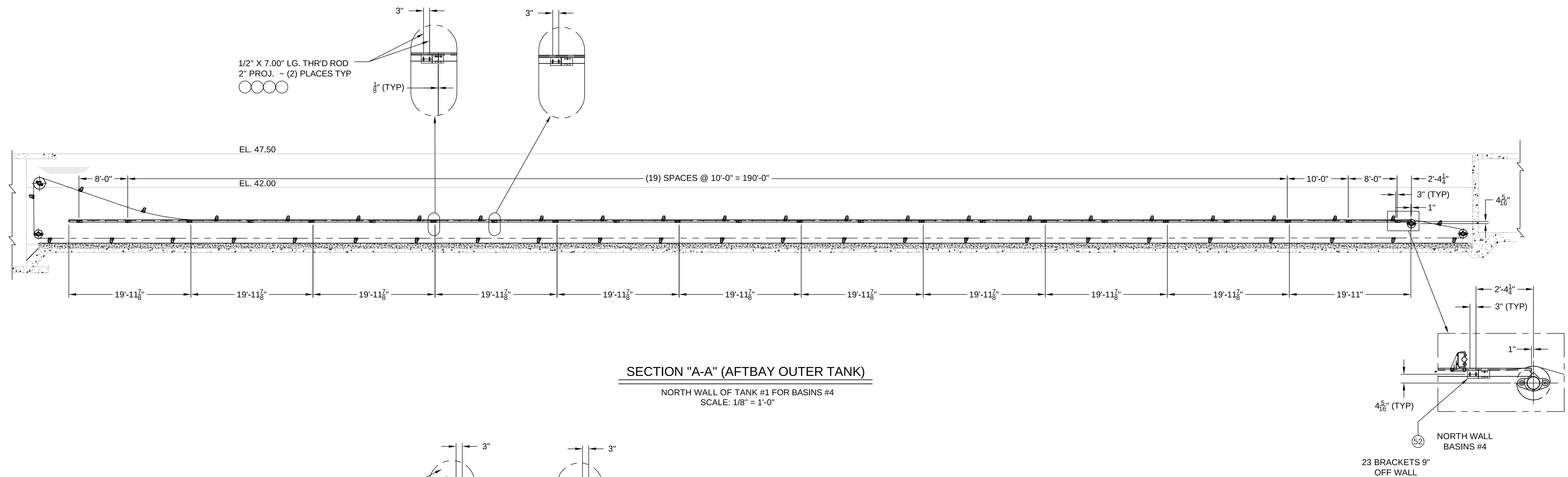
TITLE GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

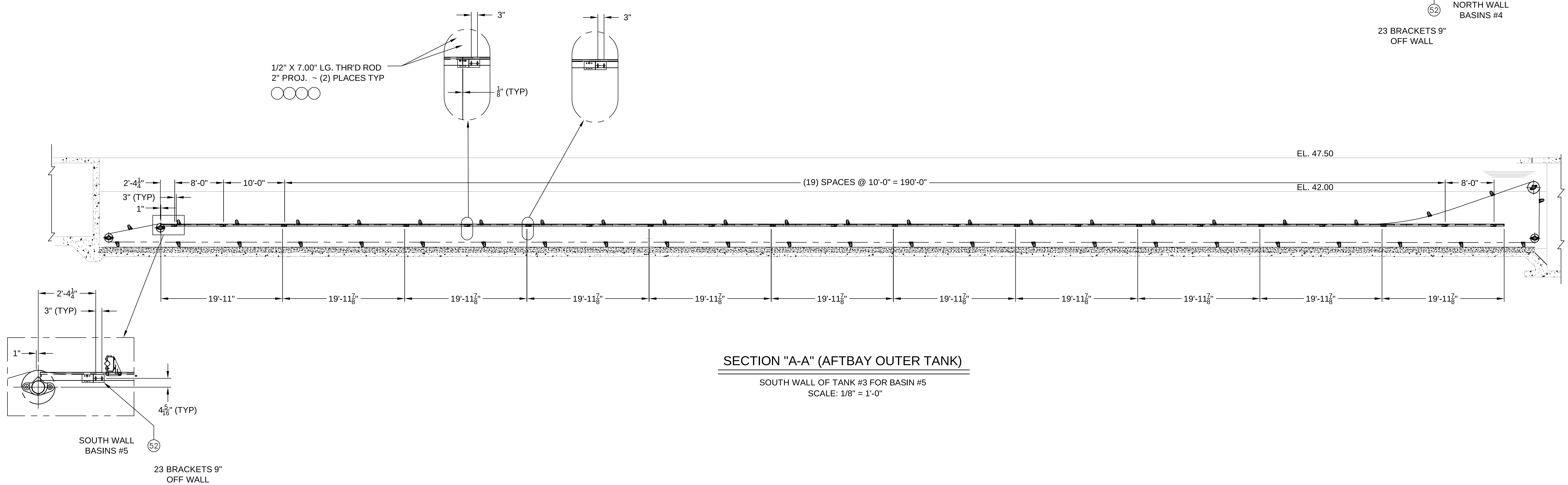
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-103	3 OF 4	B

STD-22x34_D v4.0
BAR = 1" AT PLOT SCALE



SECTION "A-A" (AFTBAY OUTER TANK)

NORTH WALL OF TANK #1 FOR BASINS #4
SCALE: 1/8" = 1'-0"



SECTION "A-A" (AFTBAY OUTER TANK)

SOUTH WALL OF TANK #3 FOR BASIN #5
SCALE: 1/8" = 1'-0"

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D FLIGHTS. REV'D HEADSHAFT LOCATION. ADDED TUBE SETTLER DIM'S. ADDED RETURN TRACK MOUNT HOLE LOC.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	
CKD BY: G.HALASE	DATE 11/5/21	
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDOND	SCALE NTS	
PART NUMBER N/A		

TITLE GEN. ARRANGEMENT - AFT BAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
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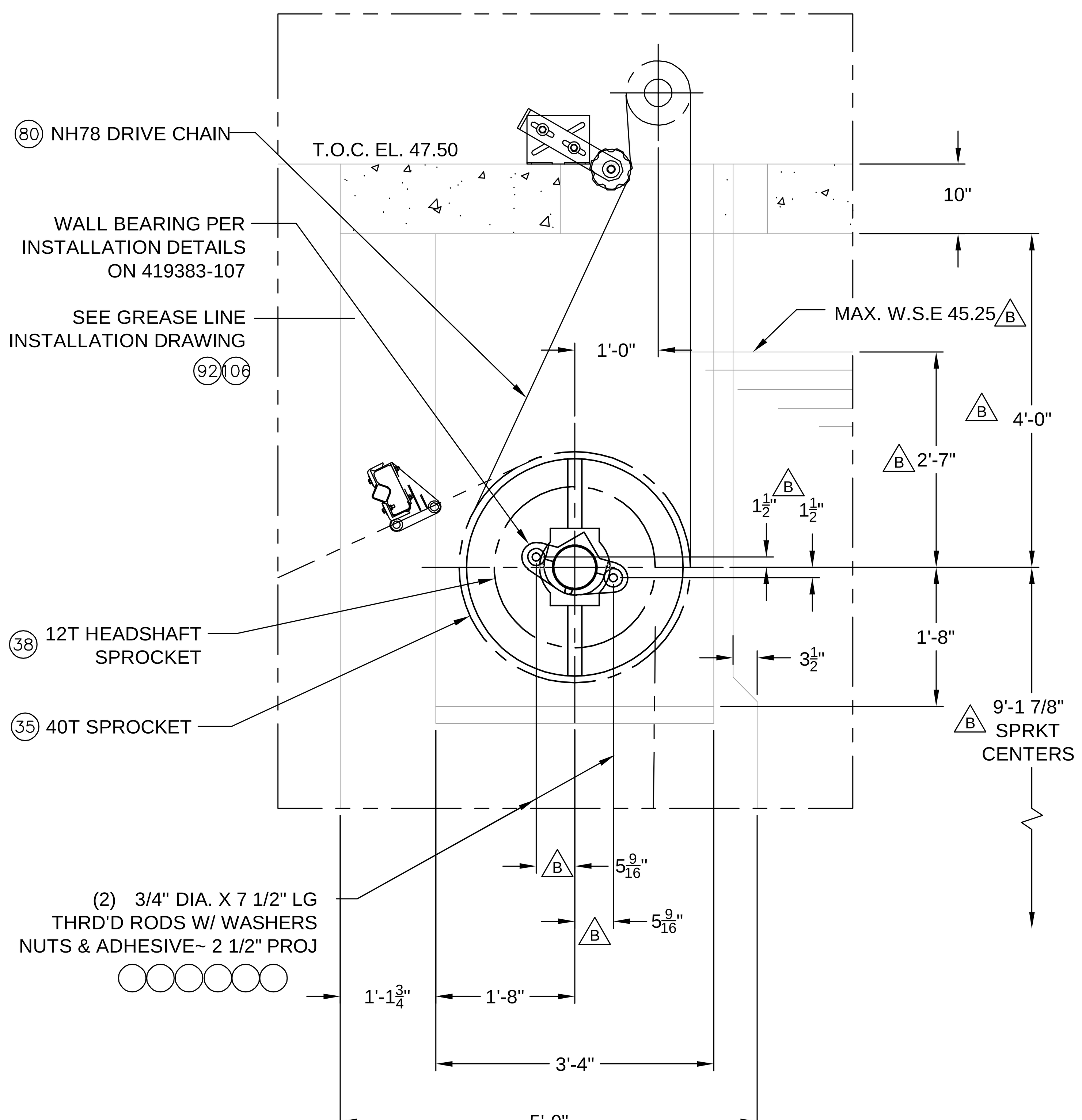
WAUKESHA WI USA
+1 262-547-0141

PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-103	4 OF 4	B

STD 22x34_D v4.0
BAR = 1" AT PLOT SCALE

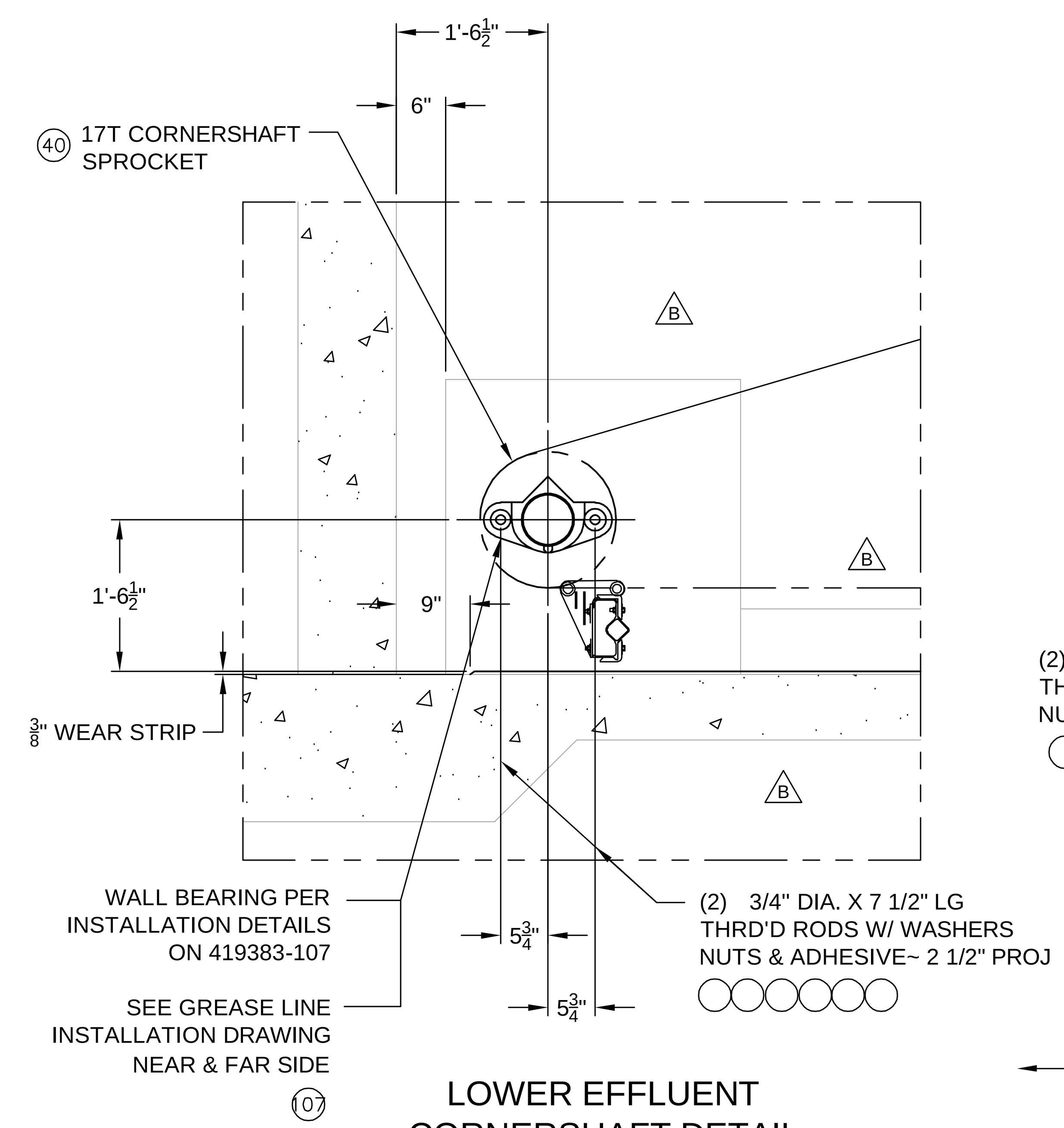
SECTION "B-B"/102 (TYP FOREBAY CENTER TANKS #2 NORTH WALLS SHOWN)
SECTION "B-B"/102 (TYP FOREBAY CENTER TANKS #2 SOUTH WALLS OPPOSITE SHOWN)

SECTION "B-B"/102 (TYP FOREBAY TANKS #3 NORTH WALLS BASINS #3,4,5 & 6 SHOWN)
SECTION "B-B"/102 (TYP FOREBAY TANKS #1 SOUTH WALLS BASINS 33,4,5 & 6 OPPOSITE SHOWN)



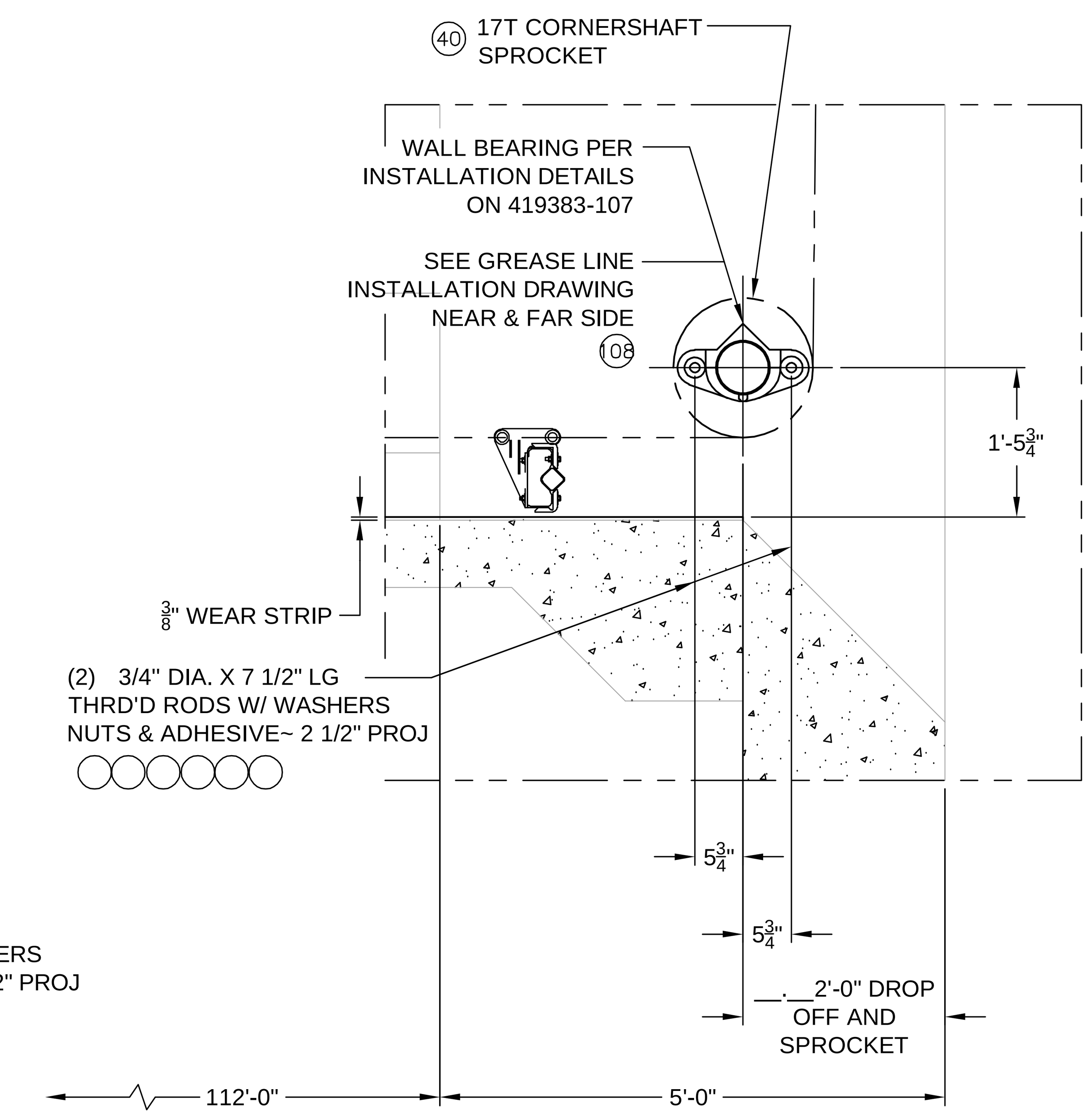
HEADSHAFT DETAIL

SCALE: 3/4" = 1'-0"



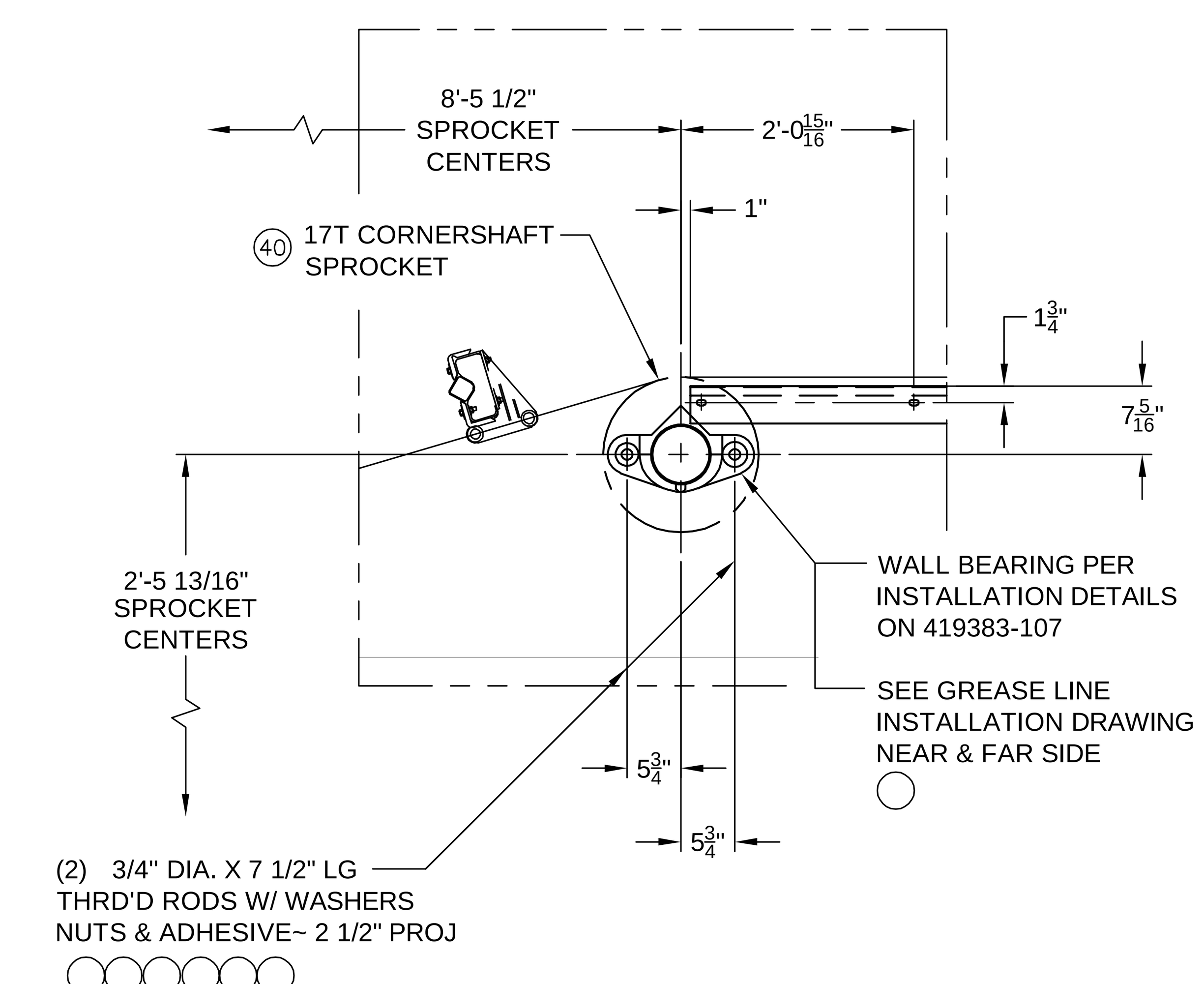
LOWER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



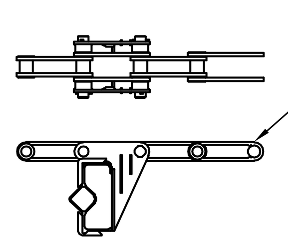
LOWER INFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



UPPER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY
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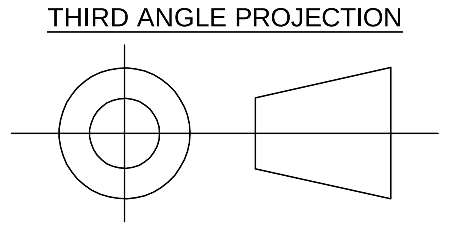
THIRD ANGLE PROJECTION



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06; .XXX ± .005; X/X ± 1/16; ANG ± 0.50°

MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90. REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	1 OF 4	B

STD 22x34_D v4.0
BAR = 1" AT PLOT SCALE

SECTION "B-B"/102 (FOREBAY OUTER TANKS #1)

B NORTH WALL OF OUTER TANKS #1 FOR BASINS #3,5 & 6

SECTION "B-B"/102 (FOREBAY OUTER WALLS TANK #3)

SOUTH WALL OF OUTER TANKS #3 FOR BASINS #3,4 & 6

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, XXX ± .005, X/X ± 1/16, ANG ± 0.50°
MACHINED SURFACES: 250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90. REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	
CKD BY: G.HALASE	DATE 11/5/21	
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDOND	SCALE NTS	

TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
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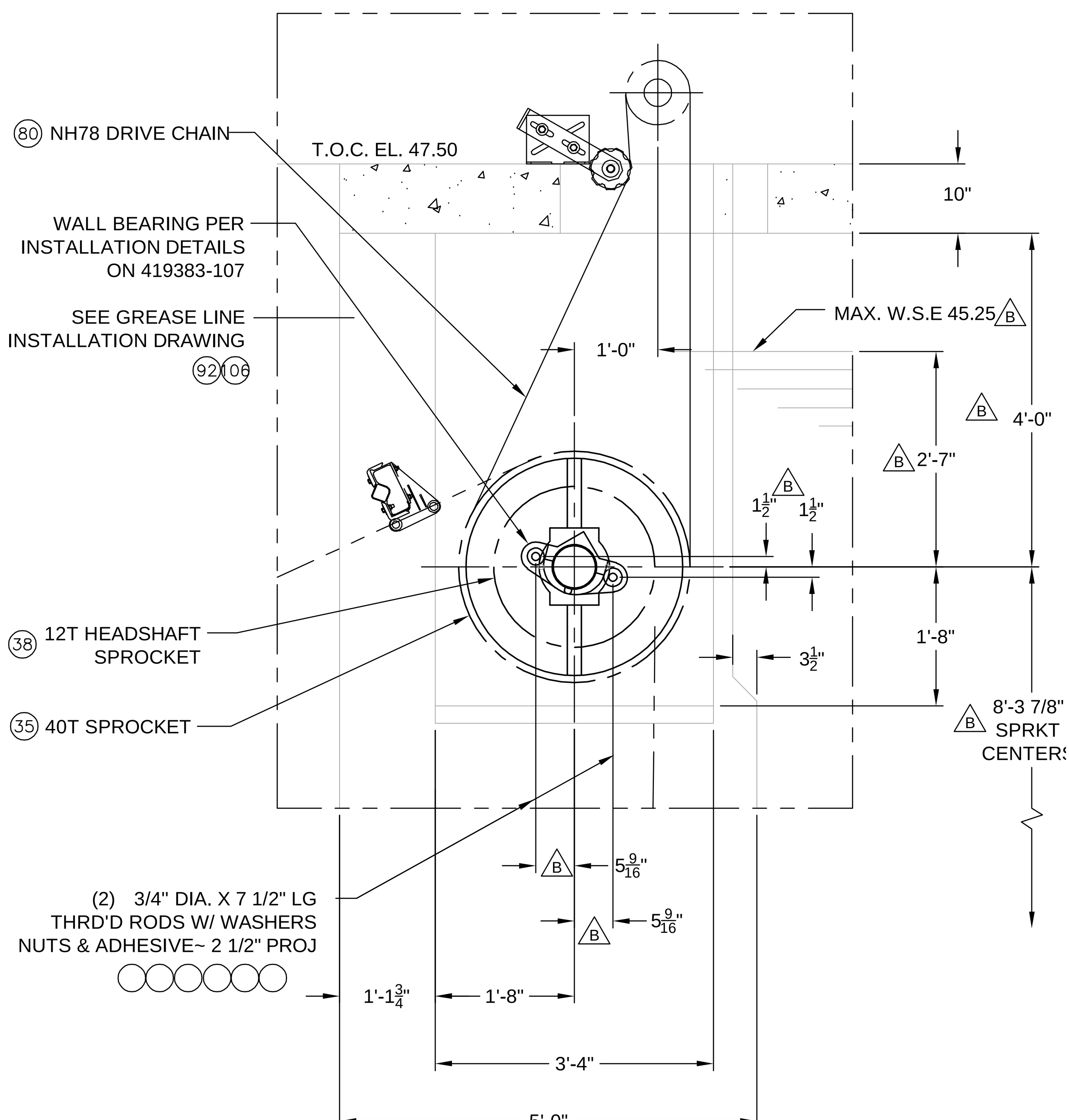
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	2 OF 4	B

