INVITATION FOR BID

FINAL BID PACKAGE

Project Name: Kiwanis Pool Improvements

IFB Number: RFP 2023-023

Bids Due
Date: 08/24/2023
Time: 10:00 a.m.

Prepared by City of Northglenn Public Works Department
11701 Community Center Drive
Northglenn, CO 80233

TABLE OF CONTENTS

PROPOSAL NO RFP 2023-023

ISSUE DATE July 28, 2023

REQUEST FOR PROPOSAL (RFP)
COVER SHEET

PROPOSAL TITLE: Kiwanis Pool Improvements

SUBMISSION DEADLINE: 10:00 AM on August 24th

SUBMIT PROPOSAL TO:
City Clerk's Office
11701 Community Center Dr
Northglenn CO 80233
or
rfp@northglenn.org

CONTACT: Daniel Martinez

EMAIL: danmartinez@northglenn.org

PHONE: 303-450-8839

Bidding instructions and drawings are available at the Rocky Mountain E-Purchasing website or at:
https://www.northglenn.org/government/bids_with_the_city.php

MANDATORY PREBID CONFERENCE: Yes

DATE & TIME: August 8, 2023 at 10:00 am

LOCATION: 12301 Claude Ct, Northglenn CO 80241

The undersigned hereby affirms that (1) they are a duly authorized agent of the vendor, (2) they have read all terms and conditions, requirements, and instructions of this bid as stated or implied, (3) the vendor warrants that they are familiar with all provisions of the contract documents and technical specifications which were made available in conjunction with this solicitation and fully understands and accepts them unless specific variations have been expressly listed in their offer, (4) that the offer is being submitted on behalf of the vendor in accordance with any terms and conditions set forth in this document, and (5) that the vendor listed on the bid submission must match all contract and insurance documents submitted upon award.

PRINT OR TYPE YOUR INFORMATION

Company _____ Fax Number _____

Address _____ City, State Zip _____

Contact Person _____ Title _____

Email _____ Phone _____

Signature _____

Print name _____

INSTRUCTIONS TO BIDDERS

1. **PROPOSAL NO:** RFP 2023-023

2. **PROPOSAL TITLE:** Kiwanis Pool Improvements

3. **PURPOSE OF SOLICITATION**:

The City of Northglenn is soliciting bids to complete the Kiwanis Pool Improvements as identified in the attached construction documents. Contractors are required to provide a detailed breakdown of the total cost to complete the work as part of their proposal.

4. **SCHEDULE OF ACTIVITIES:** The following schedule of activities delineates the timing of the solicitation and the estimated project schedule. These dates may be subject to change at the City's discretion.

July 28th, 2023	Request for Proposal Issuance
August 8th, 2023 at 10:00 am	Mandatory Pre-Bid Meeting
August 14th, 2023 at 5:00 pm	Information/Questions Period Ends
August 17th, 2023	Addendum Issuance
August 24th, 2023	Bid Submission Deadline
September 2023	Notice of Award
September 2023	Notice to Proceed

5. **INTERPRETATION OF DOCUMENTS AND SPECIFICATIONS:** Wherever the word "contract" appears, it shall be held to include all the documents as listed. No less than all of the parts of the contract documents shall constitute the formal contract. If any person contemplating submitting a proposal for the proposed contract is in doubt as to the true meaning of any part of specifications, schedules, or information sheets or the proposed contract documents, they may submit to the project manager a written request for an interpretation thereof. The person submitting the request will be responsible for its prompt and actual delivery. Any interpretation of such documents will be made only by an addendum duly issued, and a copy of such addendum will be mailed or delivered to each person receiving a set of such documents. The City will not be responsible for any explanation or interpretation of such documents which anyone presumes to make on behalf of the City.

6. **TERMS AND CONDITIONS:** As set forth in the contract agreements and any supplemental, the following terms and conditions will apply to this Request for Proposal, each vendor's proposal and to the negotiations, if any, of any said contract. The City will consider specific recommended changes that clarify the intent of the agreement. **The City will not consider contract changes that have not been specifically identified in your proposal response.** A general statement suggesting that, if selected you reserve the right to discuss contract issues at a later date will not be accepted and will be grounds for disqualification. Submission of a proposal in response to this RFP indicates the vendor's acceptance of the terms and conditions contained in this document and the contract.