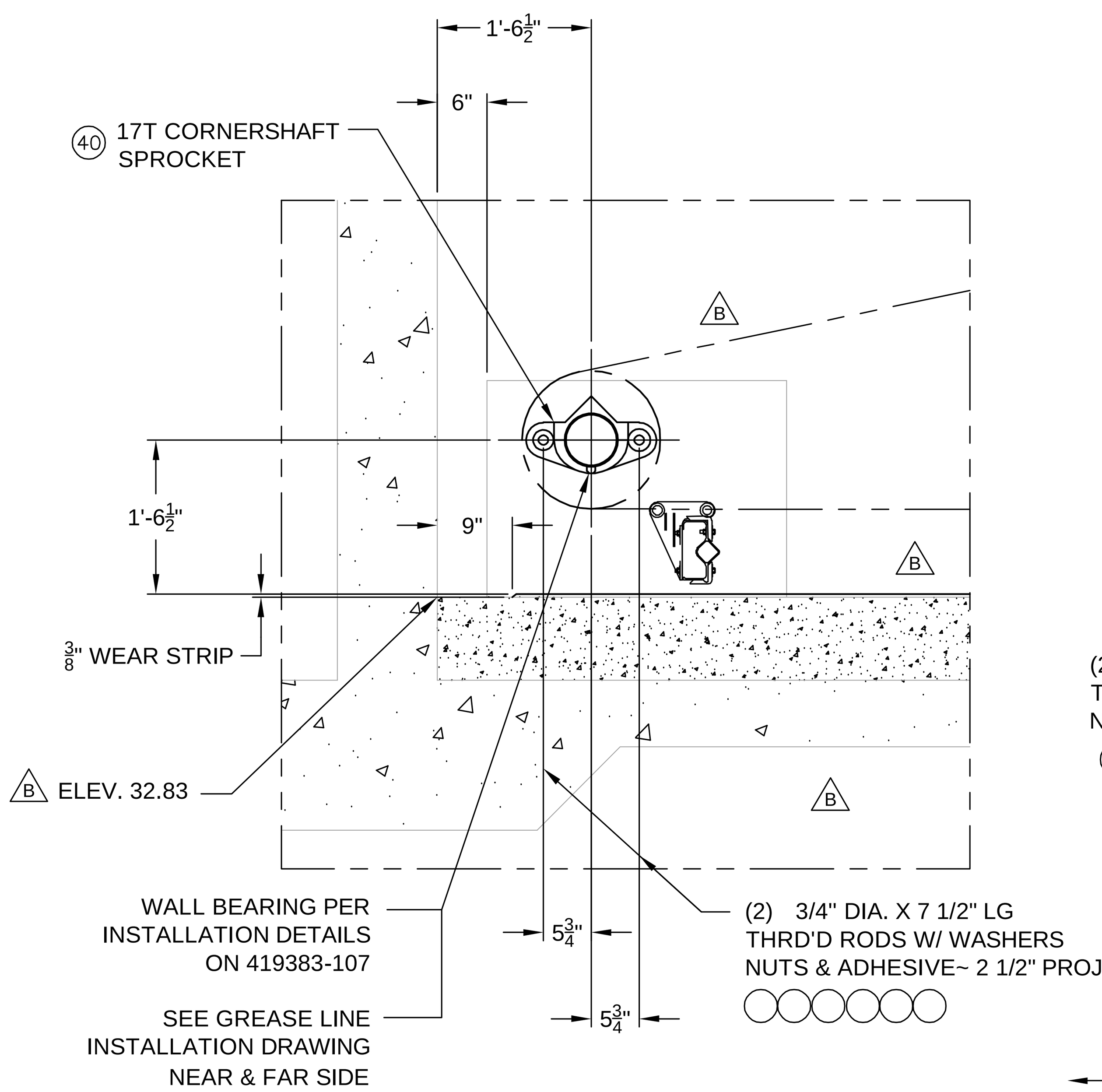
STD 22x34_D v4.0
BAR = 1" AT PLOT SCALE

SECTION "B-B"/102 (FOREBAY NORTH WALL TANK #3 BASIN #5 SHOWN)
SECTION "B-B"/102 (FOREBAY SOUTH WALL TANK #1 BASIN #4 OPPOSITE SHOWN)



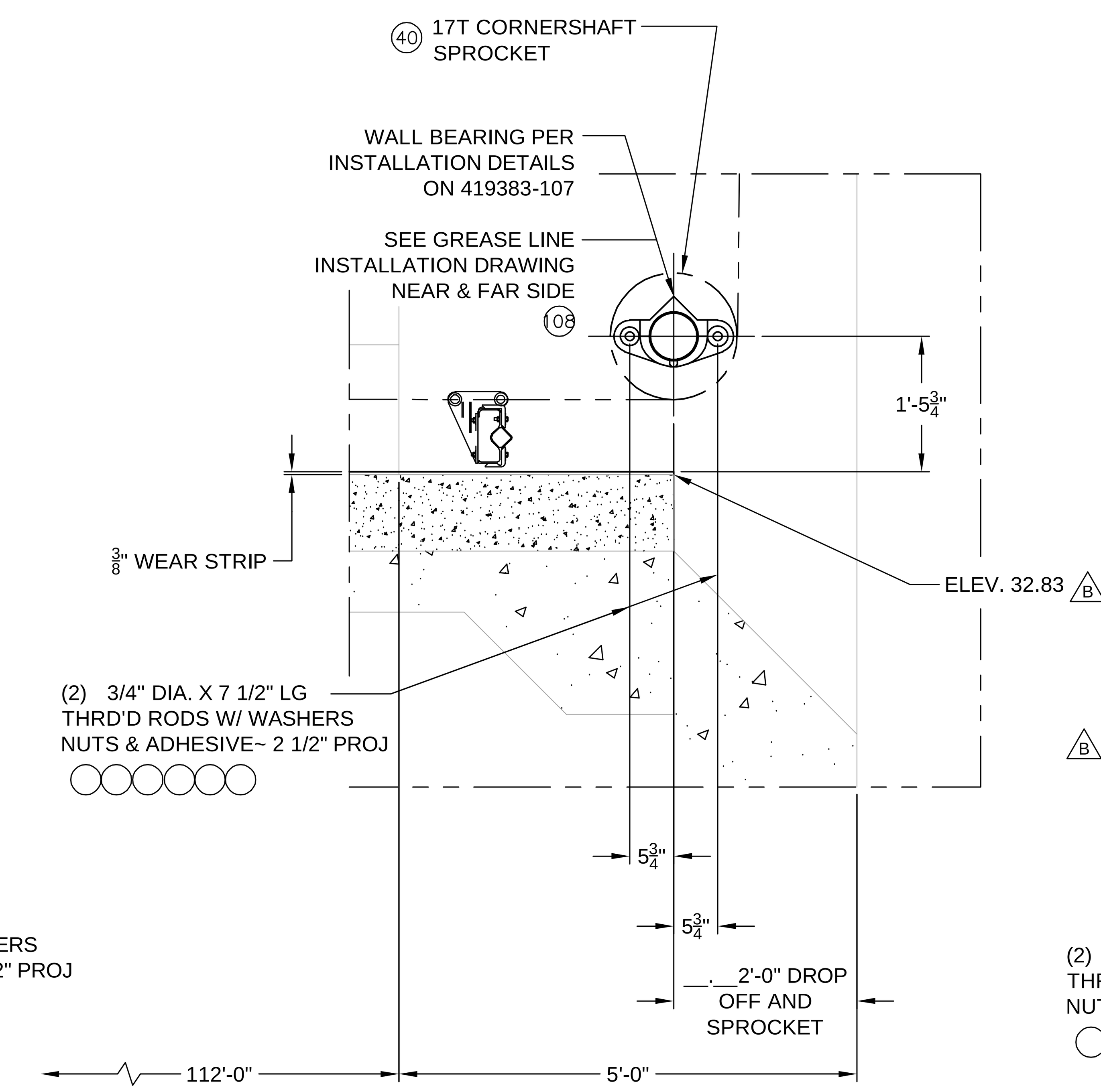
HEADSHAFT DETAIL

SCALE: 3/4" = 1'-0"



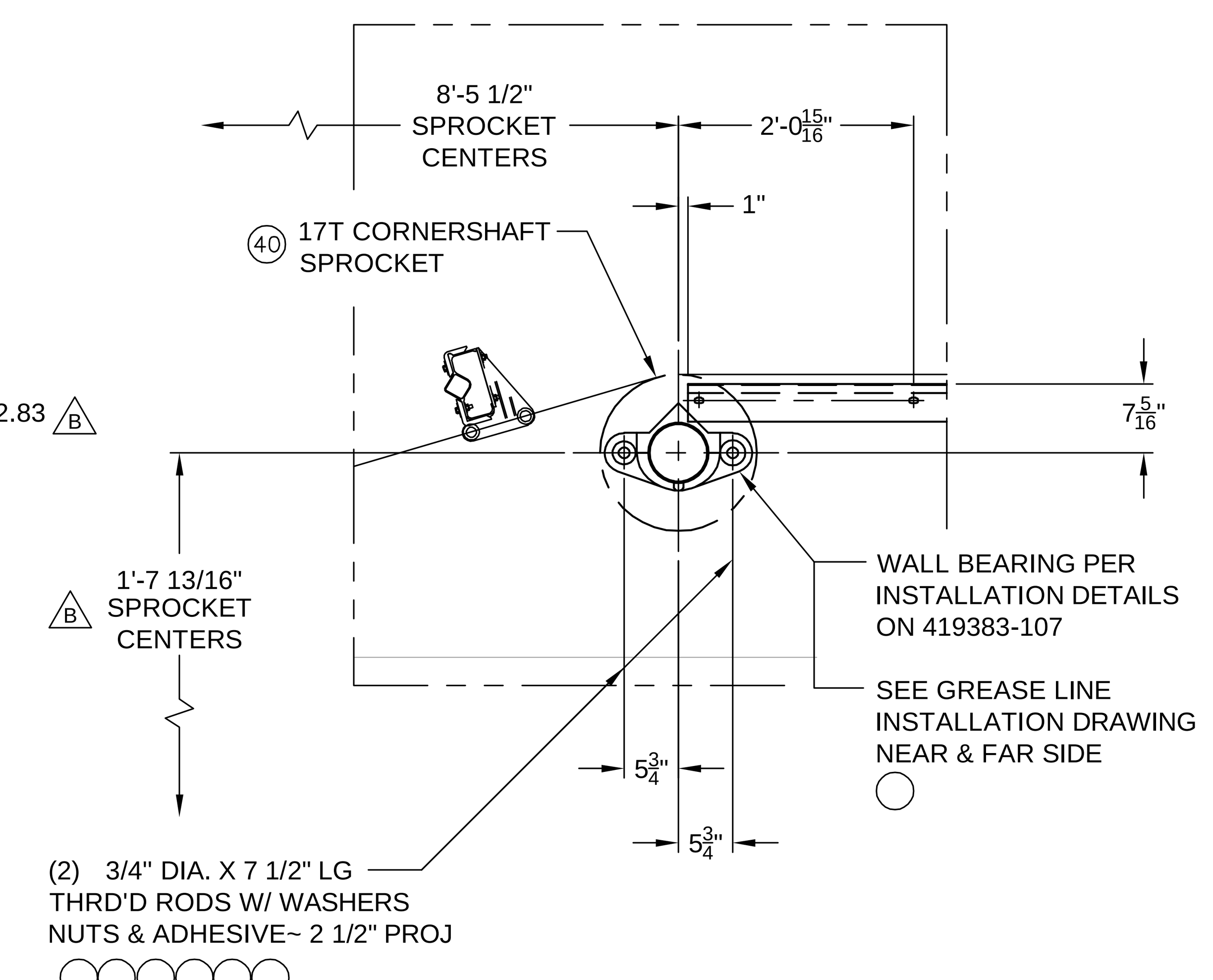
LOWER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



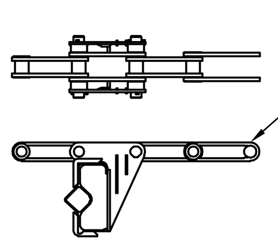
LOWER INFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



UPPER EFFLUENT CORNERSHAFT DETAIL

SCALE: 3/4" = 1'-0"



COLLECTOR CHAIN & FLIGHT DETAIL

FOR APPROVAL ONLY
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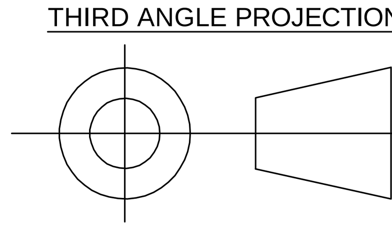
THIRD ANGLE PROJECTION



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90. REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	
CKD BY: G.HALASE	DATE 11/5/21	
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDONDO	SCALE NTS	

TITLE: GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
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+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	3 OF 4	B

BAR = 1" AT PLOT SCALE
STD-22x34_D v4.0

SECTION "B-B"/102 (FOREBAY OUTER TANK)

NORTH WALL OF TANK #1 FOR BASINS #4

SECTION "B-B"/102 (FOREBAY OUTER TANK)

SOUTH WALL OF TANK #3 FOR BASINS #5

FOR APPROVAL ONLY
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
.XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

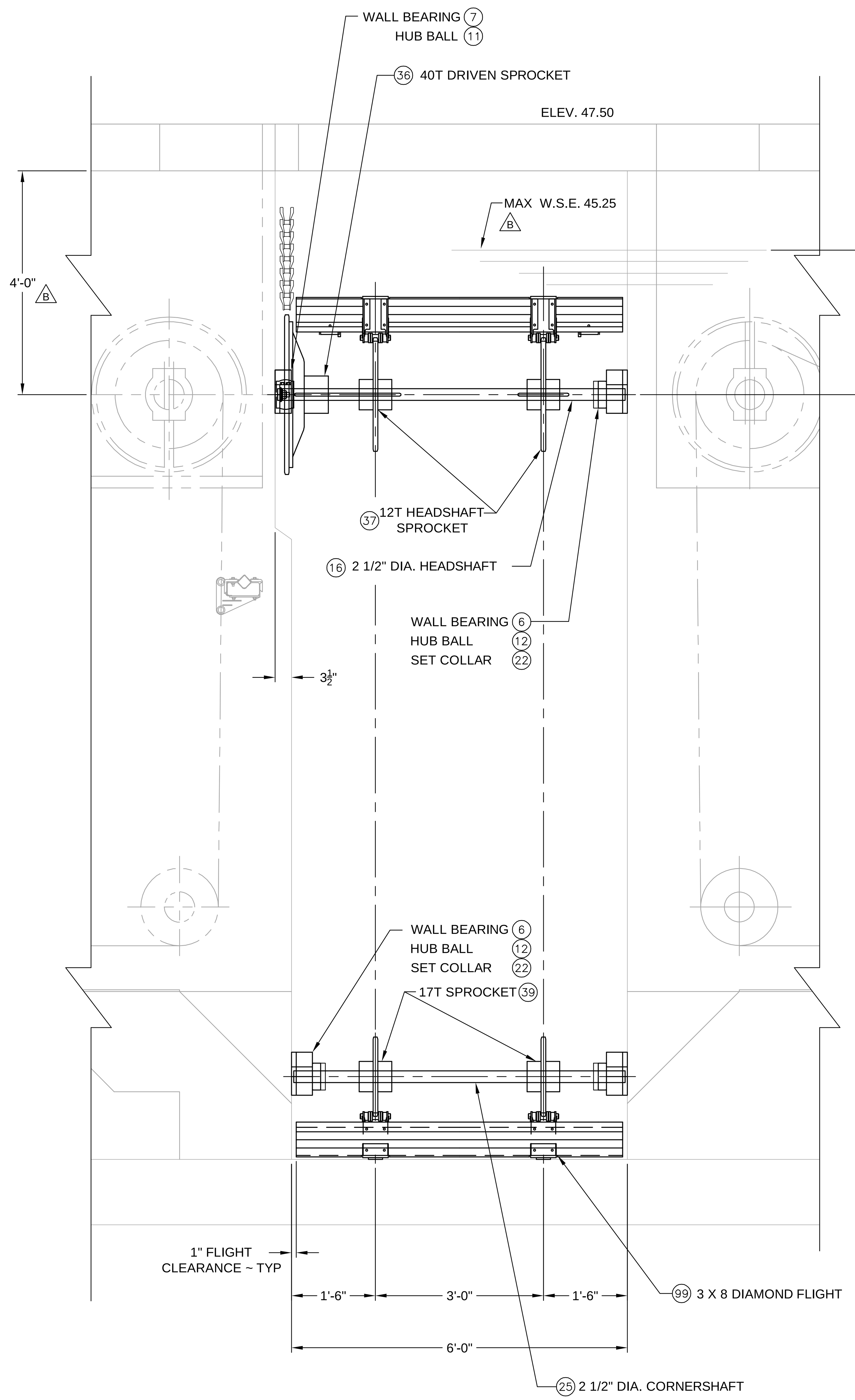
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90. REVISED RETURN TRACK LOCATION ADDED SHEET #2		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT-FOREBAY LONGITUDINAL ELEVATION VIEW (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	evoqua WATER TECHNOLOGIES — EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-104	4 OF 4	B

STD 22x34_D v4.0

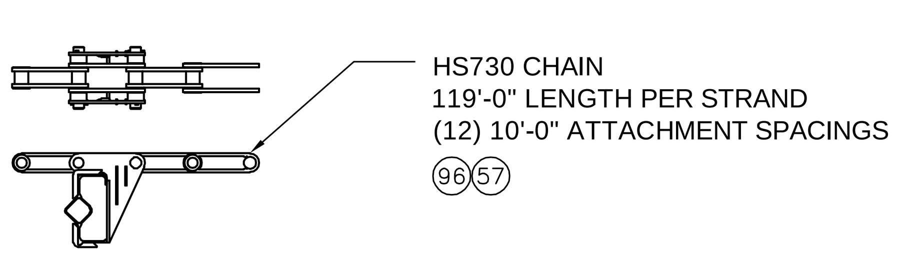
BAR = 1" AT PLOT SCALE



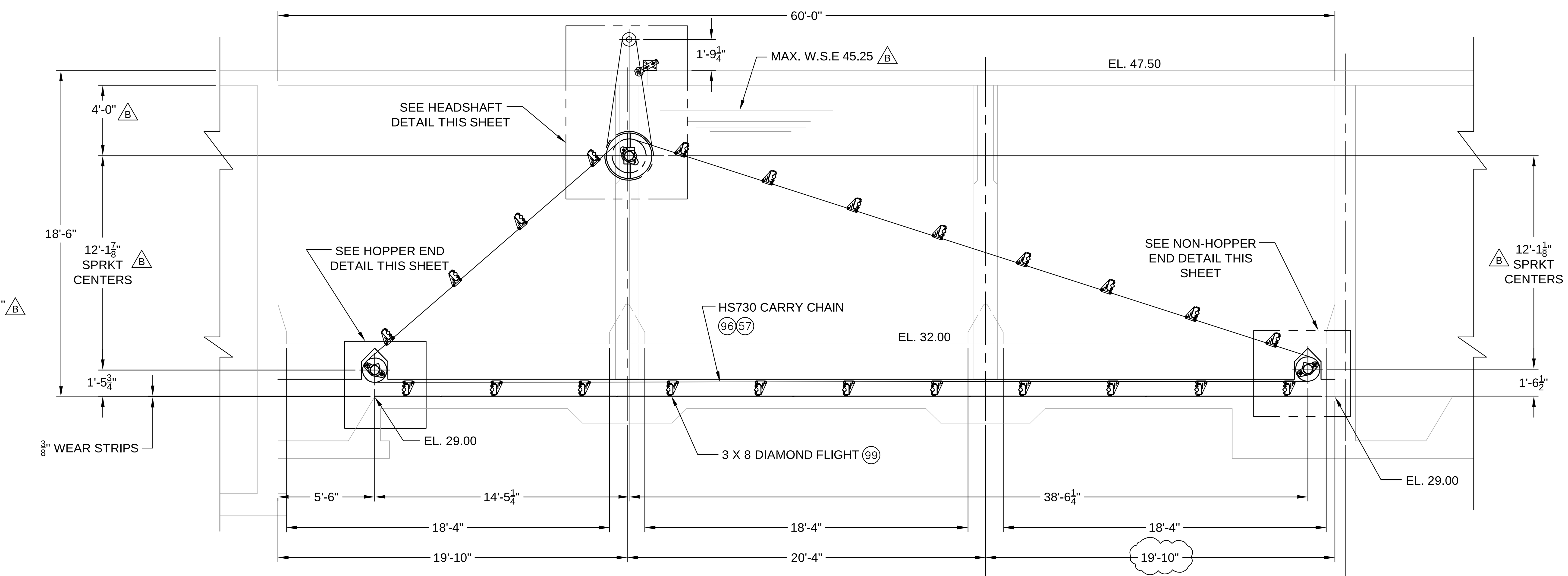
SECTION "D-D"/102

SCALE: 3/4" = 1'-0"

TRAVEL

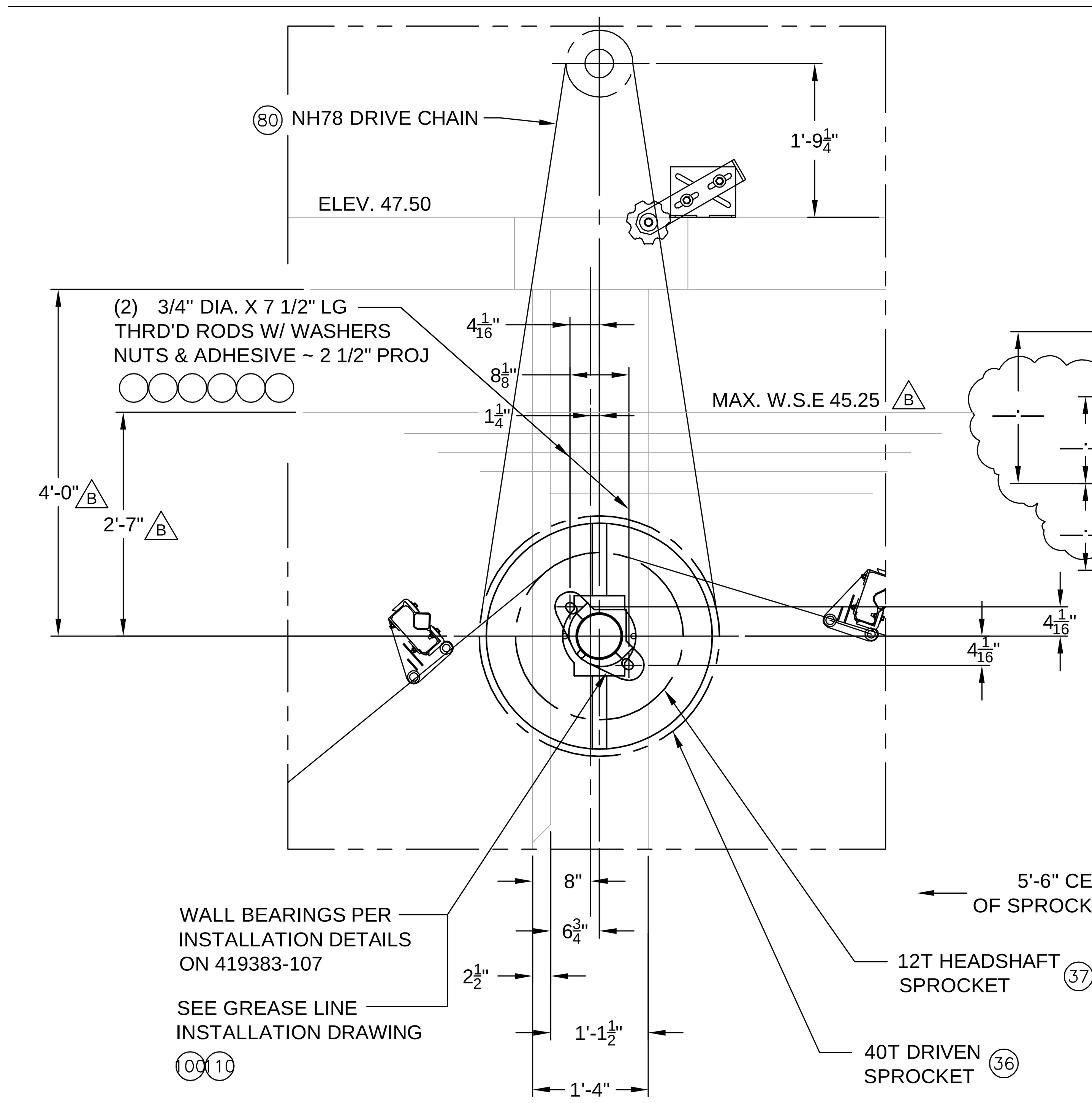


COLLECTOR CHAIN & FLIGHT DETAIL



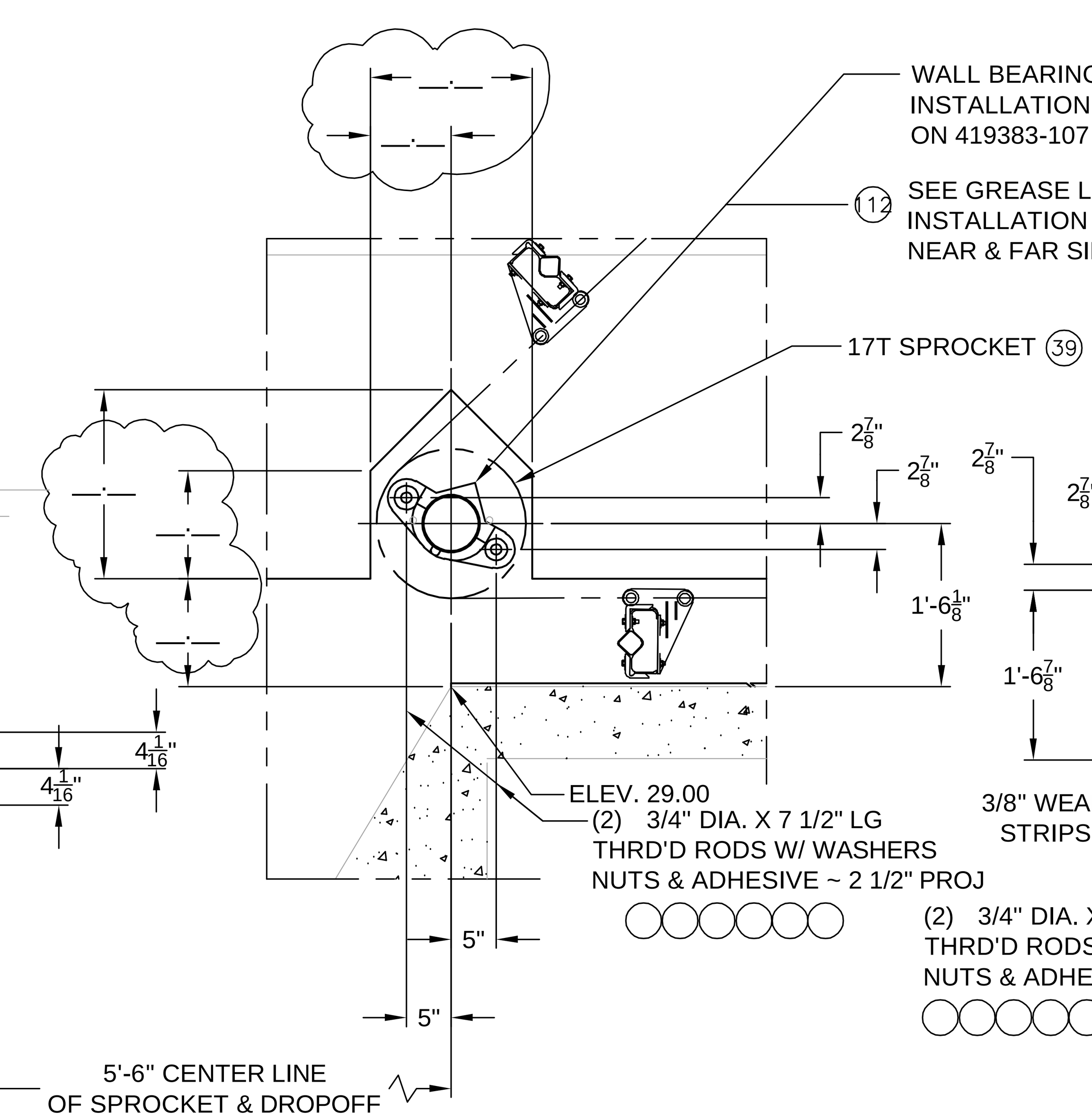
SECTION "C-C"/102

SCALE: 1/4" = 1'-0"



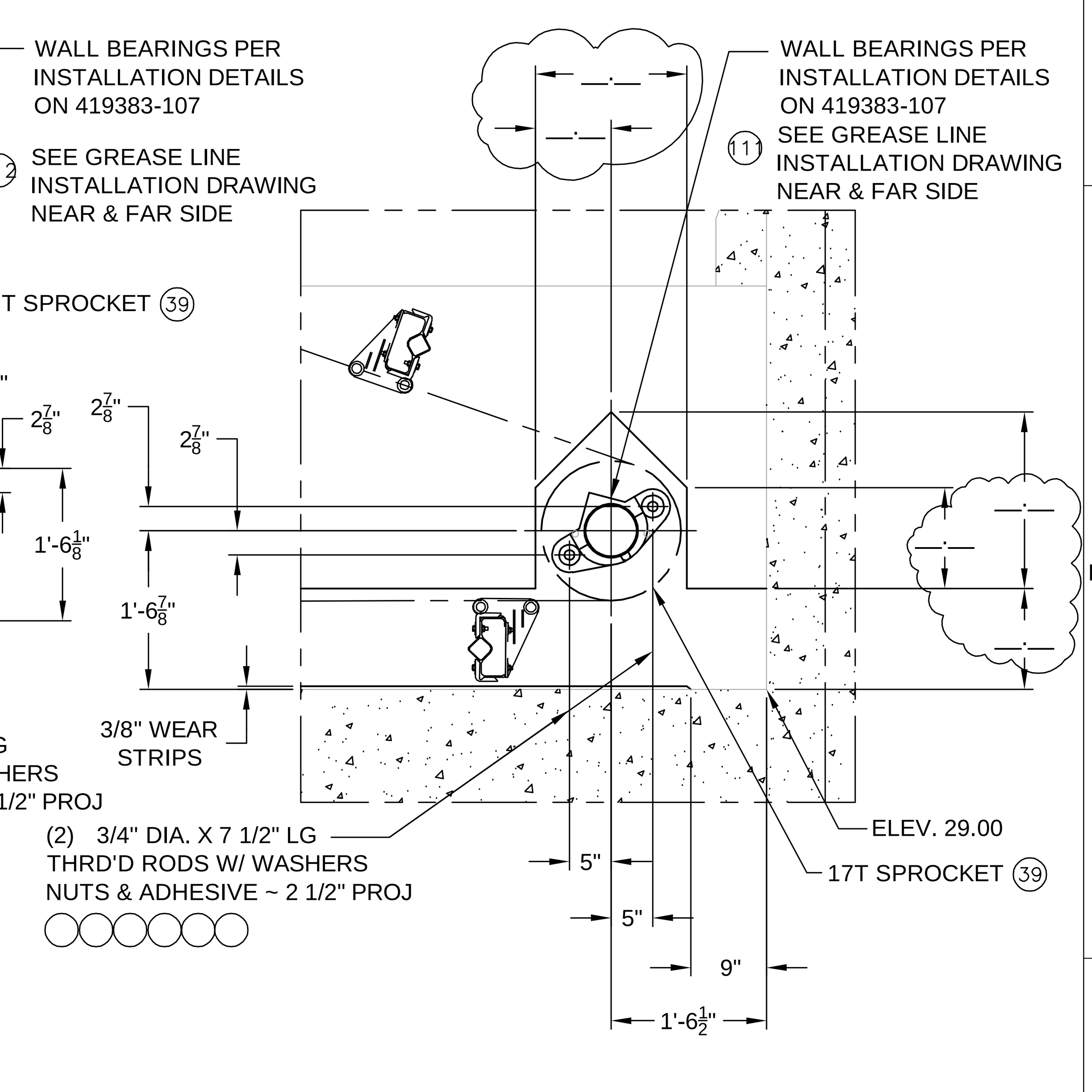
HEADSHAFT DETAIL

SCALE: 3/4" = 1'-0"



HOPPER END DETAIL

SCALE: 3/4" = 1'-0"



NON HOPPER END DETAIL

SCALE: 3/4" = 1'-0"

BAR = 1" AT PLOT SCALE

STD 22x34_D v4.0

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

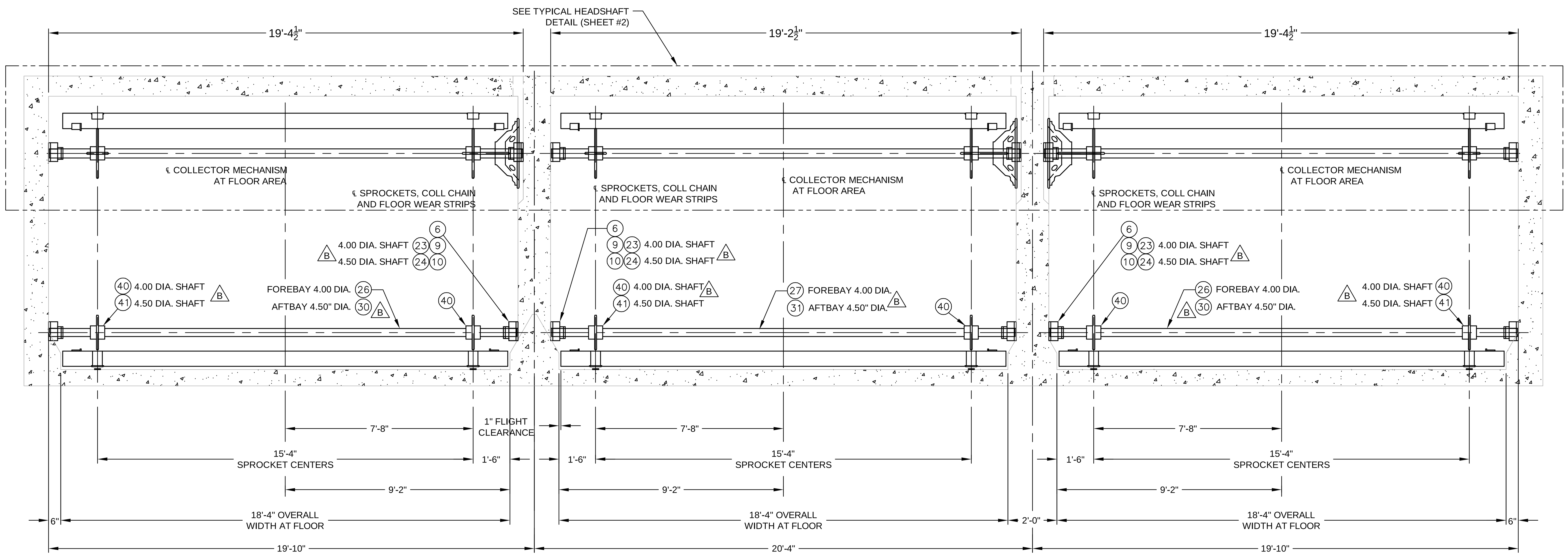
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REVISED HEADSHAFT & WATER ELEV.		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21	TITLE	GEN. ARRANGEMENT - CROSS COLLECTOR ELEVATION (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT	JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21		EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS		

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-105	1 OF 1	B



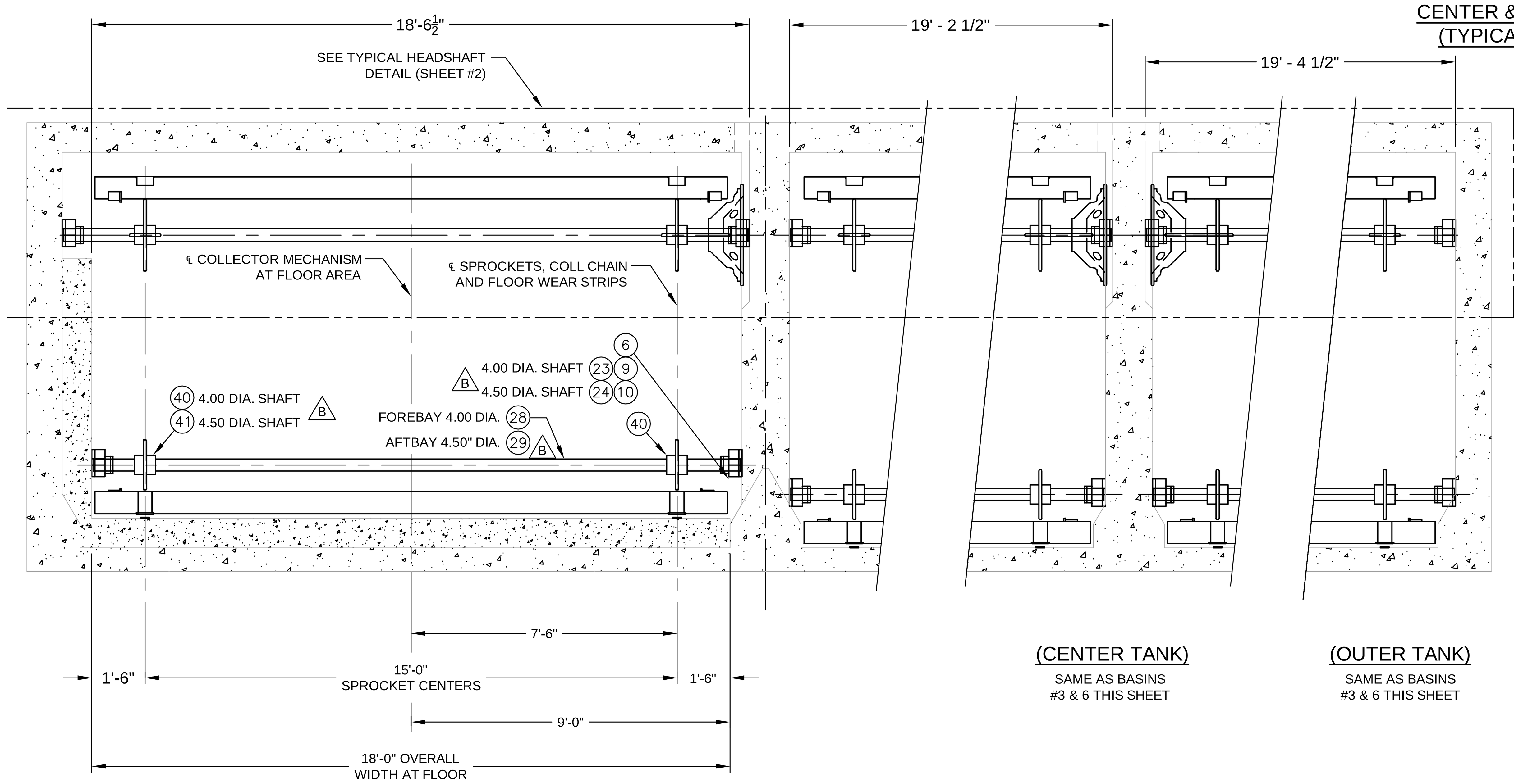
(OUTER TANKS #3 & 6 SHOWN)

(CENTER TANKS #3 & 6 SHOWN)

(OUTER TANKS #3 & 6 SHOWN)

SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #3 & 6
(TYPICAL FOR FOREBAY & AFTBAY)

(SCALE: 3/8" = 1'-0")



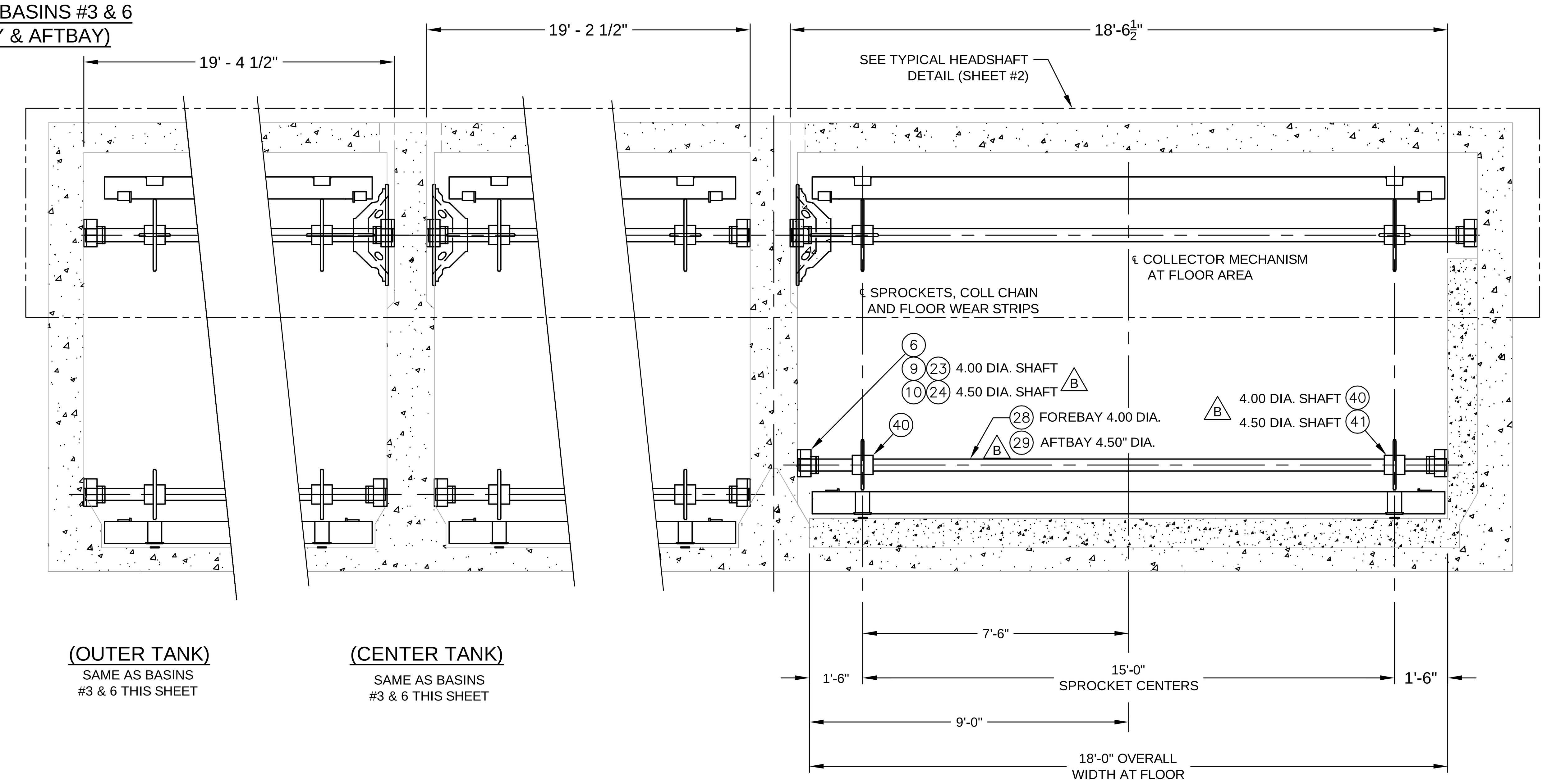
(CENTER TANK)
SAME AS BASINS #3 & 6 THIS SHEET

(OUTER TANK)
SAME AS BASINS #3 & 6 THIS SHEET

(OUTER TANK)

SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #5 SHOWN
(TYPICAL FOR FOREBAY & AFTBAY)

(SCALE: 3/8" = 1'-0")



(OUTER TANK)
SAME AS BASINS #3 & 6 THIS SHEET

(CENTER TANK)
SAME AS BASINS #3 & 6 THIS SHEET

(OUTER TANK)

SECTION E/102 HEADSHAFT END
CENTER & OUTER TANKS BASINS #4 SHOWN
(TYPICAL FOR FOREBAY & AFTBAY)

(SCALE: 3/8" = 1'-0")

BAR = 1" AT PLOT SCALE

STD 22x34_D v4.0

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

FOR APPROVAL ONLY
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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

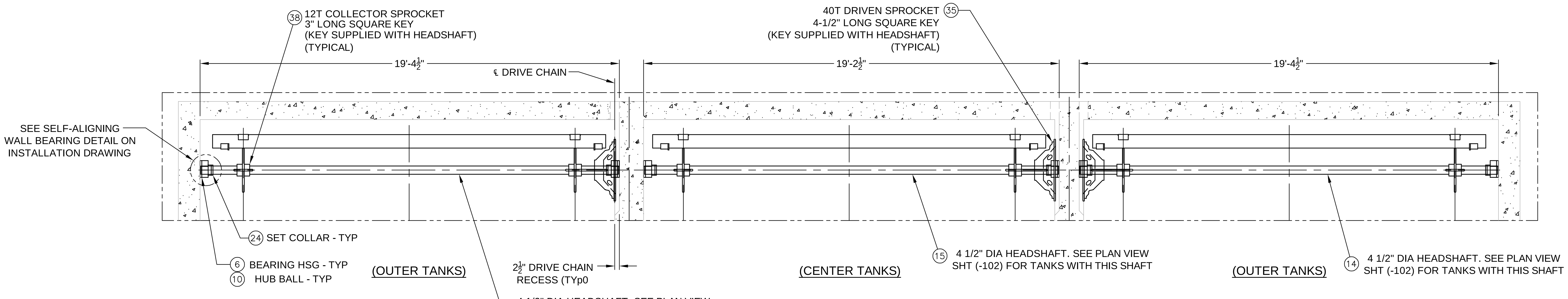
STANDARD TOLERANCE
.XX ± .06
.XXX ± .005
X/X ± 1/16
ANG ± 0.50°

MACHINED SURFACES
250

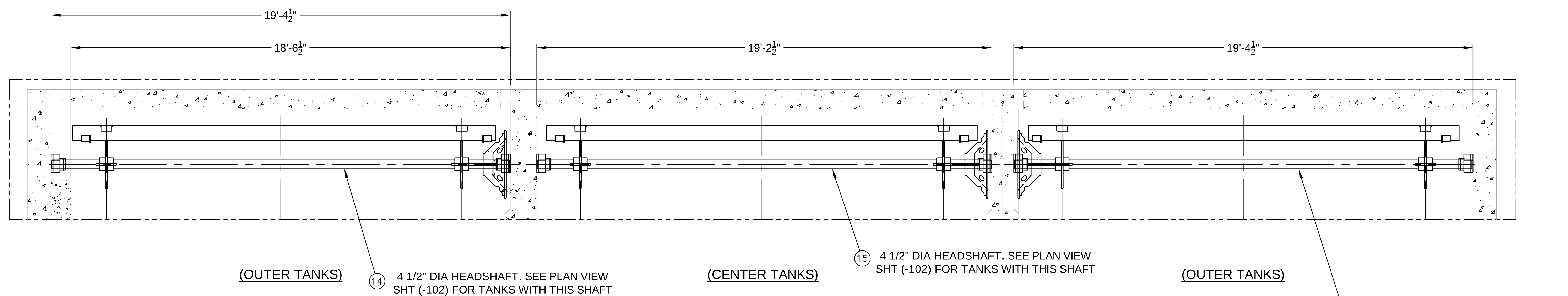
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES — EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

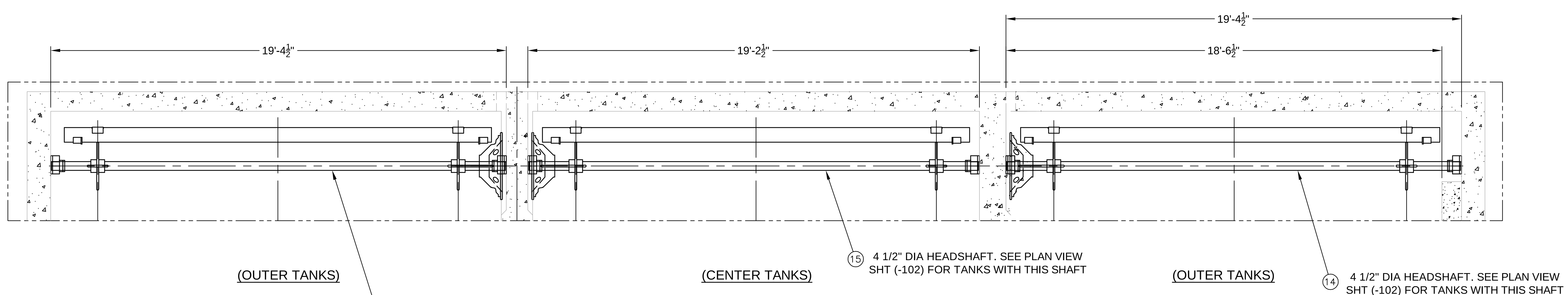
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-106	1 OF 4	C