7. **BIDDER EXPENSES:** The City of Northglenn will not be responsible for any expenses incurred by any vendor in preparing and submitting an offer.

8. **WITHDRAWAL:** A vendor may withdraw their proposal at any time prior to the expiration of the final date and time set for receipt of bids. Withdrawal notification must be in written form, and must be received in the Offices of the City Clerk prior to the closing date and time.

9. **IRREVOCABILITY:** Following the time of closing, all bids will become irrevocable offers to the City and will remain as such until 90 days from date of submission. By submission of a bid, the vendor agrees to enter into a contract. In addition all quoted prices will be firm and valid up to 90 days from date of submission The City may, in its sole discretion, release any proposal and return any bonds if applicable prior to the 90 days.

10. **LATE PROPOSALS:** Any proposal received after the Final date and time for receipt of proposal will not be accepted and will be unopened and discarded without being considered**.**

11. **SIGNATURES OF VENDORS:** Each vendor shall sign their proposal, using their legal signature and giving their full business address. The person signing the proposal must be an officer of the company or partnership. Bids by partnerships shall be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the President, Secretary, or other persons authorized to bind it in the matter. The names of all persons signing should also be printed below the signature. A proposal by a person who affixes to their signature the word, "President", "Secretary", "Agent" or other designation without disclosing their principal, may be held to be a proposal of the individual signing. When requested by the City, satisfactory evidence of the authority of the officer signing in behalf of the corporation shall be furnished. Bids submitted electronically are to be typed in lieu of written signature (see the cover letter).

12. **OPEN RECORDS ACT:** Notwithstanding any language contained in a proposal to the contrary, all proposals submitted to the City become the property of the City. Any information considered proprietary should be marked by the vendor and as such and will be kept confidential to the extent provided by law.

13. **SALES TAX:** Vendors shall not include federal, state, or local excise, sales or use taxes in prices offered, as the City is exempt from payment of such taxes.

14. **MISTAKES IN BIDDING INSTRUCTIONS:** If the City makes a mistake in drafting the bidding instructions or any other contract documents, the City reserves the right to reject any or all bids, or to require that vendors submit an alternate proposal with adjustments made to correct the error(s). Such errors will be set forth in an addendum. If the vendor has already been selected and has started performing work under the contract, and the City then discovers a mistake in the contract documents for which the City is responsible, the City may opt to reform the contract. If the mistake causes the vendor to receive compensation for materials not used in the work or for labor that would not be required for the work, the contract price shall be decreased proportionally. If the mistake causes the vendor to fail to bid on work which must be performed in order to properly complete the contract, the City may increase the contract price to equal the proportionate increase in the cost of required materials and labor caused to the vendor. In the alternative, the City may solicit bids for such additional work, or the City may reassign such additional work to another vendor, as the City deems appropriate. Nothing in this provision shall apply to mistakes made by the vendor in completing the proposal form or in performing the contract.

15. **ACCEPTANCE OF PROPOSAL:** It is expressly understood and agreed that the City reserves the right to reject any or all bids, to waive formalities, and accept the proposal which appears to be in the City's best interest.

16. **APPEAL OF AWARD:** Solicitations will be awarded based on multiple criteria, price being just one of the conditions. Vendors can review the solicitation's special terms and conditions for information on evaluation criteria. Vendors may appeal the award decision by submitting, in writing, to the City of Northglenn, a request for reconsideration within 7 calendar days after the posting of the Notice of Intent to Award, provided that the appeal is sought by the vendor prior to the City finalizing a contract with the selected vendor. Vendors who were deemed non- responsive are ineligible to participate in the appeal process.

17. **DEFENSE OF SUITS:** In case any action at law or suit in equity is brought against the City, any officer, employee, or agent thereof, for or on account of the failure, omission, or neglect of the vendor to do and perform any of the covenants, acts, matters, or things by this contract undertaken to be done or performed, or for the injury or damage caused by the negligence of the vendor or their subcontractors or their agents, or in connection with any claim or claims based on the lawful demands of subcontractors, workmen, material, men or suppliers or machinery and parts thereof, equipment, power tools and supplies incurred in the fulfillment of the contract, the vendor shall indemnify and save harmless the City, officers, employees, and agents of the City, of and from all losses, damages, costs (including attorney's fees), expenses, judgments, or decrees whatever arising out of such action of suit that may be brought as aforesaid.