HEADSHAFT DETAIL
CENTER & OUTER TANKS BASINS #3 & 6
C (TYPICAL FOR FOREBAY & AFTBAY)
SEE PLAN VIEW SHT (-102) FOR ALL HEADSHAFTING LOCATIONS WITHIN BASINS



HEADSHAFT DETAIL
CENTER & OUTER TANKS BASINS #5
C (TYPICAL FOR FOREBAY & AFTBAY)
SEE PLAN VIEW SHT (-102) FOR ALL HEADSHAFTING LOCATIONS WITHIN BASINS



HEADSHAFT DETAIL
CENTER & OUTER TANKS BASINS #4
C (TYPICAL FOR FOREBAY & AFTBAY)
SEE PLAN VIEW SHT (-102) FOR ALL HEADSHAFTING LOCATIONS WITHIN BASINS

BAR = 1" AT PLOT SCALE

STD-22x34_D v4.0

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

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THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE	MACHINED SURFACES
.XX ± .06	250
XXX ± .005	
X/X ± 1/16	
ANG ± 0.50°	

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED HEADSHAFT CALLOUTS & VIEWS	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

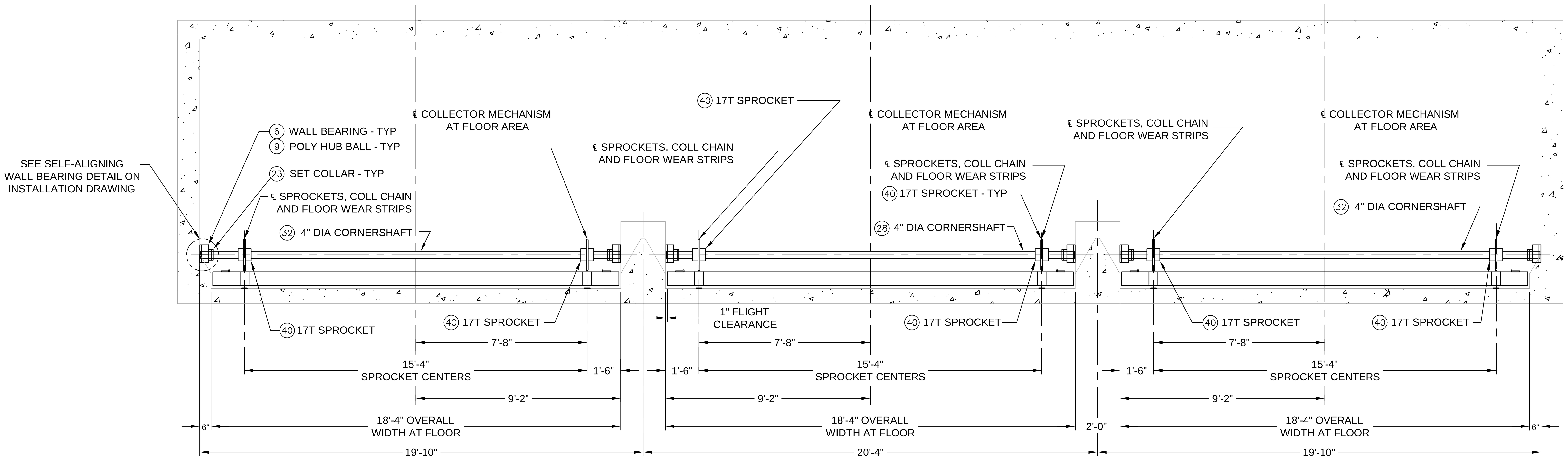
DWN BY: G.HALASE	DATE 11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDOND	SCALE NTS

TITLE GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-106	2 OF 4	C



(OUTER TANKS #3 & 6 SHOWN)

(CENTER TANKS #3 & 6 SHOWN)

(OUTER TANKS #3 & 6 SHOWN)

SECTION "G-G" & K-K / 102
FOREBAY & AFTBAY BASINS #3 & 6
(LOWER EFFLUENT END OF TANK)

SEE SHEET (4 OF 4) FOR UPPER EFFLUENT CORNERSHAFT CALLOUTS

(SCALE: 3/8" = 1'-0")

(OUTER TANK)

SECTION G-G & K-K /102 EFFLUENT END
CENTER & OUTER TANKS BASINS #5
(TYPICAL FOR FOREBAY & AFTBAY)

SEE SHEET (4 OF 4) FOR UPPER EFFLUENT CORNERSHAFT CALLOUTS

(SCALE: 3/8" = 1'-0")

SECTION G-G & K-K /102 EFFLUENT END
CENTER & OUTER TANKS BASINS #4
(TYPICAL FOR FOREBAY & AFTBAY)

SEE SHEET (-107) FOR UPPER EFFLUENT CORNERSHAFT CALLOUTS

(SCALE: 3/8" = 1'-0")

(OUTER TANK)

INSTALLATION NOTE:

NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE: .XX ± .06, .XXX ± .005, X/X ± 1/16, ANG ± 0.50°

MACHINED SURFACES: 250

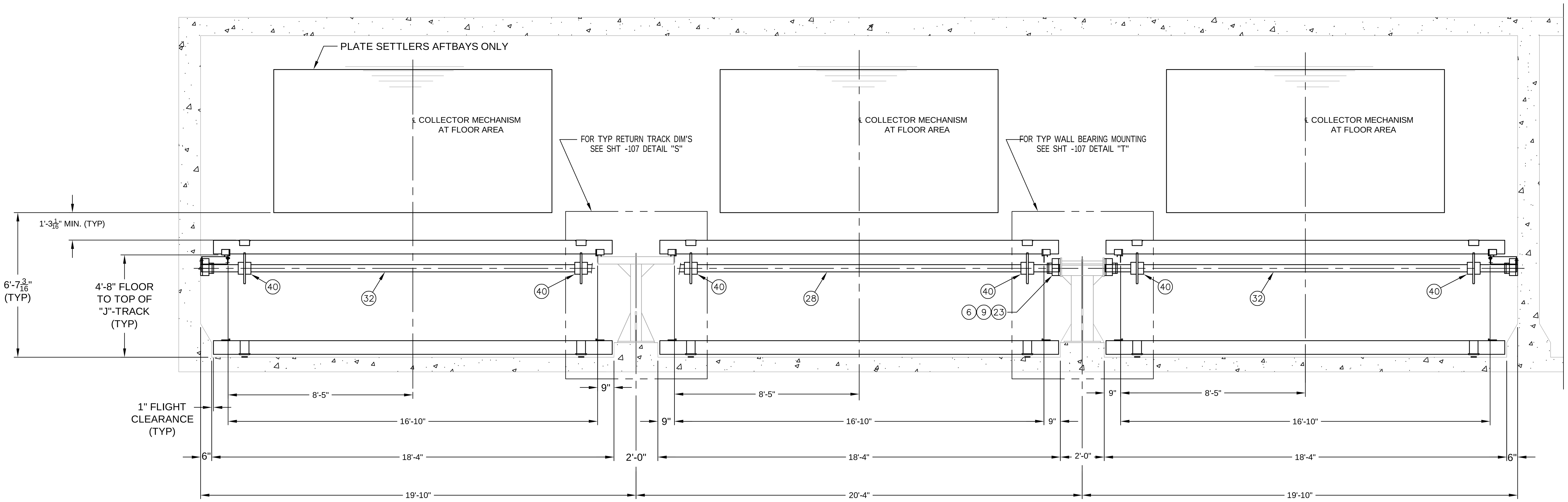
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REVISED CORNERSHAFT CALLOUTS	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

DWN BY: G.HALASE	DATE 11/5/21	TITLE: GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES, WAUKESHA WI USA, +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

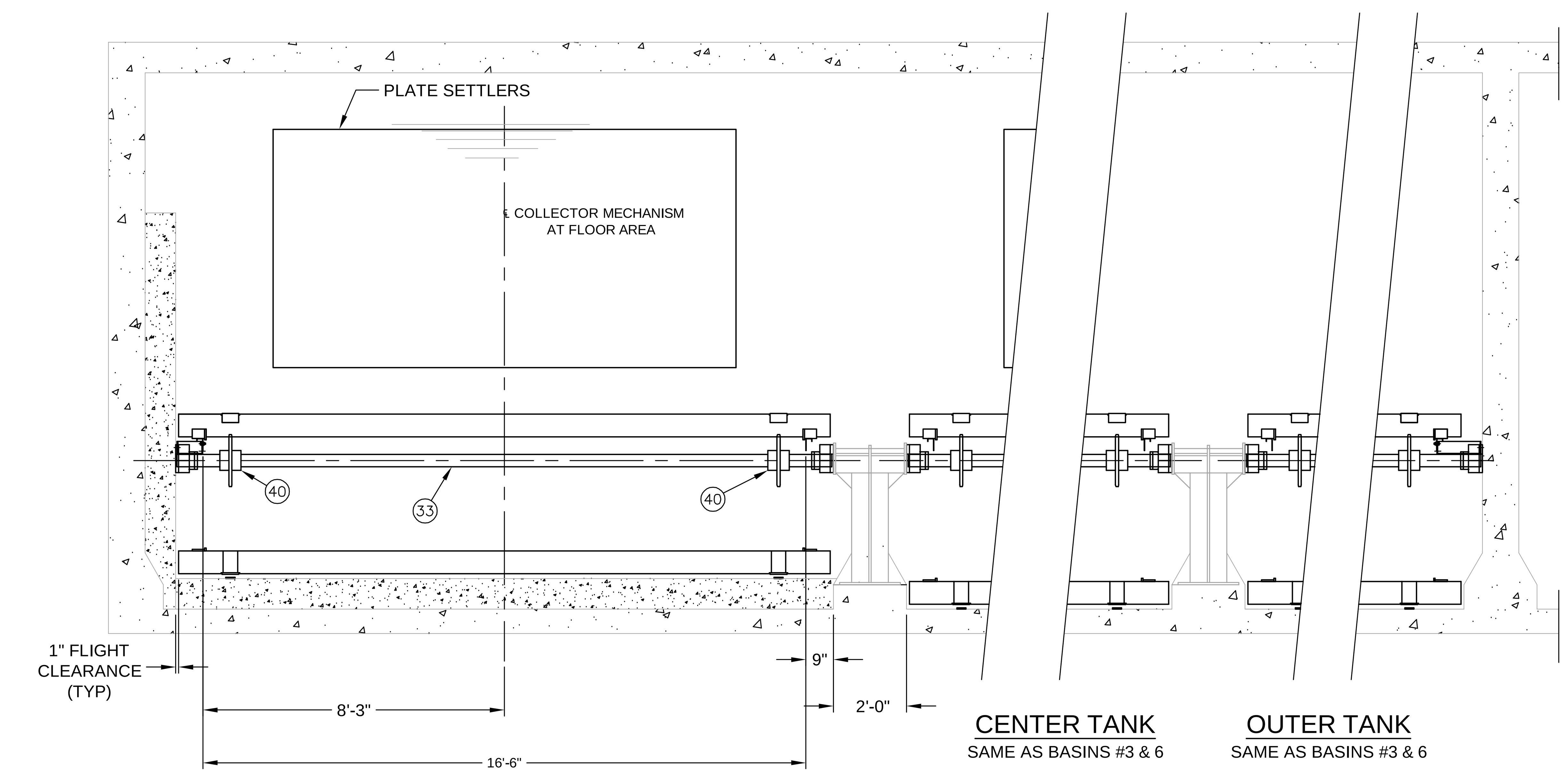
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-106	3 OF 4	C

STD 22x34_D v4.0

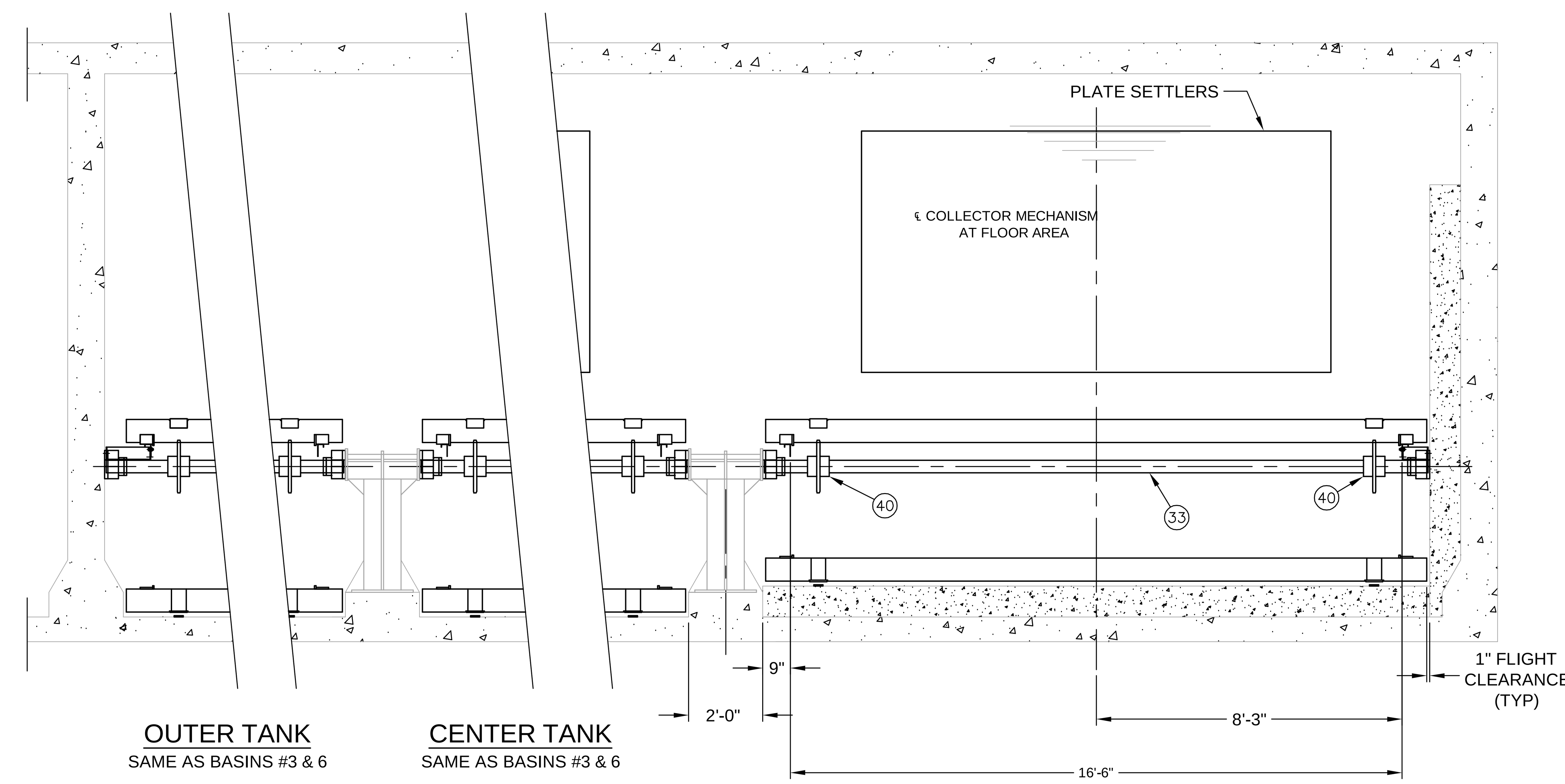
BAR = 1" AT PLOT SCALE



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY BASINS #3 & 6
(SCALE : 3/8" = 1'-0")



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY
BASINS #5
(SCALE : 3/8" = 1'-0")



SECTION "H-H"/102 TANK CROSS SECTION VIEW / 4-SHAFT AFTBAY SHOWN
SECTION "L-L"/102 TANK CROSS SECTION VIEW / 4-SHAFT FOREBAY AS NOTED
UPPER EFFLUENT SHAFT ONLY
BASINS #4
(SCALE : 3/8" = 1'-0")

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

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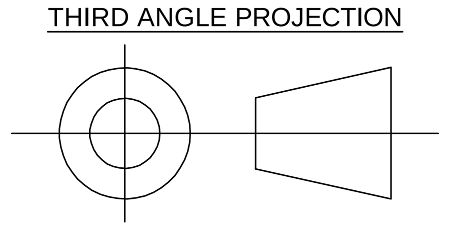
THIRD ANGLE PROJECTION



UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
ALL WEIGHTS ARE POUNDS AND EACH
DRAWN PER ASME Y14.5M

STANDARD TOLERANCE
.XX ± .06
.XXX ± .005
X/X ± 1/16
ANG ± 0.50°

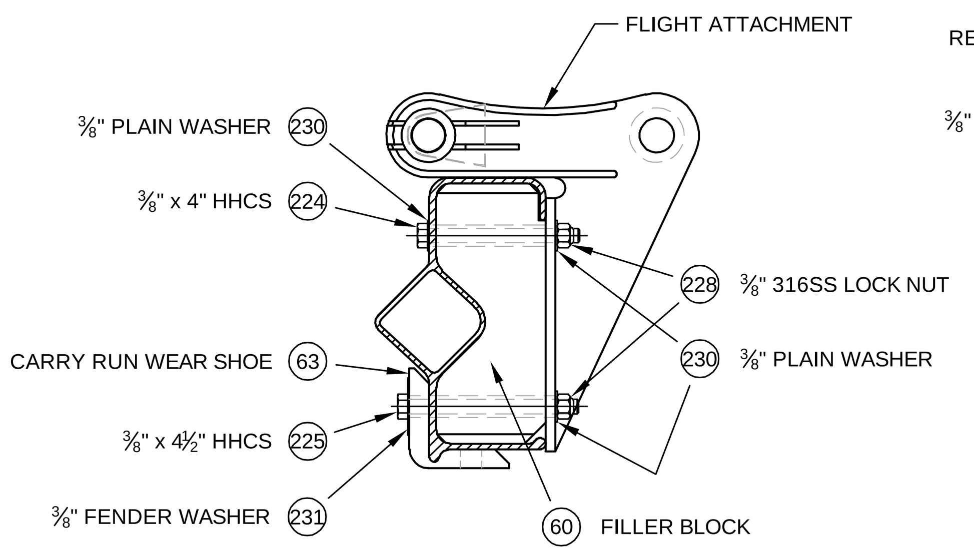
MACHINED SURFACES
250

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
C	REV'D CORNERSHAFT CALLOUTS.REV'D WATER ELEV. LOWERED RETURN TRACKS. REV'D TANK WIDTH	4/8/22	GLH	AJK	SW	
B	LOWER INFLUENT CORNERSHAFT DIA. WAS 4.00" NOW 4.50 REVISED SPROCKETS LOWER INFLUENT SHAFT ACCORDINGLY	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	SW	

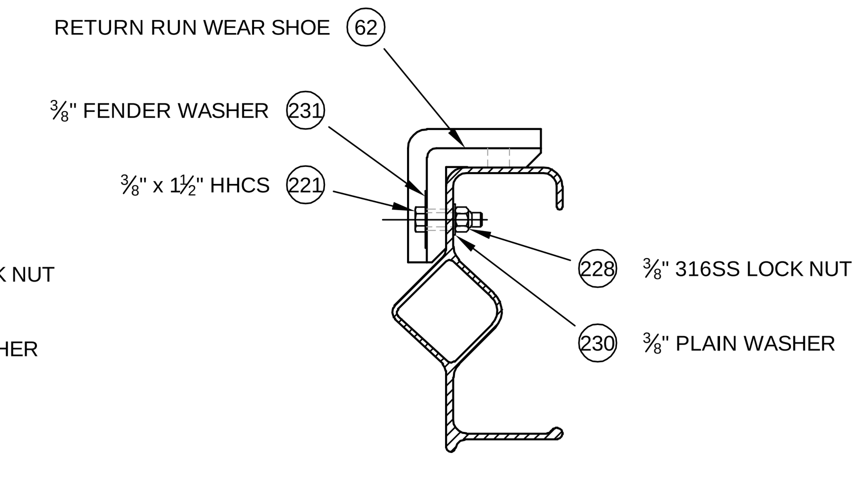
DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - SHAFT SECTIONS & DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES — EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDOND	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-106	4 OF 4	C

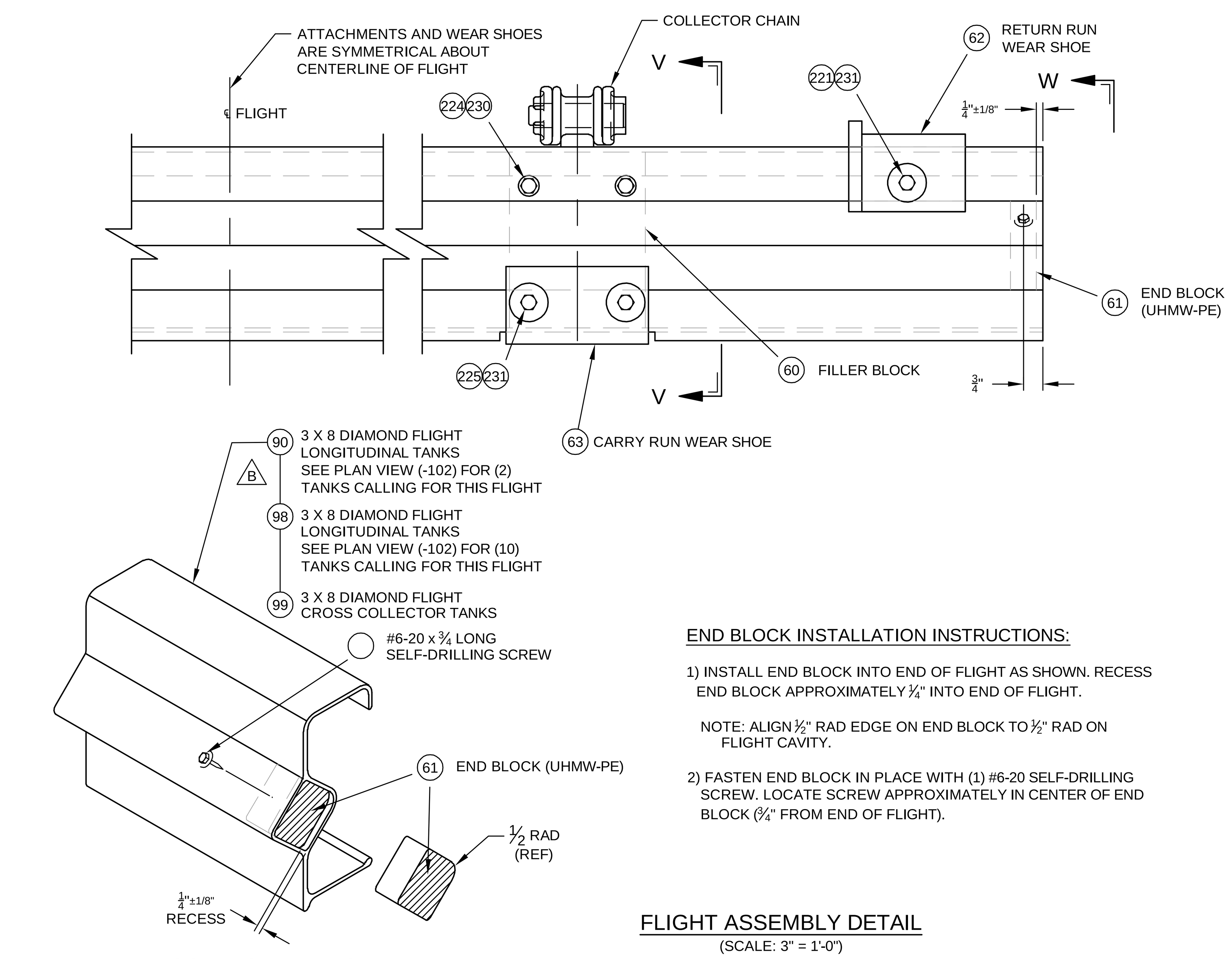
BAR = 1" AT PLOT SCALE
STD 22x34_D v4.0



SECTION V-V
(SCALE: 3" = 1'-0")



SECTION W-W
(SCALE: 3" = 1'-0")



END BLOCK INSTALLATION INSTRUCTIONS:

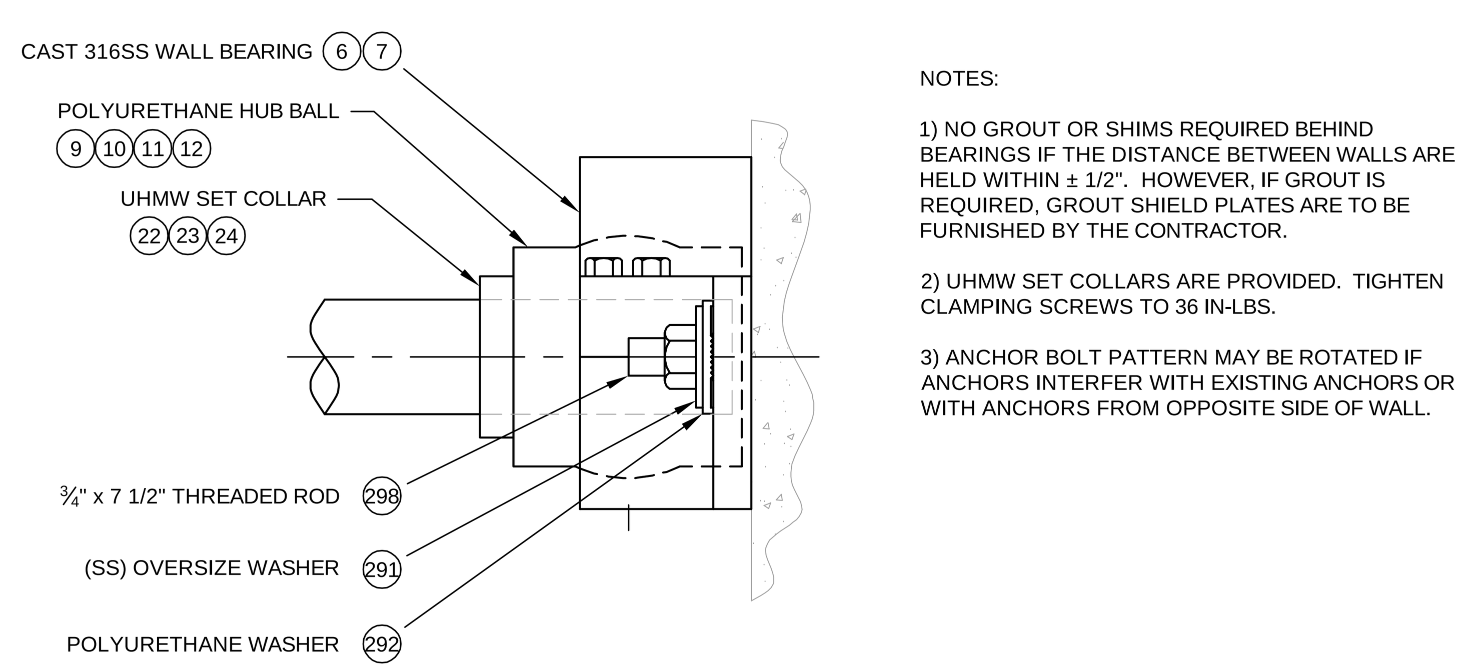
1) INSTALL END BLOCK INTO END OF FLIGHT AS SHOWN. RECESS END BLOCK APPROXIMATELY ½" INTO END OF FLIGHT.

NOTE: ALIGN ½" RAD EDGE ON END BLOCK TO ½" RAD ON FLIGHT CAVITY.

2) FASTEN END BLOCK IN PLACE WITH (1) #6-20 SELF-DRILLING SCREW. LOCATE SCREW APPROXIMATELY IN CENTER OF END BLOCK (¾" FROM END OF FLIGHT).

TYP END BLOCK INSTALLATION
(SCALE: 3" = 1'-0")

FLIGHT ASSEMBLY DETAIL
(SCALE: 3" = 1'-0")



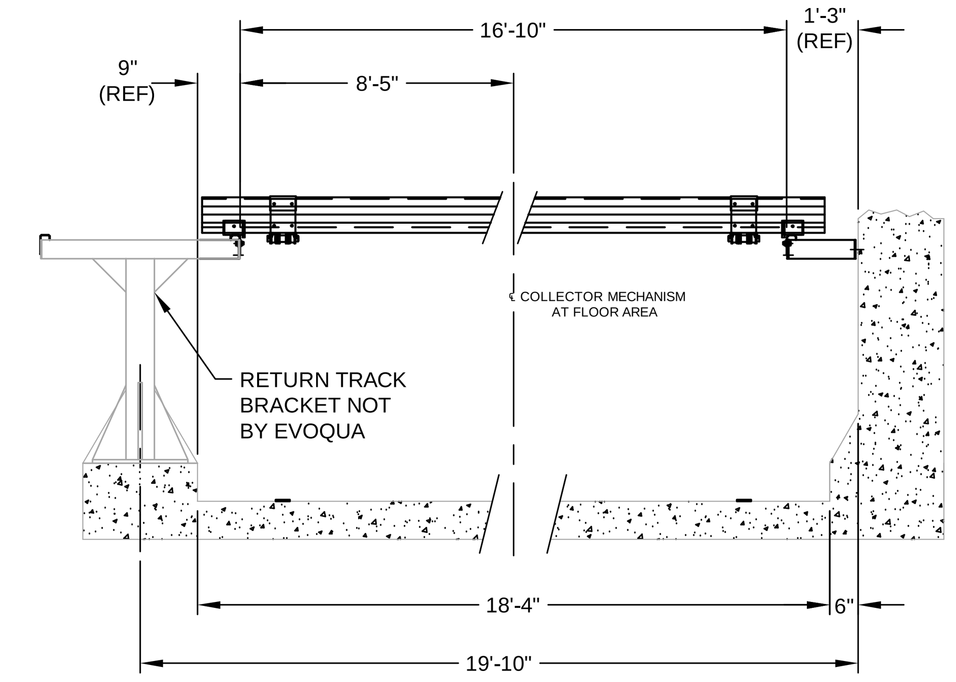
NOTES:

1) NO GROUT OR SHIMS REQUIRED BEHIND BEARINGS IF THE DISTANCE BETWEEN WALLS ARE HELD WITHIN ± 1/2". HOWEVER, IF GROUT IS REQUIRED, GROUT SHIELD PLATES ARE TO BE FURNISHED BY THE CONTRACTOR.

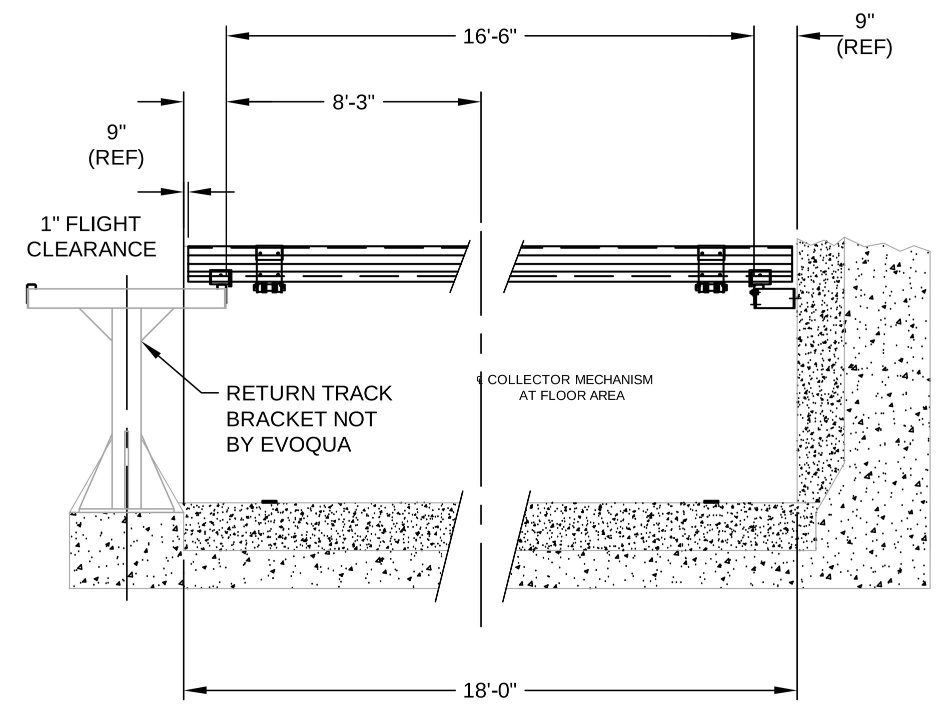
2) UHMW SET COLLARS ARE PROVIDED. TIGHTEN CLAMPING SCREWS TO 36 IN-LBS.

3) ANCHOR BOLT PATTERN MAY BE ROTATED IF ANCHORS INTERFER WITH EXISTING ANCHORS OR WITH ANCHORS FROM OPPOSITE SIDE OF WALL.

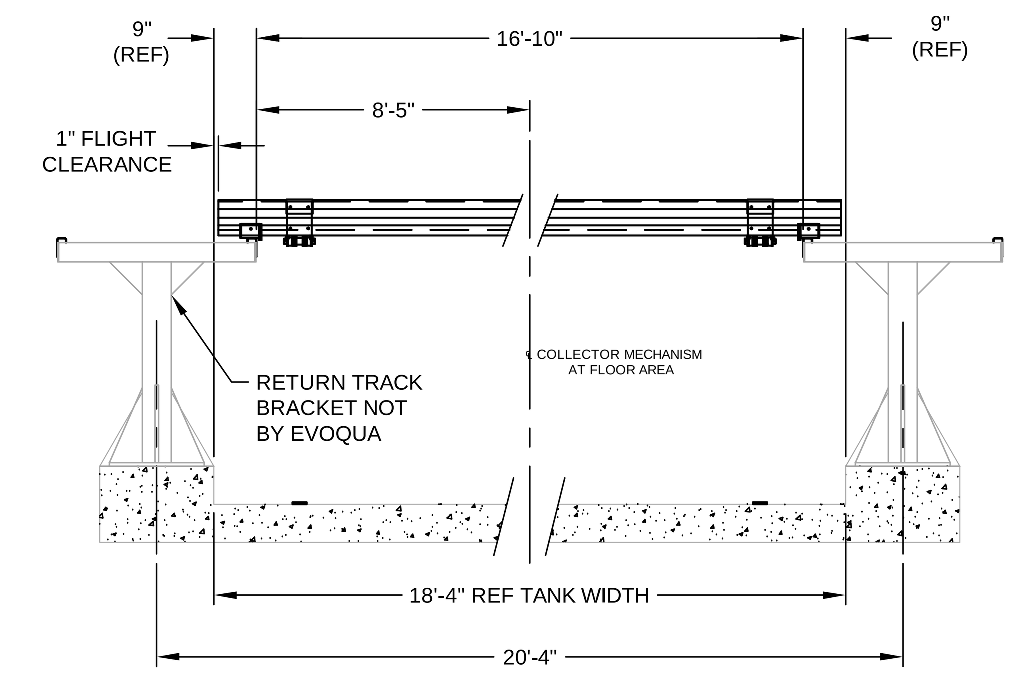
SELF-ALIGNING WALL BEARING DETAIL
(SCALE: 3" = 1'-0")



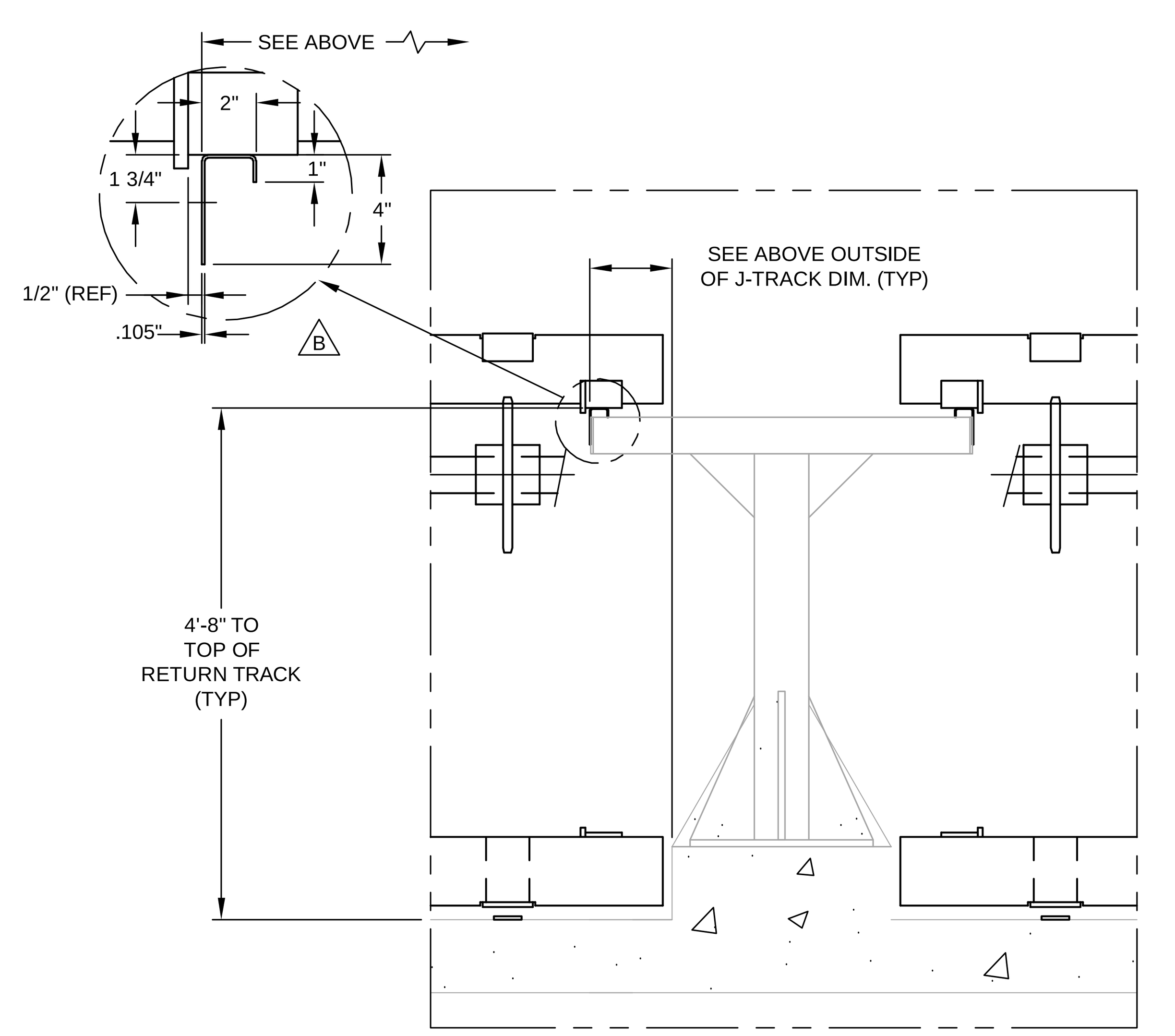
B TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY@ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



B TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY@ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")

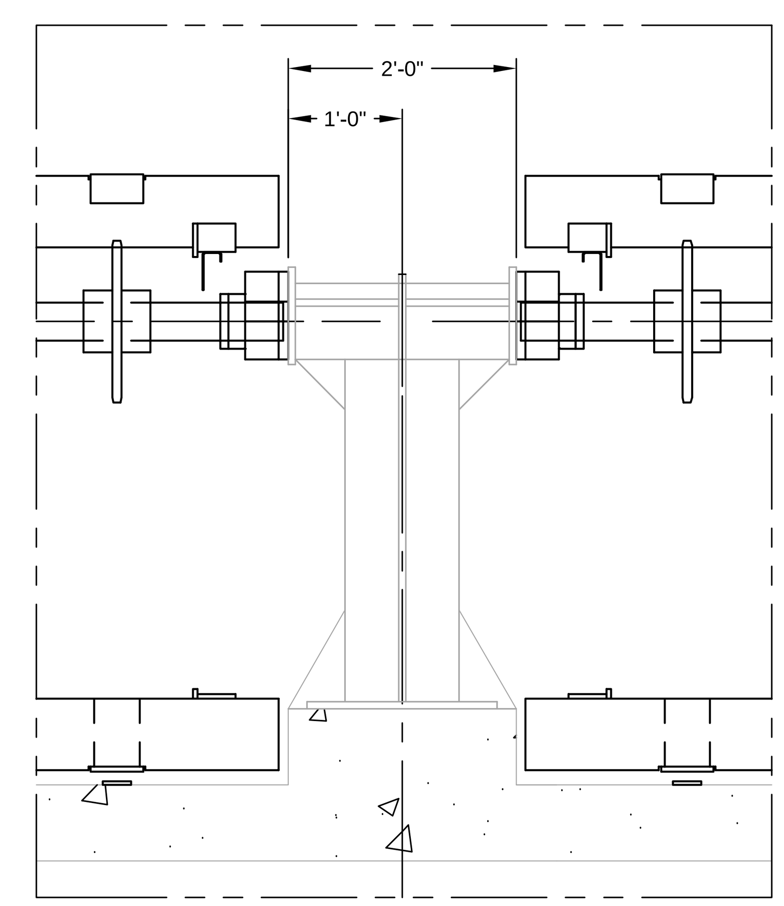


B TRACK CROSS SECTION VIEW
4-SHAFT AFTBAY @ KNEE WALLED CENTER TANKS
(SCALE : 1/16" = 1'-0")



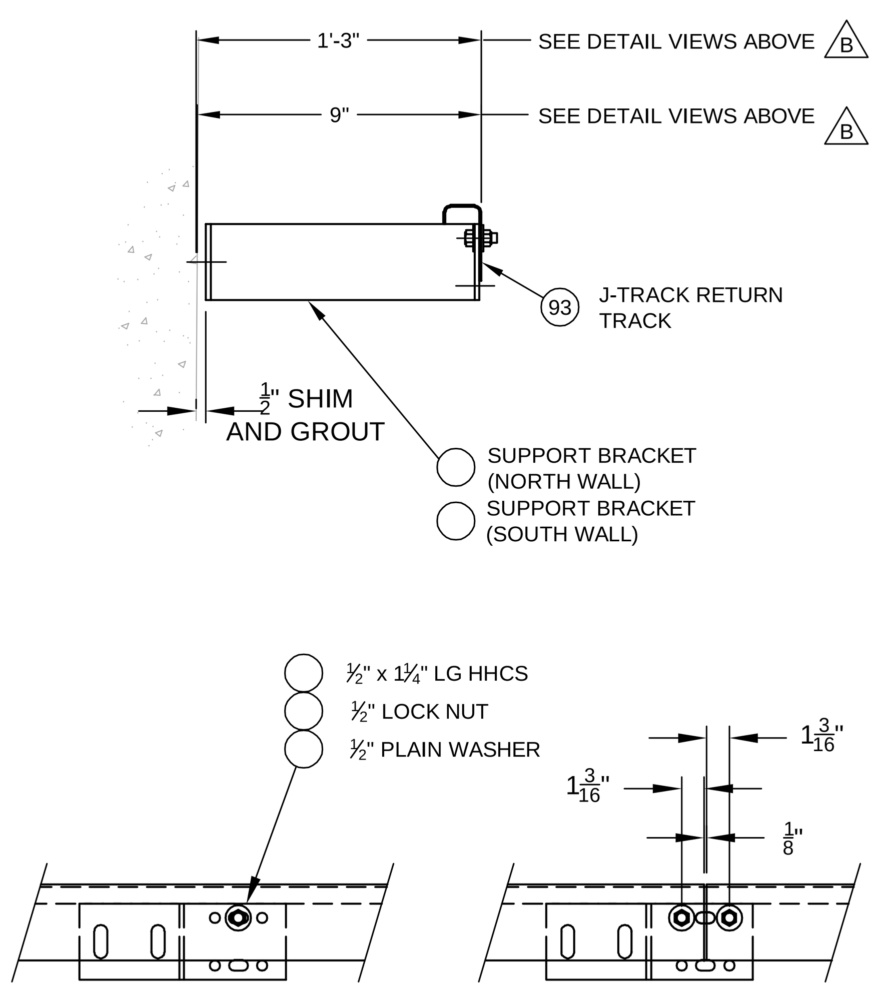
DETAIL "S" / 106 SHEET 4

B TYPICAL RETURN TRACK MOUNTING DIMENSIONS FOR INNER TANKS
(BRACKETS FOR SUPPORTING J-TRACK NOT BY EVOQUA WATER TECHNOLOGIES)



B DETAIL "T" / 106 SHEET 4

TYPICAL WALL BEARING MOUNTING DIMENSIONS FOR INNER TANKS
(BRACKETS FOR SUPPORTING WALL BEARINGS NOT BY EVOQUA WATER TECHNOLOGIES)



TYPICAL CONNECTION

CONNECTION AT SPLICE

TYPICAL CONNECTION
TO OUTER WALLS ON OUTER TANKS
4-SHAFT AFTBAY

INSTALLATION NOTE:
NON-METALLIC COMPONENT INSTALLATION REQUIRES SPECIAL CARE DURING ASSEMBLY OF HARDWARE TO PREVENT DAMAGE TO THE COMPONENTS. SEE O&M MANUAL FOR ASSEMBLY INSTRUCTIONS AND TORQUE VALUES FOR FASTENERS.

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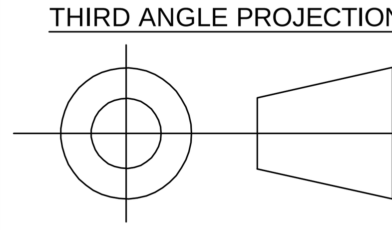
THIRD ANGLE PROJECTION



REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED ITEM 90. ADDED & RESTRUCTED DWG		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDONOND	SCALE NTS

TITLE: GEN. ARRANGEMENT - INSTALLATION DETAILS
(12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT: JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

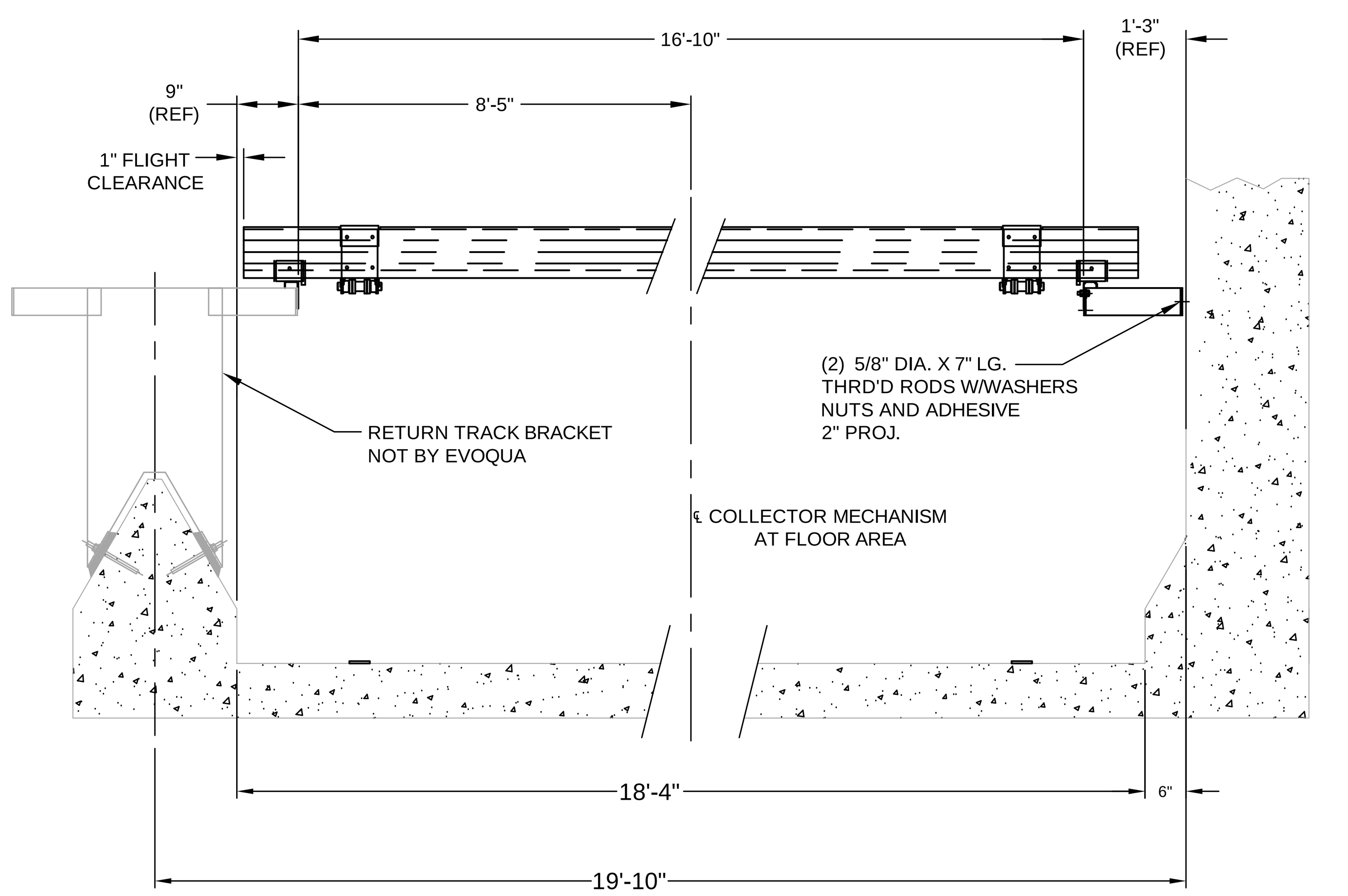
EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-107	1 OF 2	B