18. **CONTRACT NEGOTIATIONS:** If the City decides to proceed and to negotiate a contract, the City intends to provide written notification to the vendor whose proposal is deemed by the City to be in the best interests of the City and the City will attempt to negotiate a contract with the selected vendor(s) on terms and conditions stated in this RFP or in the successful vendor's bid, but shall also include terms and conditions later negotiated. If the City and the successful vendor are unable to execute a contract and the vendor has been notified that it is the successful vendor then the City may cease all discussions with the (first) successful vendor without any further obligation to that vendor and select another (second) vendor as the successful vendor. If the (second) vendor is rejected, as per the terms above, then the City, without any further obligation to that vendor, may select another (third) vendor as the successful vendor and so on, or the City reserves the right to reject all proposals and re-bid.

19. **OPENING OF PROPOSALS:** The City reserves the right to open Proposals received in response to this RFP, privately and unannounced, after the closing date and time.

20. **EXTENSION OF TIME:** No time extensions are being considered at this time; however, should the City extend this proposal, all vendors will be given the same considerations.

PROPOSAL FORM

City of Northglenn
11701 Community Center Drive
Northglenn, Colorado 80233-8061

PROPOSAL: Pursuant to the "advertisement for proposal" for the above named project, and being familiar with all contractual requirements therefore, the undersigned bidder hereby proposes to furnish all labor, materials, tools, supplies, equipment, transportation, services and all other things necessary for the completion of the contractual work, and perform the work in accordance with the requirements and intent of the contract documents, within the time of completion set forth herein, for, and in consideration of the following prices.

Proposal of _____ (hereinafter called **BIDDER**) organized and existing under the laws of the State of _____ doing business as _____*. To the **CITY OF NORTHGLENN** (hereinafter called **CITY**). In compliance with your advertisement for bids, **BIDDER** hereby proposes to perform WORK on

_____ - _____

in strict conformance with the **CONTRACT DOCUMENTS**, within the time set forth therein, and at the prices stated below.

By submission of this **BID**, each **BIDDER** certifies, and in case of a joint bidder each party thereto certifies as to their own organization that this **BID** has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this **BID** with any other **BIDDER** or with any competitor.

BIDDER hereby agrees to commence **WORK** under this contract on or before a date to be specified in the **NOTICE TO PROCEED** and to fully complete the **PROJECT** as indicated in the General Conditions.

BIDDER acknowledges receipt of the following **ADDENDUM:**

_____

_____

*Insert "a corporation", "a partnership", or "an individual" as applicable.

Sub-contractors (if any): Work they will perform:

1._____ Email:_____

2._____ Email:_____

3._____ Email:_____

Please provide a complete and accurate list of at least three references and contact phone numbers:

1._____Phone:_____

Email:_____

2. _____Phone:_____

Email:_____

3. _____Phone:_____

Email:_____

Respectfully
submitted,

_____
Signature

(Seal, if Proposal is by a
Corporation)

_____
Address

_____
Title

_____ _____
Attest Date

_____
License Number
(If Applicable Signature)

_____
Phone Number

BID SUMMARY

(Vendor Name)

Hereby submits to the City of Northglenn, Colorado the following bid items complete and in place as specified for the: Kiwanis Pool Improvements - IFB 2023-023

Item No.	Description	Quantity	Unit	Total Cost
1	Kiwanis Pool Improvements	1	LS	$ -

TOTAL FOR ALL ITEMS $

TOTAL IN WORDS

Note: Provide detailed breakdown of total cost as part of your proposal

TRADE CONTRACTOR AGREEMENT

TABLE OF CONTENTS

TRADE CONTRACTOR AGREEMENT

THIS AGREEMENT is made and entered into this _____ day of _____,20_____, by and between the City of Northglenn, State of Colorado, a Colorado home rule municipal corporation, hereinafter referred to as the "City" or “Owner” and , hereinafter referred to as the "Trade Contractor".