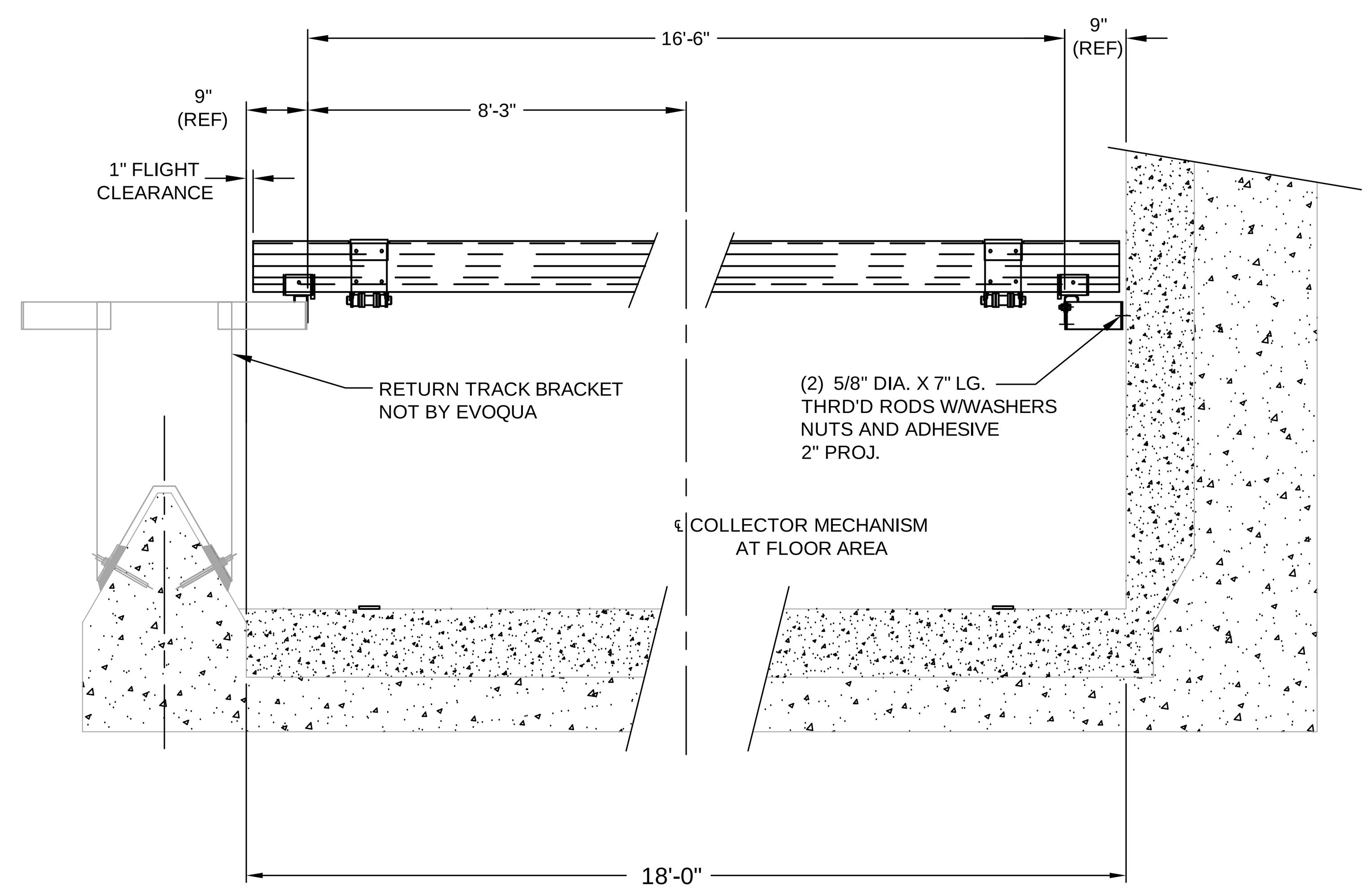
STD 22x34_D v4.0

BAR = 1" AT PLOT SCALE

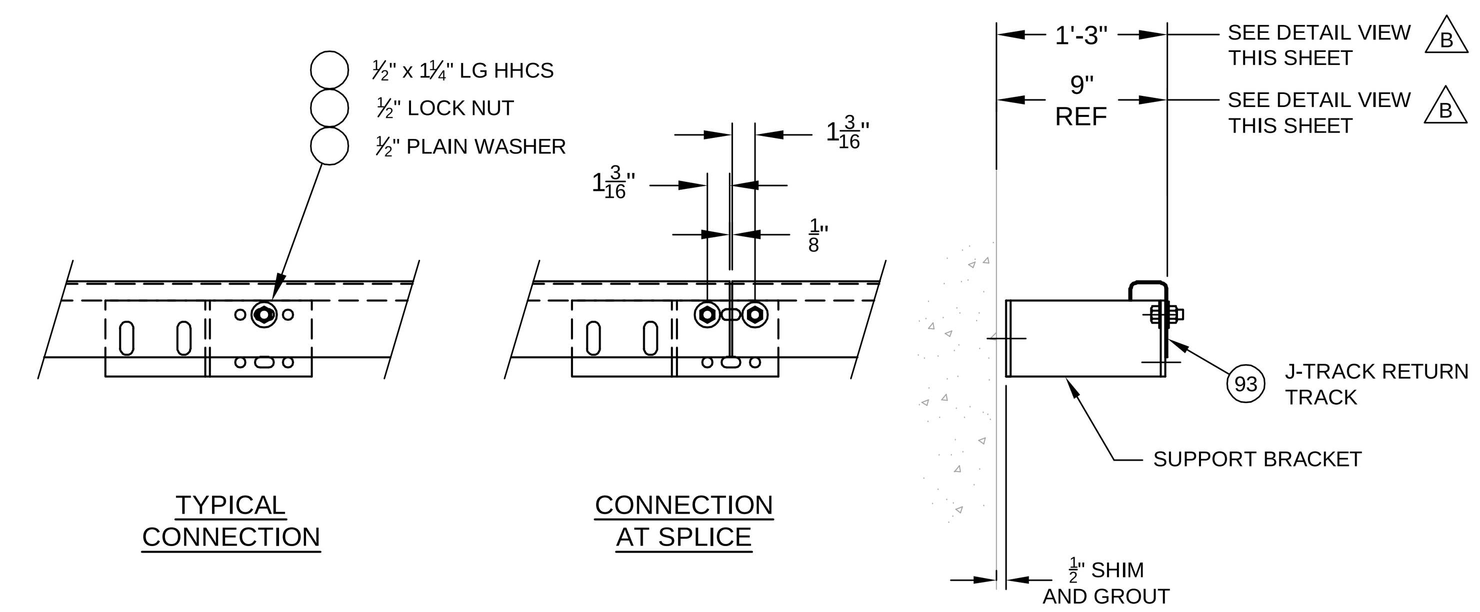
8	7	6	5	4	3	2	1



B TRACK CROSS SECTION VIEW OUTER TANKS
4-SHAFT FOREBAY @ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



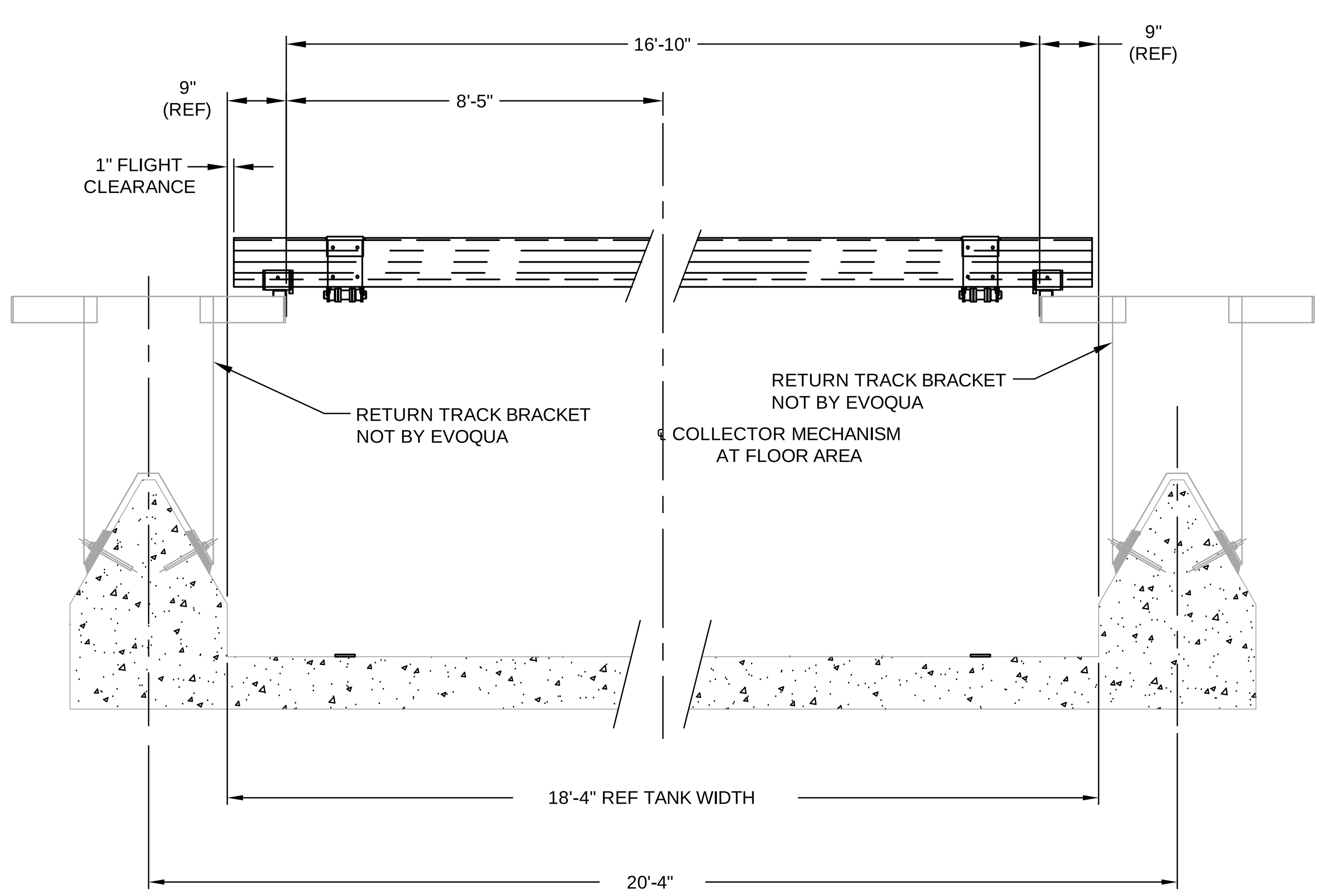
B TRACK CROSS SECTION VIEW OUTER TANKS
4-SHAFT FOREBAY @ KNEE WALLS & OUTER WALLS
(SCALE : 1/16" = 1'-0")



TYPICAL CONNECTION

CONNECTION AT SPLICE

TYPICAL CONNECTION
4-SHAFT FOREBAY AT LOWER EFFLUENT
SHAFT & OUTER WALLS



B TRACK CROSS SECTION VIEW
4-SHAFT FOREBAY @ KNEE WALLED CENTER TANKS
(SCALE : 1/16" = 1'-0")

BAR = 1" AT PLOT SCALE

STD 22x34_D v4.0

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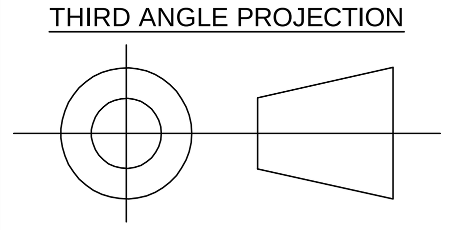
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

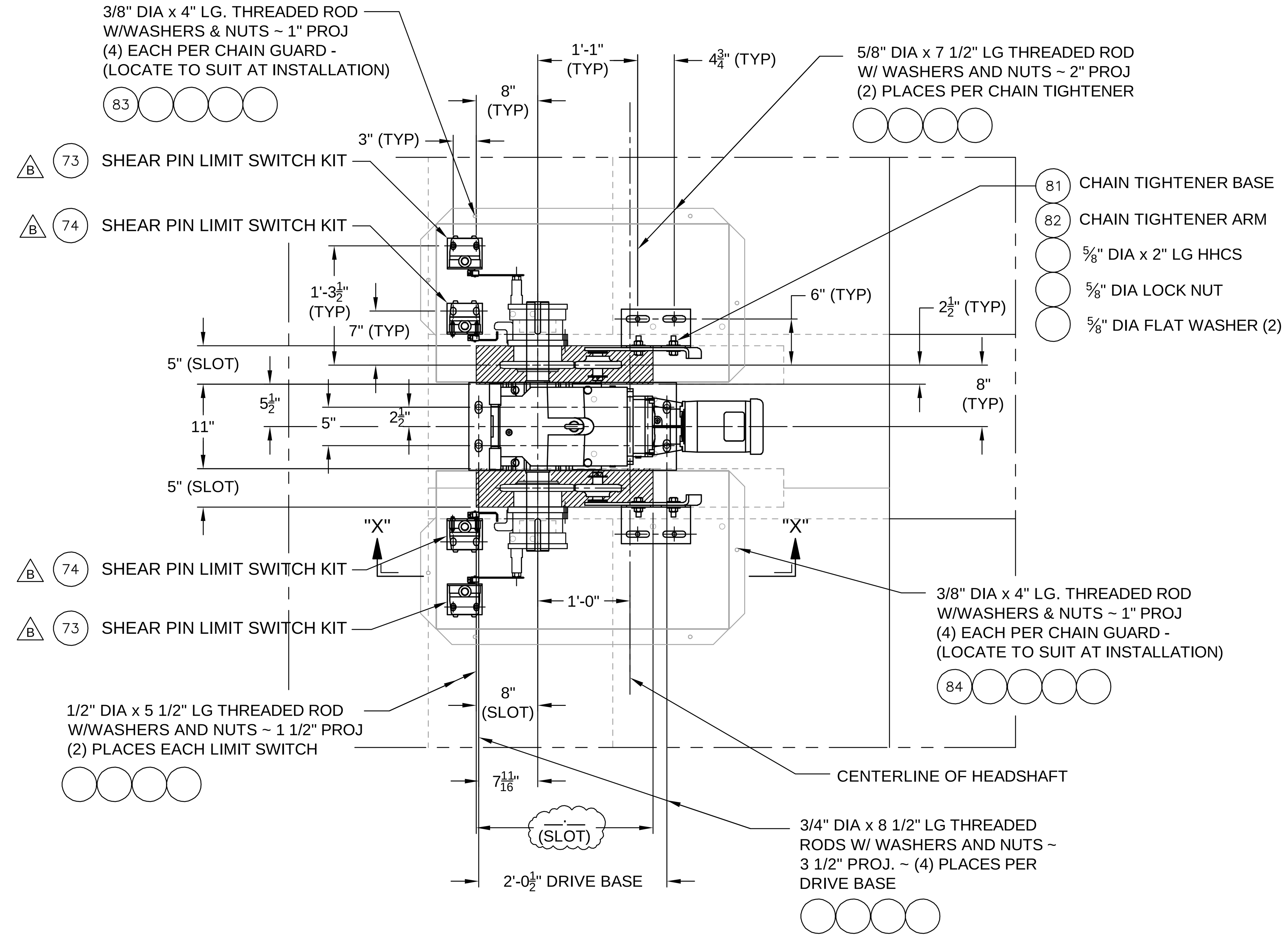
THIRD ANGLE PROJECTION



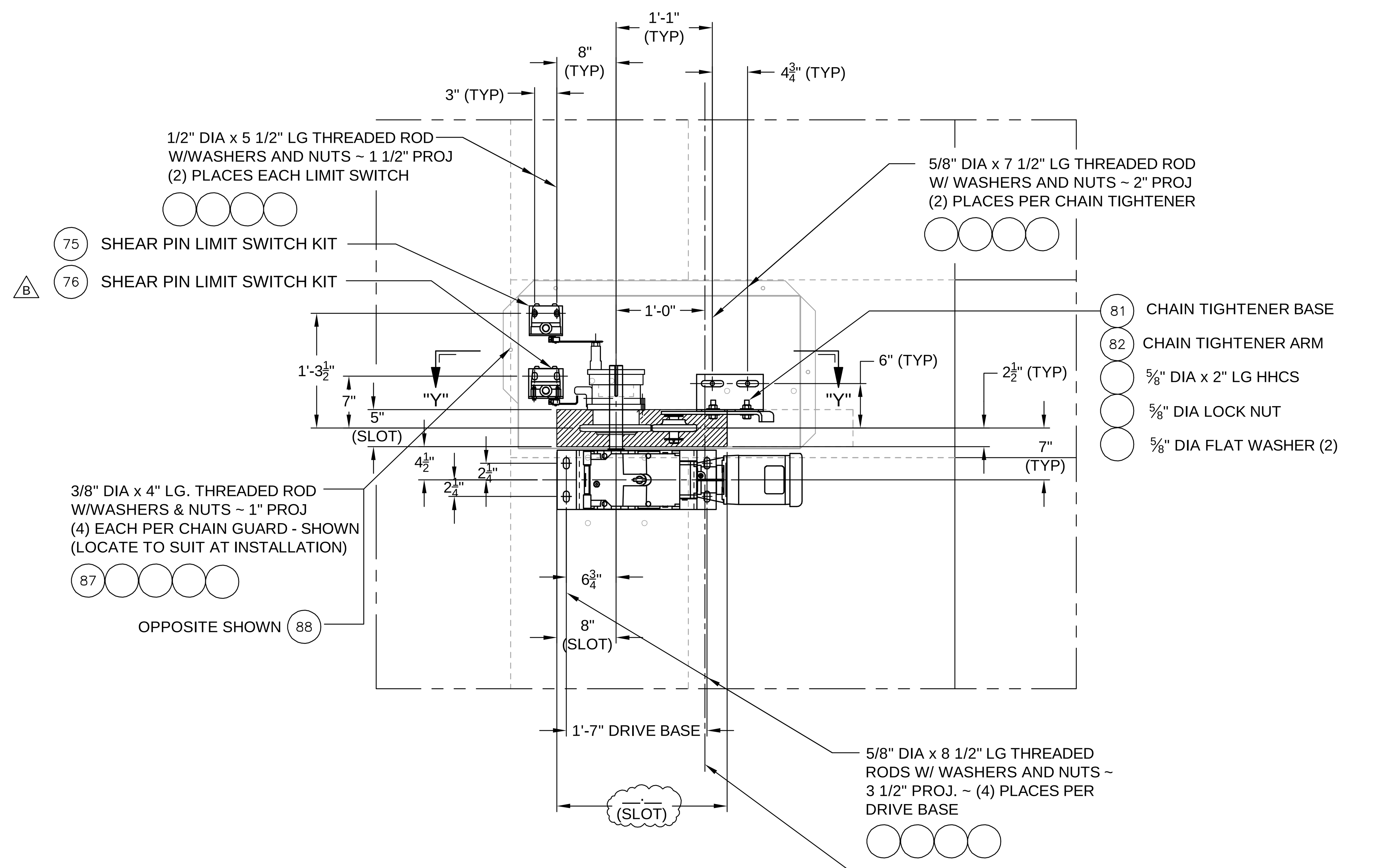
REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	ADDED SECTION Y-Y. REVISED CROSS SECTION VIEWS		GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - INSTALLATION DETAILS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	
MGD BY: J.MCDONOND	SCALE NTS	EVOQUA WATER TECHNOLOGIES EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141

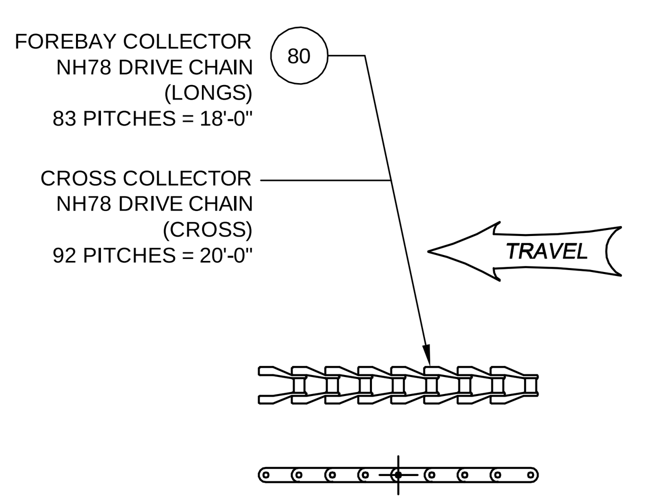
PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-107	2 OF 2	B



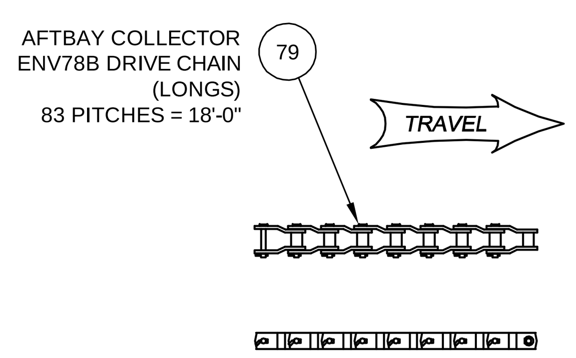
AFTBAY DUAL OUTPUT
SED BASINS #5 & 6 SHOWN / #3 & 4 OPPOSITE SHOWN