ARTICLE 1 - GENERAL PROVISIONS AND SERVICES

A. The Trade Contractor will commence and fully complete the construction of the Project, which is described in **Exhibit A**, which is attached hereto and made a part hereof (“Project”).

B. The Trade Contractor will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the project described herein.

C. The Trade Contractor will commence the work required by the contract documents within ten (10) calendar days after the date of the notification to proceed and will complete the same within _____ ( ) day, unless the period for completion is extended otherwise by the contract documents. The Trade Contractor agrees to pay as liquidated damages, and not as a penalty, the sum of ($) for each consecutive calendar day's delay in completing this Contract after the completion dated specified herein, excluding any approved extensions of time because of unavoidable delay.

D. The Trade Contractor agrees to perform all of the work described in the contract documents and to comply with the terms therein for an amount not to exceed ($) as described in Article 5 of this Agreement.

ARTICLE 2 - DEFINITIONS

A. Wherever used in the contract documents, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1. Addenda - Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the contract documents, drawings and specifications, by additions, deletions, clarifications or corrections.

2. Architect - The Architect shall be

3. Bid - The offer or proposal of the bidder submitted in the prescribed form setting forth the prices for the work to be performed.

4. Bidder - Any person, firm or corporation submitting a bid for the work.

5. Bonds - Bid, performance and payment bonds and other instruments of security, furnished by the Trade Contractor and his surety in accordance with the contract documents.

6. Change Order - A written order to the Trade Contractor authorizing an addition, deletion or revision in the work within the general scope of the contract documents or authorizing an adjustment in the contract price and/or contract time.

7. Contract Documents - The contract, including advertisement for bids, information for bidders, bid, bid bond agreement, bid schedule, labor and material, payment bond, performance bond, notice of award, notice to proceed, change order, general conditions, special conditions, general specifications, special specifications, scopes of work, addenda, drawings, schedules and any and all other documents or papers included or referred to in the foregoing documents are part of the Contract Documents

8. Contract Price - The total monies payable to the Trade Contractor under the

terms and conditions of the contract documents.

9. Contract Time - The number of calendar days stated in the contract documents for the completion of the work.

10. Date of Award - Date of award of contract shall mean the date formal notice of such award, approved by the Owner, has been delivered to the intended awardee, or mailed to him at the main business address shown in his proposal by the Owner or it's authorized representative.

11. Day or Days - Unless herein otherwise expressly defined, "day" shall mean calendar day or days.

12. Drawings, Plans or Contract Documents - The part of the contract documents which shows the characteristics and scope of the work to be performed and which has been prepared or approved by the Engineer and/or Architect.

13. Engineer shall be

14. Field Order - A written order effecting a change in the work not involving an adjustment in the contract price or an extension of the contract time, issued by the Engineer or the Owner to the Trade Contractor during construction.

15. Major Equipment or Major Equipment Items - Installation of major equipment to be furnished and placed under the contract awarded to the Trade Contractor and/or installations of major equipment to be furnished by the Owner and received, unloaded, stored, and placed under the contract awarded to the Trade Contractor.

16. Notice of Award - The written notice of the acceptance of the bid from the Owner to the successful bidder.

17. Notice to Proceed - Written communication issued by the Owner to the Trade Contractor authorizing him to proceed with the work and establishing the date of commencement of the work.

18. Owner or City - The City of Northglenn, Colorado, a home rule municipality. The Public Works Director of the Owner, or his designee, is the Owner's representative.

19. Project - Construction of the project described in **Exhibit A.**

20. Shop Drawings - All drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by the Trade Contractor, a subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the work shall be fabricated or installed.

21. Site - The lands and other places on, under, in, or through which the work is to be executed or carried out and any other lands or places provided by the Owner for the purposes of the contract together with such other places as may be specifically designed in the contract documents as forming part of the site.

22. Special Conditions - Supplemental conditions that apply to specific aspects of the project or modifications to the general conditions that are to be adhered to in the project.

23. Subcontractor - An individual, firm or corporation having a direct contract with the Trade Contractor or with any other subcontractor for the performance of a part of the work at

the site.

24. Substantial Completion - That date as certified by the Owner when the construction of the project or a specified part thereof is sufficiently completed, in accordance with the contract documents, so that the project or specified part can be utilized for the purposes for which it is intended.

25. Suppliers - Any person, supplier, or organization who supplies materials or equipment for the work, including that fabricated to a special design, but who does not perform labor at the site. A supplier is not a subcontractor who purchases an item of equipment from a manufacturer.

26. Trade Contractor - The person, firm or corporation with whom the City of Northglenn has executed this Agreement.

27. Work - All labor necessary to produce the construction required by the contract documents, and all materials and equipment incorporated or to be incorporated in the project. The work and the project are used interchangeably to mean the same thing.

28. Written Notice - Any notice to any party of the Agreement relative to any part of the Agreement in writing and considered delivered and the service thereof completed when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the work.

ARTICLE 3 - DESCRIPTION OF WORK AND SERVICES

Section 1. Drawings and Specifications.

A. The intent of the drawings and specifications is that the Trade Contractor shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the work in accordance with the contract documents and all incidental work necessary to complete the project in an acceptable manner, ready for use, occupancy or operation by the Owner.

B. Up to three (3) copies of the drawings and specifications will be furnished to the Trade Contractor without charge upon request, and any additional copies which the Trade Contractor may request will be furnished at the cost of reproduction. The drawings and specifications are to be used only in connection with the work specified herein and, with the exception of the signed contract set and As-Built drawings, are to be returned at the completion of the contract.

C. In case of conflict between the drawings and specifications, the drawings will govern. In case of conflict between the special specifications and the general specifications, the special specifications shall govern. Figure dimension on drawings will govern over scale dimensions, and detailed drawings will govern over general drawings. Notwithstanding the above, a document which is more restrictive or requires greater responsibility or increased compliance by the Trade Contractor shall govern.

D. Any discrepancies found between the drawings and specifications and site conditions or any inconsistencies or ambiguities in the drawings or specifications shall be immediately reported to the Owner, in writing, who will promptly resolve such inconsistencies or ambiguities in writing. Work done on unreported discrepancies, inconsistencies or ambiguities by the Trade Contractor shall be done at the Trade Contractor's risk.

E. The Trade Contractor may be furnished additional instructions and detail drawings, by the Owner, as necessary to carry out the work required by the contract documents. All additional

instructions and detail drawings shall be issued to the Trade Contractor by the Owner.

F. The additional drawings and instructions thus supplied will become a part of the contract documents. The Trade Contractor shall carry out the work in accordance with the additional detail drawings and instructions.

Section 2. Materials, Services and Facilities.

A. It is understood that, except as otherwise specifically stated in the contract documents, the Trade Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature and all other services and facilities of any nature whatsoever necessary to execute, complete and deliver the work within the specified time.

B. In addition to the requirements for major equipment items previously given, within fourteen (14) days after execution of the Contract, the Trade Contractor shall submit to the Owner and Engineer a complete listing of the manufacturers of each item of equipment or assembly fabricated off the site which he proposed to furnish for the project, together with sufficient information, including shop assembly and detail drawings, manufacturers' specifications and performance data, to demonstrate clearly that the materials and equipment to be furnished comply with the provisions and intent of the contract documents. If the information shows any deviation from the Contract requirements, the Trade Contractor shall advise the Engineer and Owner of the deviation and state the reason for it in writing.

C. Only first-class materials and materials which conform to the requirements of the specifications shall be incorporated in the work. All materials shall be new unless specified to be otherwise.

D. When requested by the Owner, the Trade Contractor shall furnish a written statement of the origin, composition, and manufacturer of any or all materials (manufactured, produced or grown) that are to be used in the work. The sources of supply of each material used will be approved by the Owner before delivery is started. If, at any time, sources previously approved, fail to produce materials acceptable to the Owner, the Trade Contractor shall furnish materials from other sources.

E. Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection.

F. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

G. Materials, supplies, and equipment shall be in accordance with samples submitted by the Trade Contractor and approved by the Engineer or Architect.