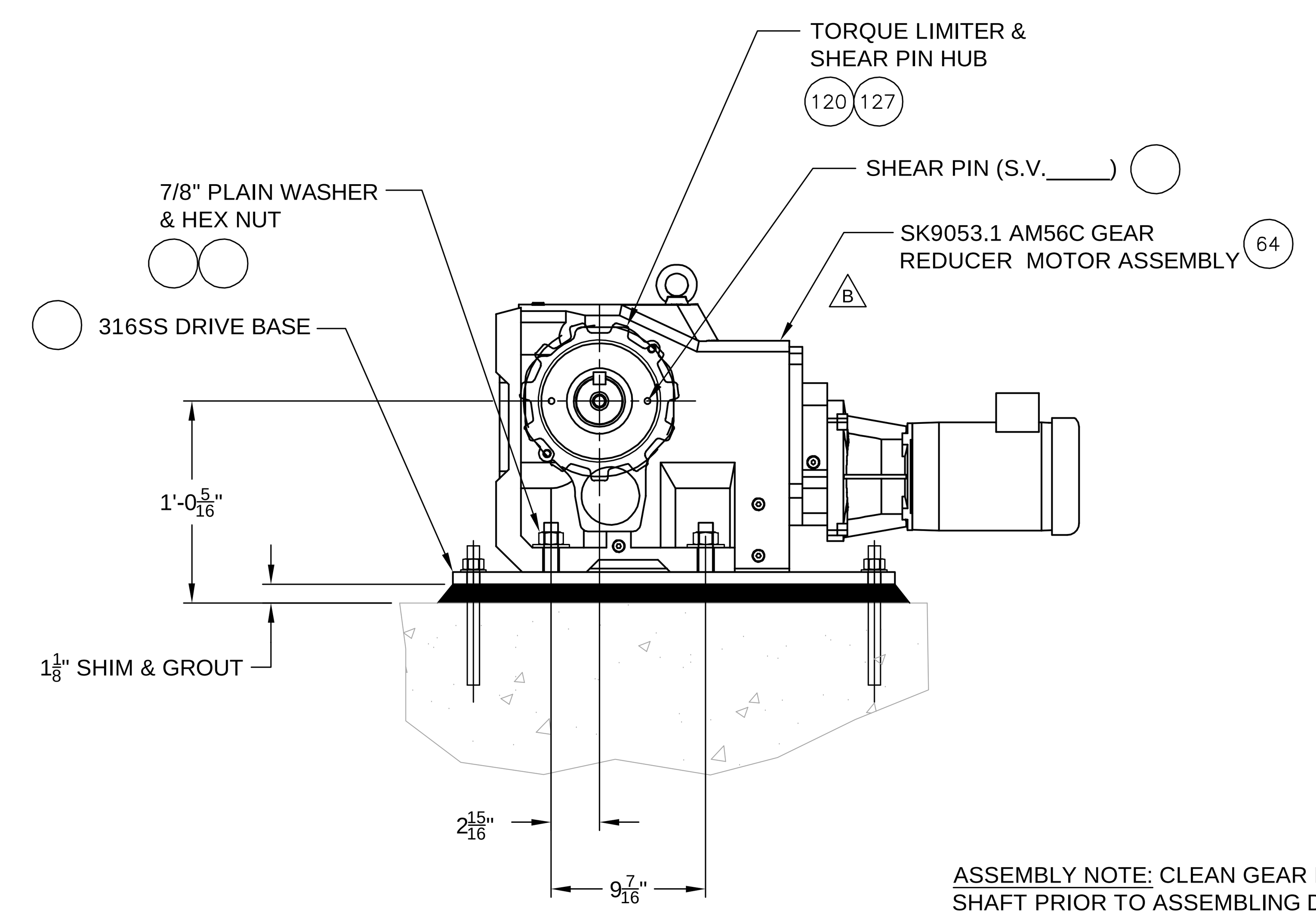
AFTBAY SINGLE OUTPUT
SED BASINS #5 & 6 SHOWN
SED BASINS # 3 & 4 OPPOSITE SHOWN



DRIVE CHAIN DETAIL
FOREBAY LONGITUDINAL & CROSS

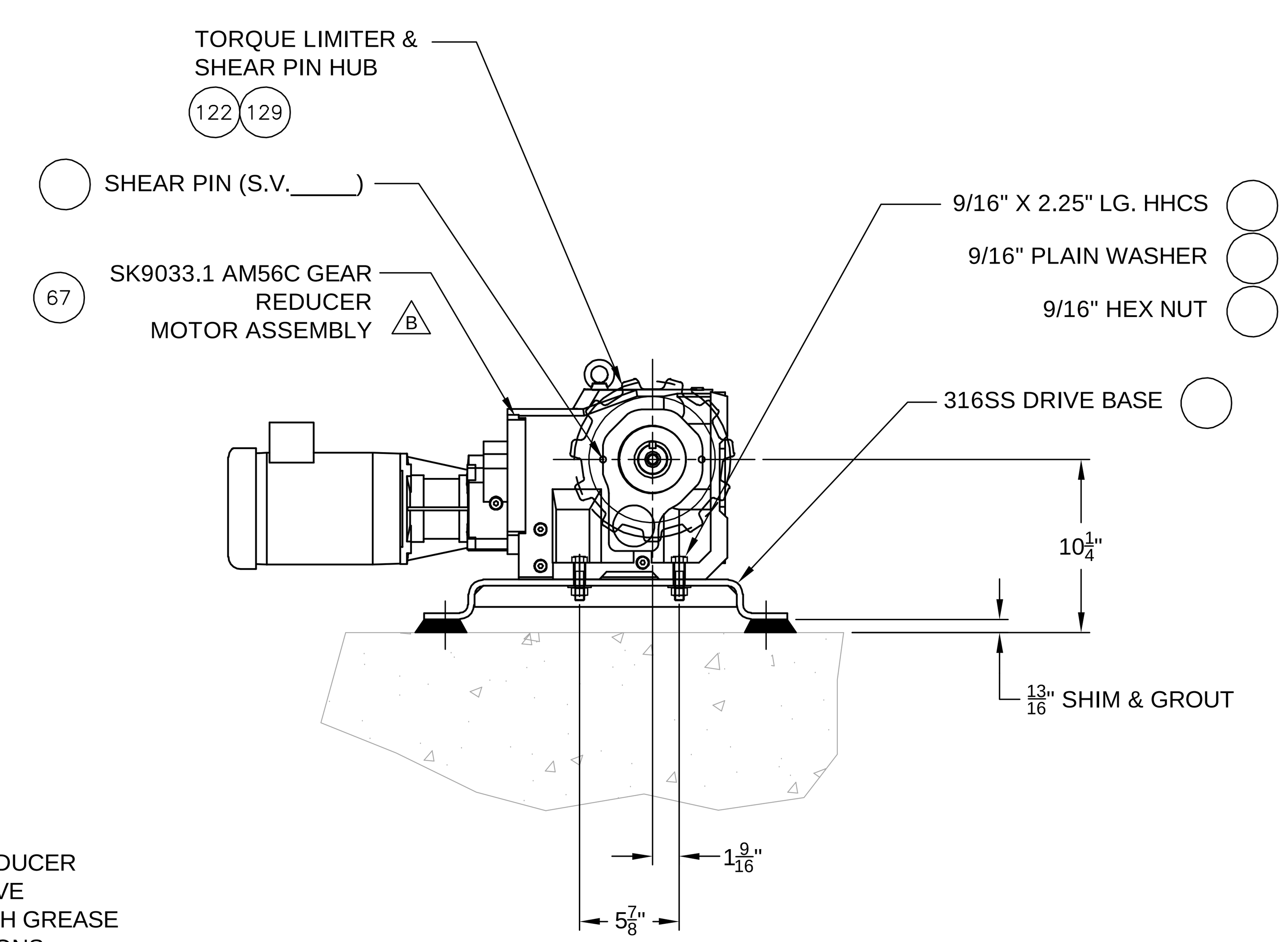


DRIVE CHAIN DETAIL
AFTBAY LONGITUDINAL

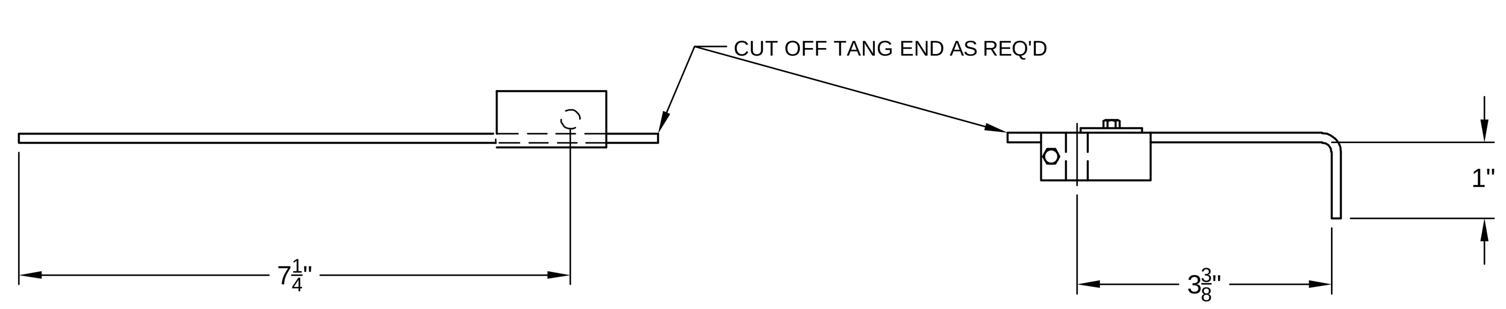


SECTION "X-X"/108

ASSEMBLY NOTE: CLEAN GEAR REDUCER SHAFT PRIOR TO ASSEMBLING DRIVE SPROCKET. LUBRICATE SHAFT WITH GREASE COMPATIBLE WITH PLANT CONDITIONS BEFORE ASSEMBLING DRIVE SPROCKET.



SECTION "Y-Y"/108



TYPICAL LIMIT SWITCH
LEVER ARM FOR TORQUE LIMITER

INSTALLING CONTRACTOR TO CUT AS SHOWN

TYPICAL LIMIT SWITCH
LEVER ARM FOR SHEAR PIN

INSTALLING CONTRACTOR TO CUT AS SHOWN

FOR APPROVAL ONLY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES FROM EURODRIVE TO NORD. ADDED LIMIT SWITCHES FOR SHEAR PIN HUBS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDOND	SCALE NTS
PART NUMBER N/A	

TITLE GEN. ARRANGEMENT - DRIVE PLAN VIEW, AFT BAY (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

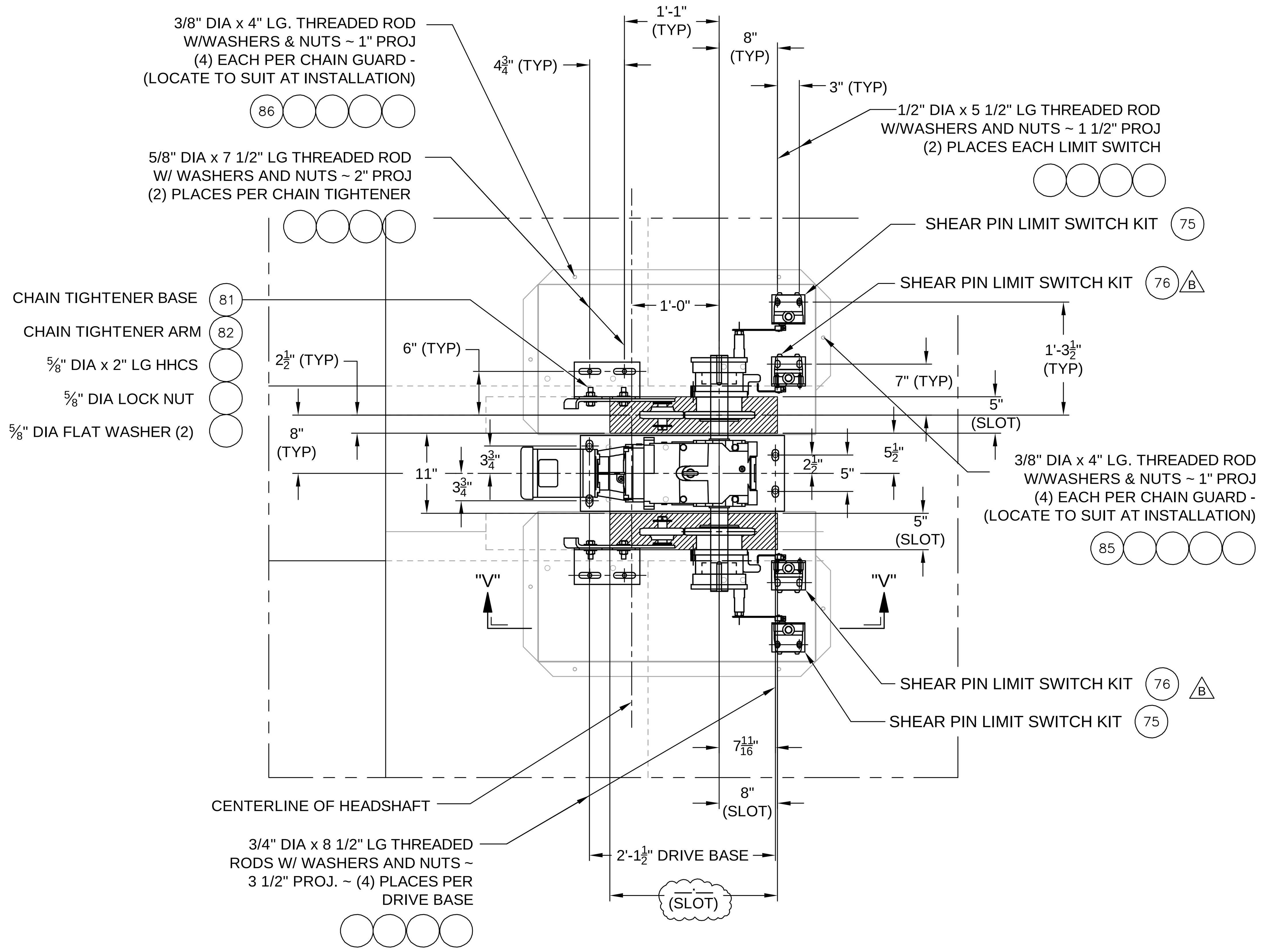
CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

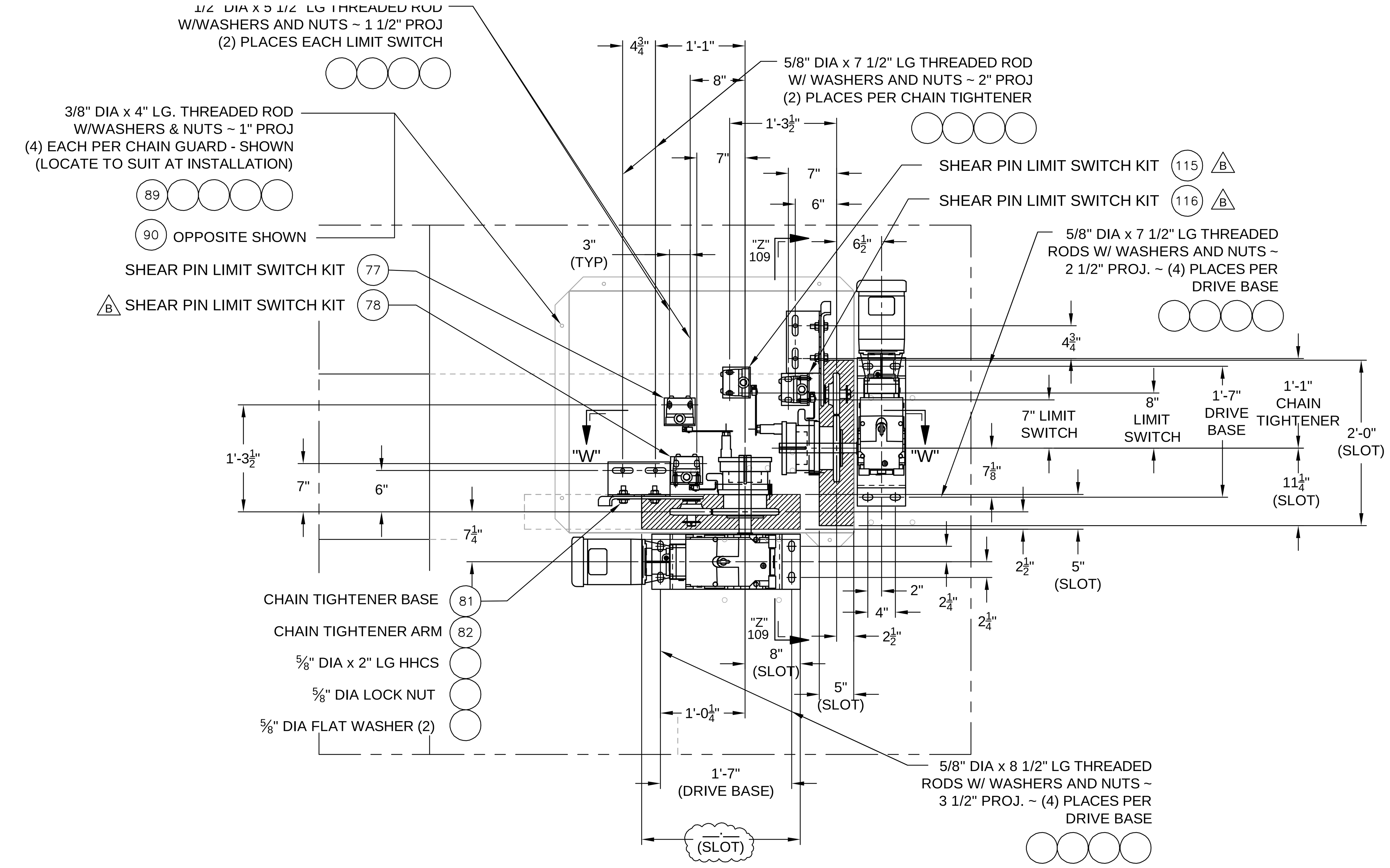
PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
2033/001724	M-GA01	419383-108	1 OF 1	B

BAR = 1" AT PLOT SCALE

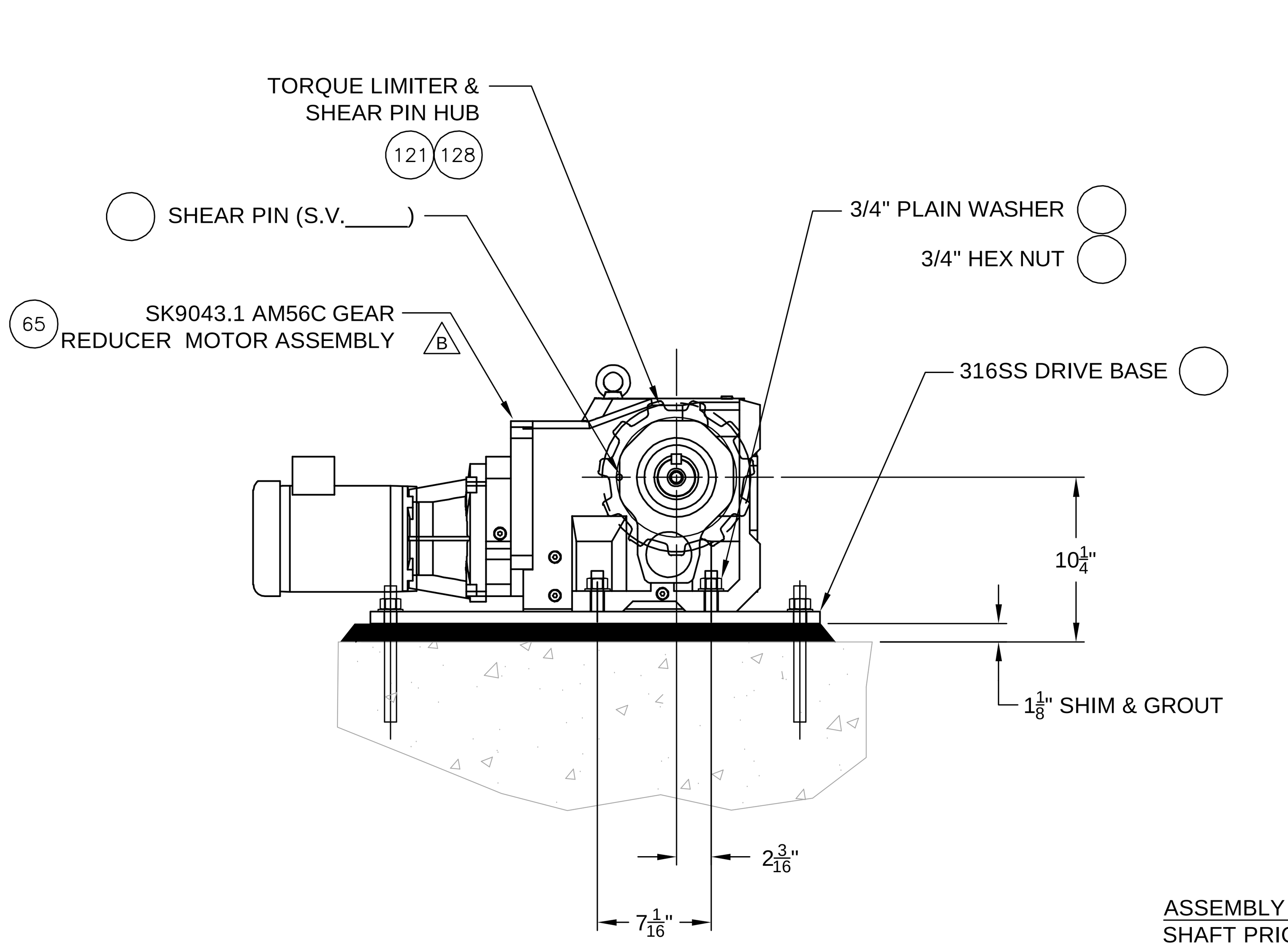
STD:22x34_D v4.0

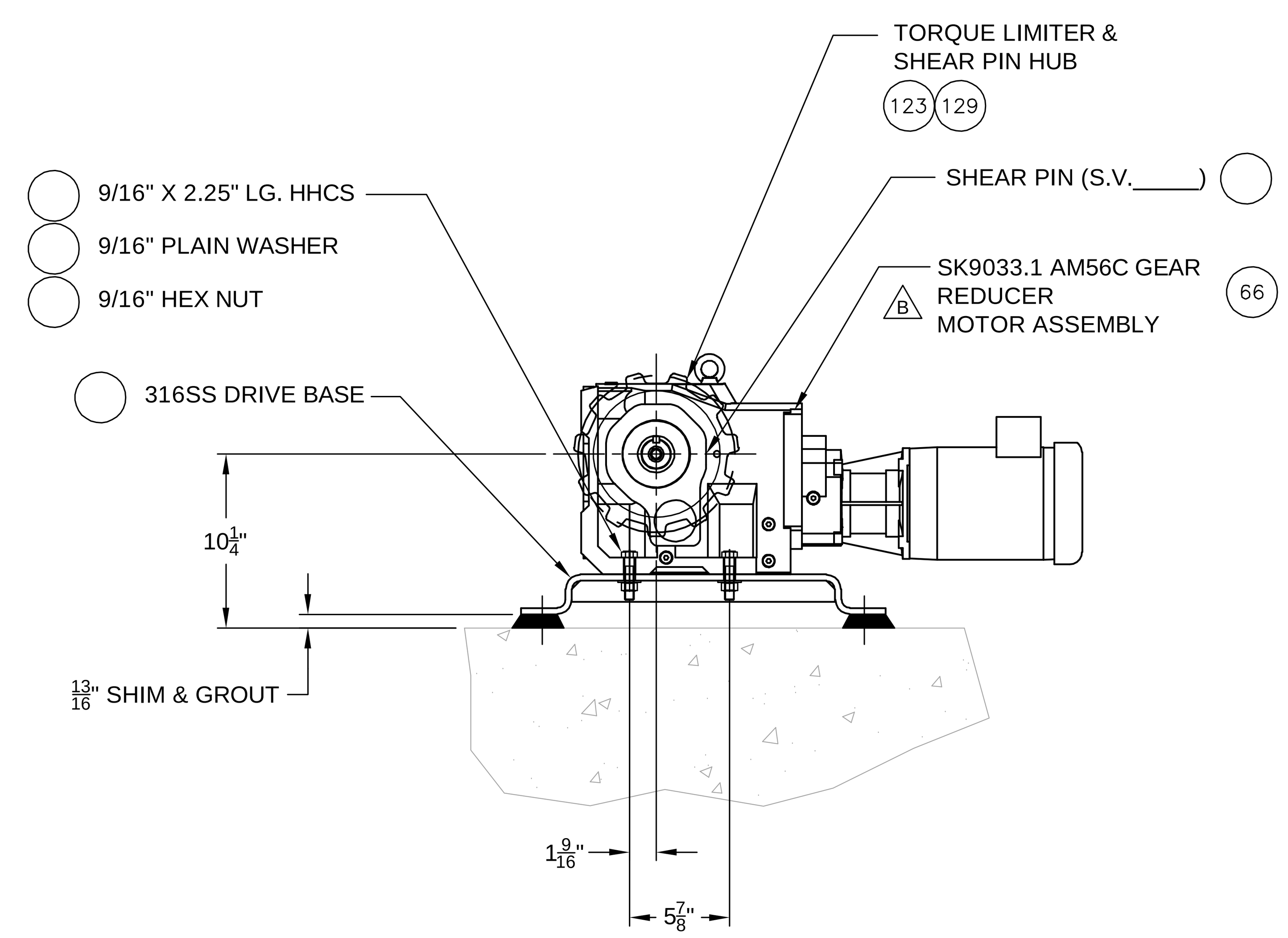


FOREBAY DUAL OUTPUT
SED BASINS #5 & 6 SHOWN / #3 & 4 OPPOSITE SHOWN



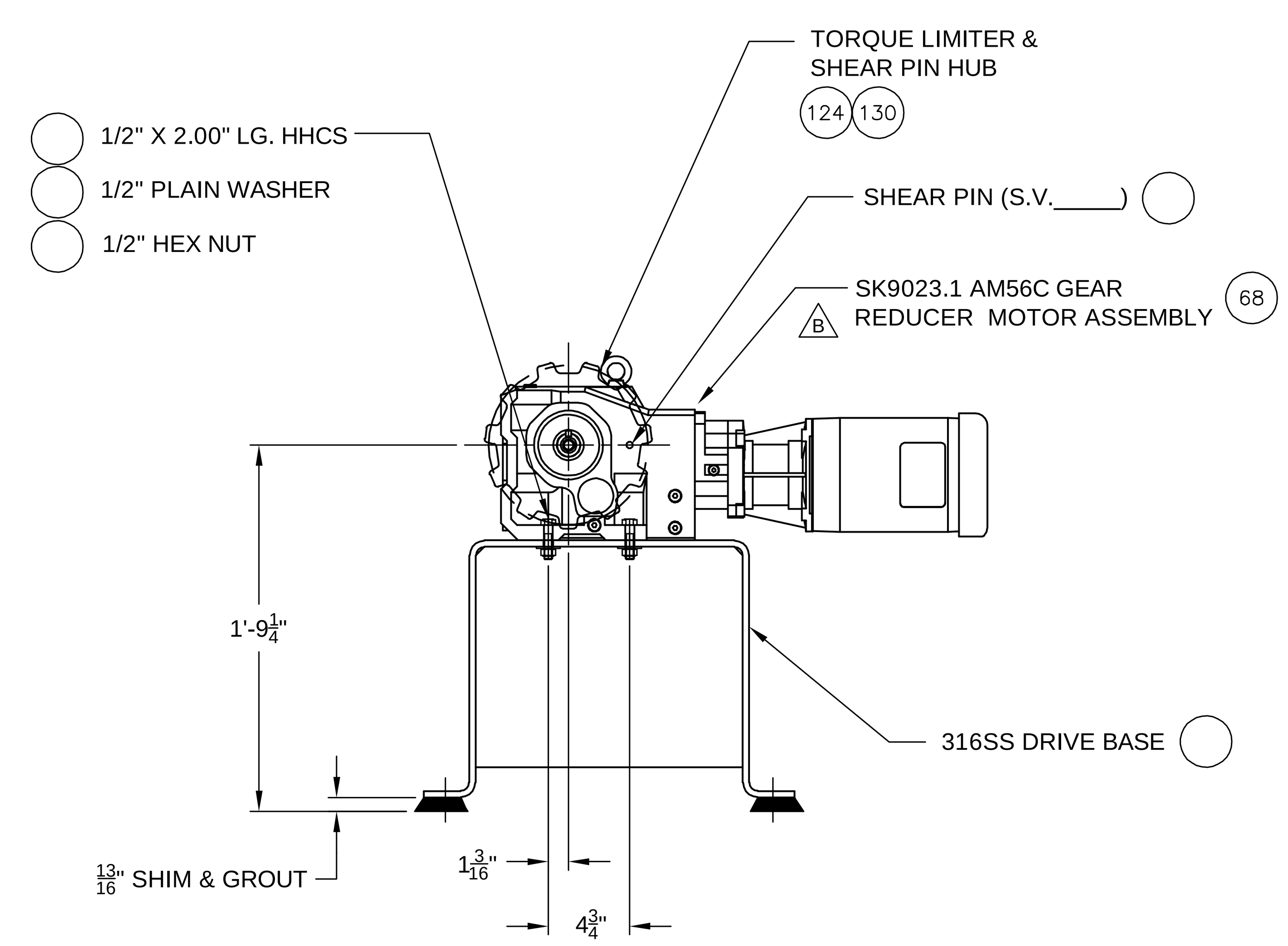
FOREBAY SINGLE OUTPUT & CROSS
SED BASINS #5 & 6 SHOWN
SED BASINS # 3 & 4 OPPOSITE SHOWN





ASSEMBLY NOTE: CLEAN GEAR REDUCER SHAFT PRIOR TO ASSEMBLING DRIVE SPROCKET. LUBRICATE SHAFT WITH GREASE COMPATIBLE WITH PLANT CONDITIONS BEFORE ASSEMBLING DRIVE SPROCKET.

SECTION "W-W"/109



SECTION "Z-Z"/109

THIRD ANGLE PROJECTION

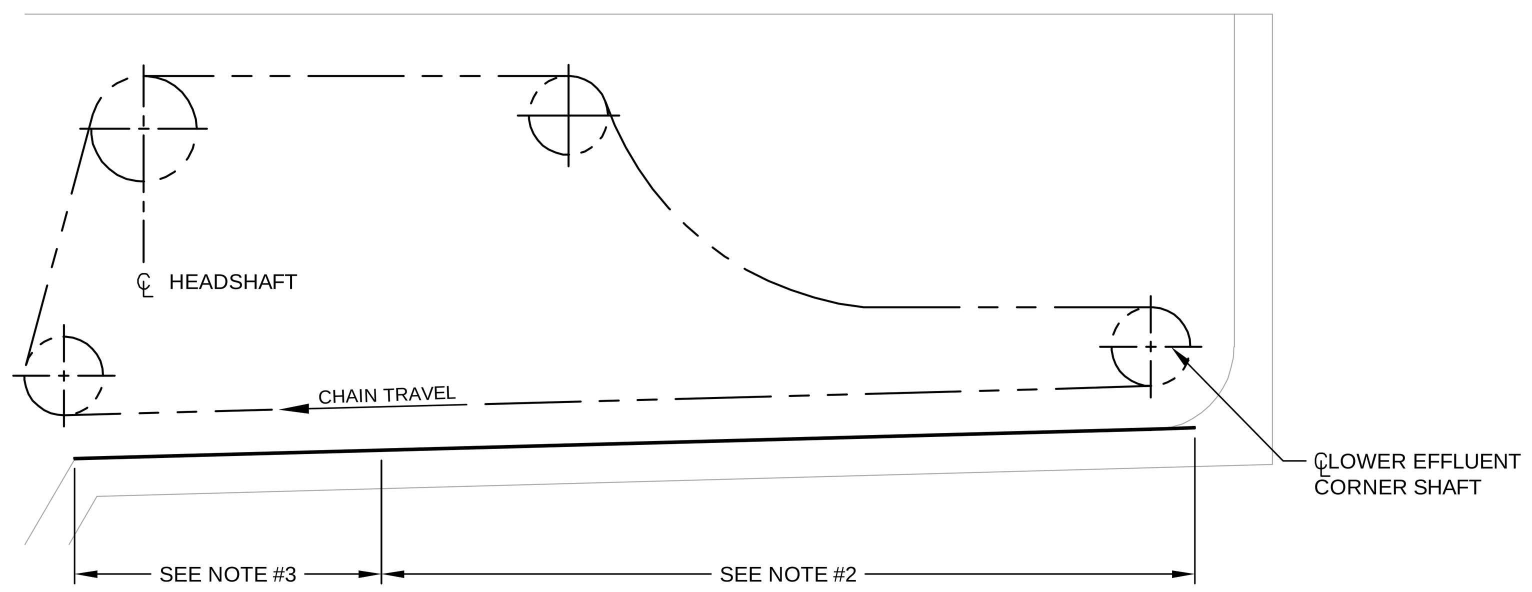
FOR APPROVAL ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	REV'D DRIVES FROM EURODRIVE TO NORD ADDED LIMIT SWITCH FOR SHEAR PIN HUBS	3/18/22	GLH	AJK	SW	
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

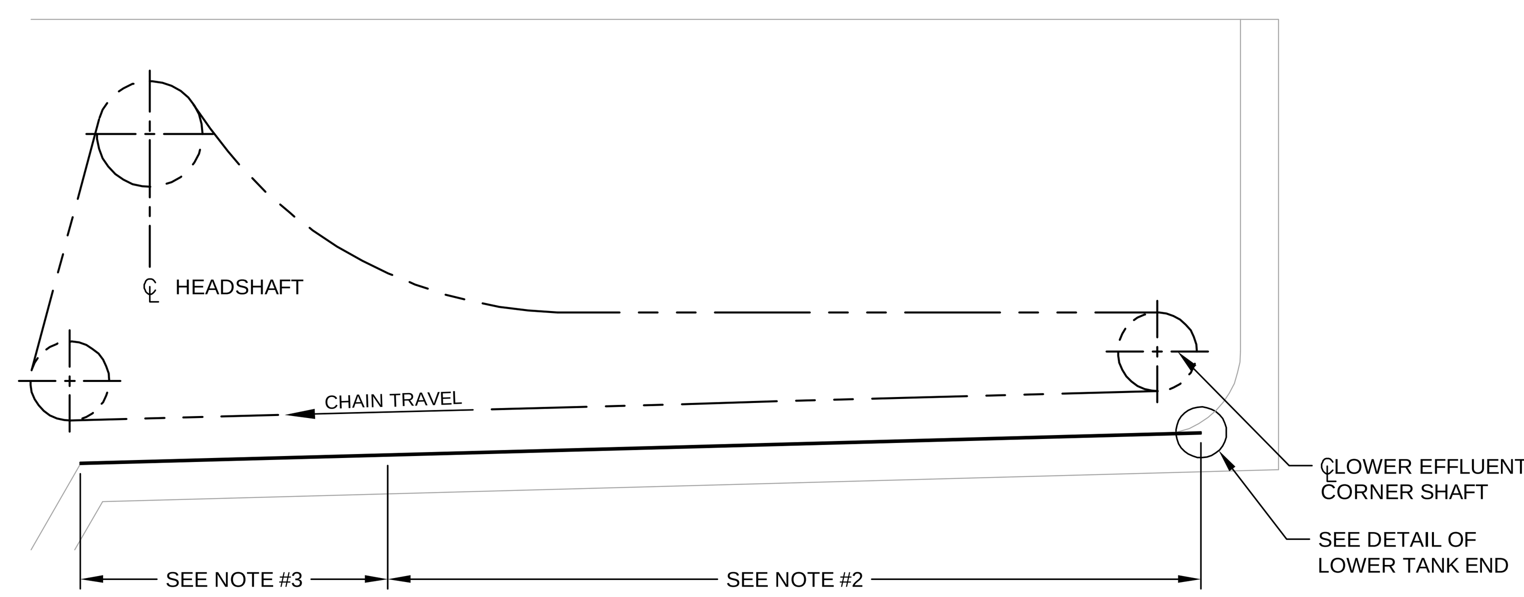
DWN BY: G.HALASE	DATE 11/5/21	TITLE GEN. ARRANGEMENT - DRIVE PLAN VIEW, FORE BAY & CROSS (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS
CKD BY: G.HALASE	DATE 11/5/21	CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT JORDAN VALLEY WTP, HERRIMAN UTAH
APPD BY: A.KLUESS	DATE 11/5/21	EVOQUA WATER TECHNOLOGIES — EVOQUA WATER TECHNOLOGIES WAUKESHA WI USA +1 262-547-0141
MGD BY: J.MCDONOLD	SCALE NTS	

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-109	1 OF 1	B

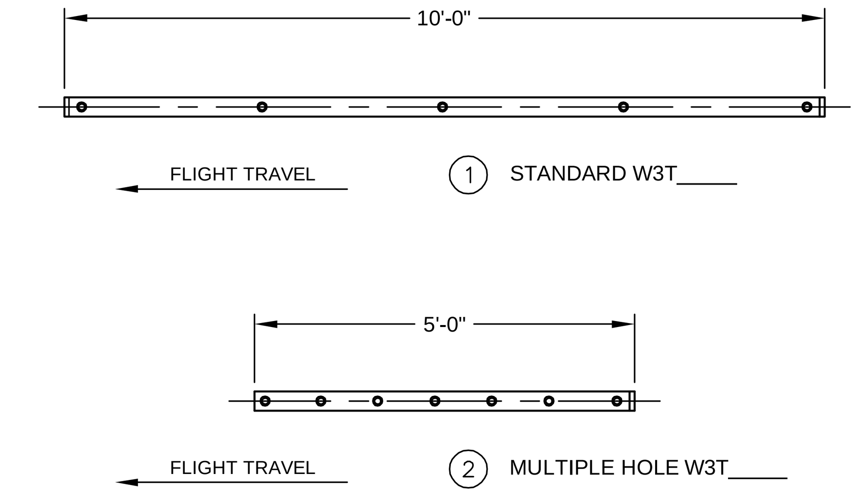
STD 22x34_D v4.0   BAR = 1" AT PLOT SCALE



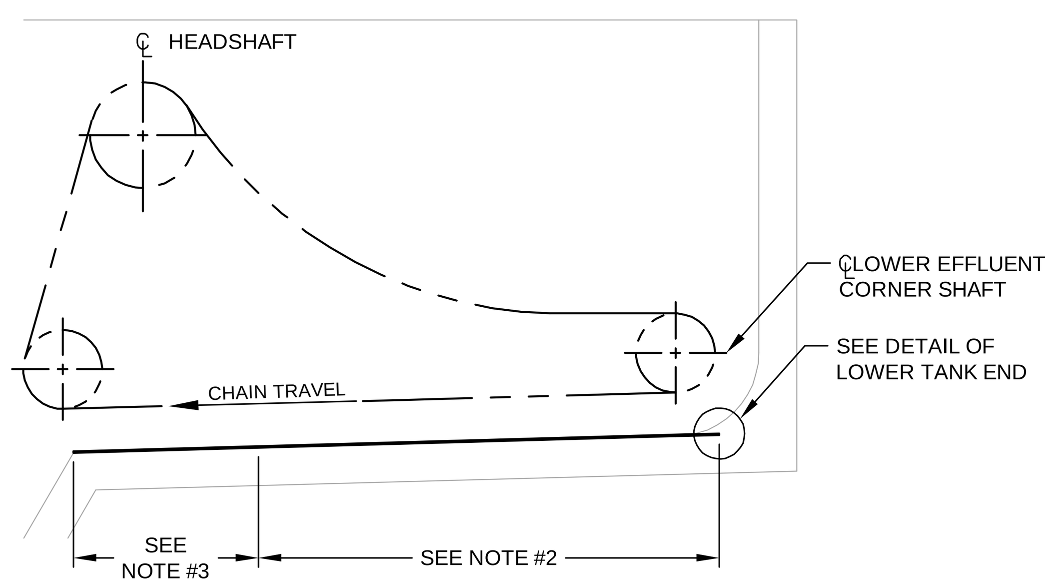
LONGITUDINAL COLLECTOR



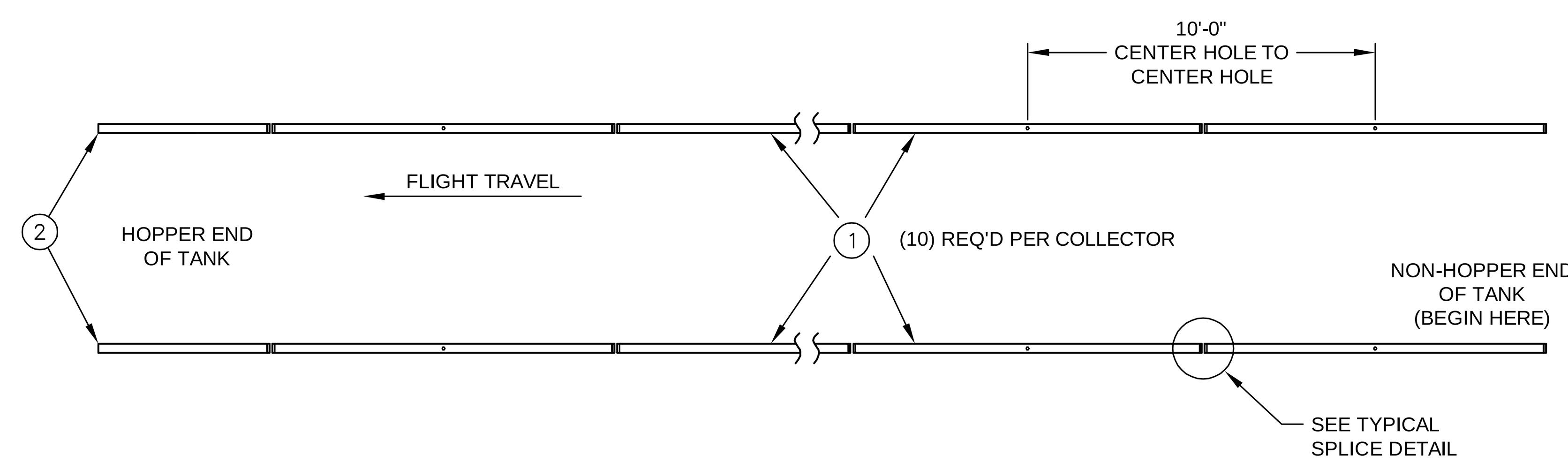
LONGITUDINAL COLLECTOR



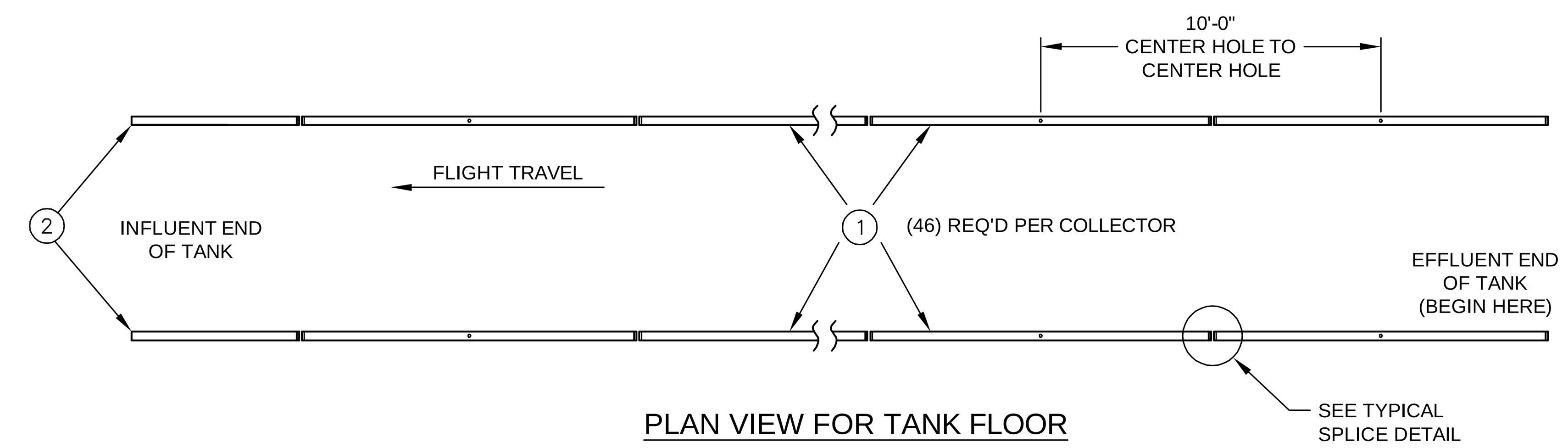
TYPICAL WEAR STRIP DETAILS



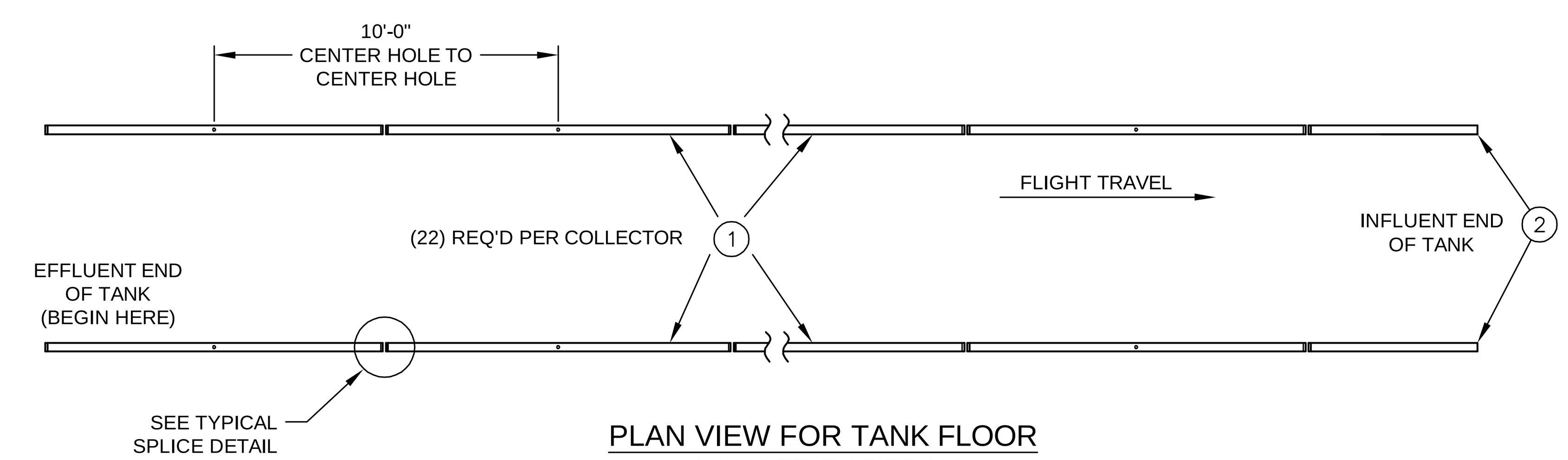
CROSS COLLECTOR



PLAN VIEW FOR TANK FLOOR
CROSS COLLECTOR
WEAR STRIP INSTALLATION



PLAN VIEW FOR TANK FLOOR
4-SHAFT AFTBAY
WEAR STRIP INSTALLATION



PLAN VIEW FOR TANK FLOOR
4-SHAFT FOREBAY
WEAR STRIP INSTALLATION

TYPICAL WEAR STRIP INSTALLATION INSTRUCTIONS

1. FASTEN WEAR STRIPS WITH CONVEX WASHERS & HARDWARE TO TANK FLOOR, SEE "TYPICAL FLOOR MOUNTING".

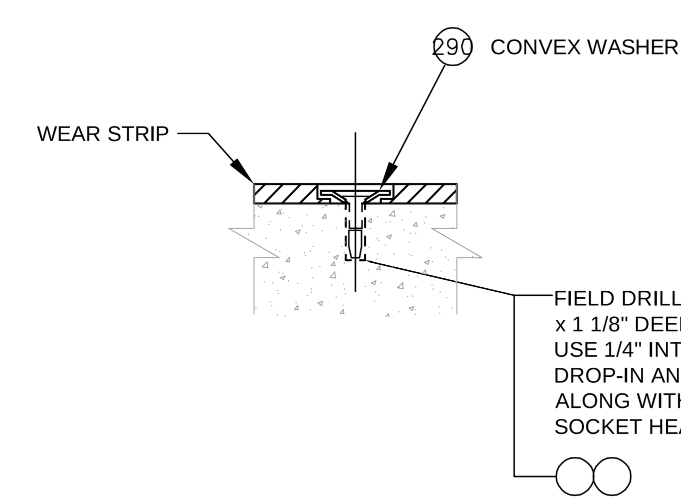
2. INSTALL (5) HOLE WEAR STRIPS W3T_____ (10'-0" LG SECTION) AS FOLLOWS:

   NOTE FLIGHT TRAVEL SHOWN ON THE "TYPICAL WEAR STRIP DETAILS". ALL BEVELLED WEAR STRIP ENDS ARE TO BE INSTALLED IN A DIRECTION TO PROVIDE A RAMP-UP OR LEAD-IN FOR THE FLIGHT WEAR SHOES.

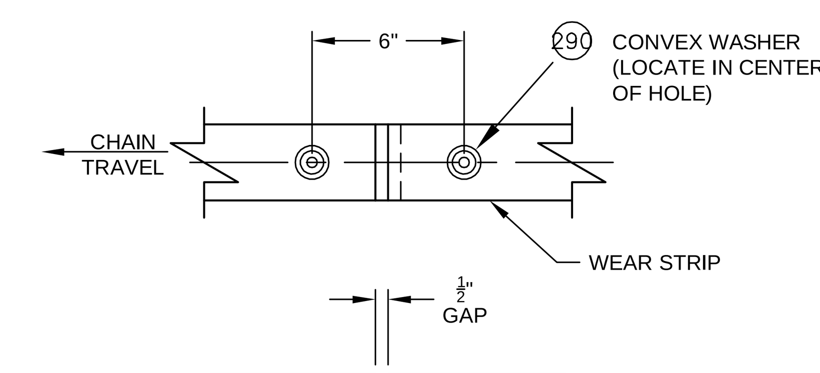
   ON THE TANK FLOOR, BEGIN AT THE EFFLUENT CORNER SHAFT END OF THE TANK AND WORK TOWARD THE HEADSHAFT END OF TANK.

   THE CENTER ANCHOR HOLES IN EACH (5) HOLE WEAR STRIP ARE TO BE LOCATED AT 10'-0" SPACINGS, REGARDLESS OF AMBIENT TEMPERATURE (SEE PLAN VIEWS).

3. MULTIPLE HOLE WEAR STRIPS W3T_____ (5'-0" LG SECTION) ARE TO BE FIELD CUT TO REQUIRED LENGTH AND INSTALLED WITH A CONVEX WASHER IN ALL HOLES. THIS SECTION IS TYPICALLY THE LAST INSTALLED IN A ROW. WHERE A W3T_____ (5'-0" LG SECTION) IS USED, INSTALL IT SUCH THAT THERE IS A 1/2" GAP BETWEEN IT AND THE LAST ADJACENT WEAR STRIP SECTION, ALSO TRIMMING THE LENGTH AS REQUIRED (SEE "TYPICAL SPLICE BETWEEN WEAR STRIPS" DETAIL).

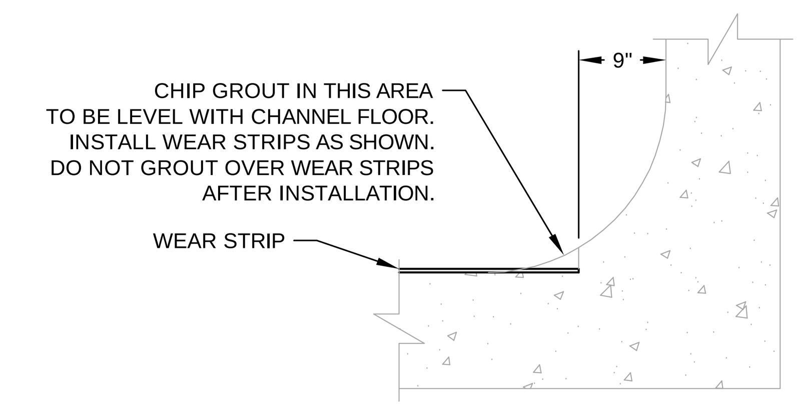


TYPICAL FLOOR MOUNTING



NOTE: THIS DIMENSION IS FOR REFERENCE ONLY. WEAR STRIPS TO BE SPACED AT 10'-0" CENTER HOLE TO CENTER HOLE. IF THE LAST SECTION IN A GIVEN ROW IS 5'-0" OR LESS, INSTALL THAT SECTION WITH A ½" GAP TO THE PREVIOUSLY INSTALLED, ADJACENT WEAR STRIPAS SHOWN IN THE VIEW ABOVE.

TYPICAL SPLICE BETWEEN WEAR STRIPS



LOWER TANK END
WEAR STRIP LOCATION

(SEE NOTE #1)

CONTRACTOR NOTE:

THE SUBSURFACE THAT THE WEAR STRIP(S) WILL BE ATTACHED TO MUST BE IN "SOUND" OR "AS NEW" CONDITION.

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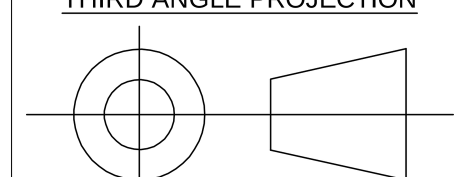
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

THIRD ANGLE PROJECTION



REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	ISSUED FOR APPROVAL	8/13/21	GLH	AJK	WC	

DWN BY: G.HALASE	DATE 11/5/21
CKD BY: G.HALASE	DATE 11/5/21
APPD BY: A.KLUESS	DATE 11/5/21
MGD BY: J.MCDOND	SCALE NTS

TITLE GEN. ARRANGEMENT - WEAR STRIP INSTALLATION DRAWING (12) FORE BAY LONGITUDINALS, (12) AFT BAY LONGITUDINALS & (4) CROSS COLLECTORS

CLIENT JORDAN VALLEY WATER CONSERVANCY DISTRICT
JORDAN VALLEY WTP, HERRIMAN UTAH

EVOQUA WATER TECHNOLOGIES
WAUKESHA WI USA
+1 262-547-0141

PART NUMBER	PROJ/PROD NUMBER	CODE	FILE/DRAWING NUMBER	SHEET	REV
N/A	2033/001724	M-GA01	419383-110	1 OF 1	A

BAR = 1" AT PLOT SCALE

STD 22x34_D v4.0