H. Materials, supplies or equipment to be incorporated into the work shall not be purchased by the Trade Contractor or the subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

I. The Trade Contractor shall retain, for the benefit of the Owner, all materials and supplies that are purchased for the project but are not used as a part of the project. The Owner may take any of the materials and supplies that are used in the project for any City purpose. Any materials and supplies not taken by the Owner shall be removed from the project site by the Trade Contractor.

Section 3. Shop Drawings.

A. The Trade Contractor shall submit shop drawings, samples and O&M manuals as may be necessary for the prosecution of the work as required by the contract documents on a timely basis so that the project schedule is not affected. The Engineer will promptly review all shop drawings. All such drawings will be approved and signed by the Engineer, and will be null and void unless authorized by such signature. The Engineer's approval of any shop drawing will not release the Trade Contractor from responsibility for deviations from the contract documents. The approval of any shop drawings which substantially deviates from the requirements of the contract documents shall be evidenced by a change order.

B. All drawings and details on items of major equipment will be reviewed by the Engineer only after the complete set of drawings and details covering the entire equipment package to be furnished under a particular major equipment item are submitted. Drawings submitted on a piecemeal basis covering only parts of the equipment package will be held for checking until the entire set of drawings are received.

C. The Trade Contractor shall also submit to the Engineer shop drawings showing all necessary detail for the proper installation of materials into the completed work, as provided by this Agreement.

D. The Trade Contractor shall make any indicated corrections on the drawings returned and shall resubmit corrected drawings until final approval is obtained.

E. The Trade Contractor shall have no claims for damages or extension of time on account of any delay in the work resulting from the rejection of material or from review, revision and resubmittal of drawings when the review, revision and resubmittal is due to changes to the original design documents, and other data for approval by the Engineer.

F. Each shop drawing shall be dated and shall be identified with the name of the project, the division, if any, the Contract item number, and the name of the Trade Contractor.

G. When submitted for the Engineer's review, shop drawings shall bear the Trade Contractor's certification that he has reviewed, checked and approved the shop drawings and that they are in conformance with the requirements of the contract documents.

H. The Trade Contractor shall submit the shop drawings in accordance with the general requirements.

I. Portions of the work requiring a shop drawing or sample submission shall not begin until the shop drawing or submission has been approved by the Engineer. A copy of each approved sample shall be kept in good order by the Trade Contractor at the site and shall be available to the Engineer.

J. By approving and submitting shop drawings and samples, the Trade Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that he has checked and coordinated each shop drawing and sample with the requirements of the work and of the contract documents.

Section 4. Records, Accounts and Audits.

A. The Trade Contractor agrees to keep one complete set of records and books of account on a recognized cost accounting basis (satisfactory to the Engineer), showing all expenditures, of whatever nature, made pursuant to the provisions of this Contract.

B. The Trade Contractor shall furnish the Engineer and Owner with such records, information and data as may be reasonable. The Engineer and Owner shall at all reasonable times be afforded the opportunity to inspect and/or audit the above-specified books and records of said Trade Contractor.

Section 5. Inspection and Testing.

A. All materials and equipment used in the construction of the project will be subject to adequate inspection and testing in accordance with generally accepted standards.

B. The Trade Contractor shall give sufficient advance notice of placing orders to permit tests to be completed before materials are incorporated in the work.

C. The Owner will provide all inspection and testing services required by the Contract Documents, unless specifically noted in the contract specifications for special inspection and testing services, such as, by way of example, welding inspections on off-site assembly.

D. Neither observations by the Engineer, and Owner, tests nor approvals by persons other than the Engineer and Owner will relieve the Trade Contractor from his obligations to perform the work in accordance with the requirements of the contract documents.

E. The Engineer, the Owner, and their representatives will at all times have access to the work and to locations where materials or equipment are being manufactured, stored, or prepared for use under these contract documents, and they shall have full facilities for unrestricted inspection of such materials, equipment, and work including full access to purchasing and engineering information, but not including prices, to the extent of uncovering, testing, or removing portions of the finished work. The Engineer and Owner shall be furnished with such information as may be required regarding materials used and the process of manufacture for the various items of equipment. Inspections by the Engineer and Owner of equipment or materials during its manufacture will be performed by or for the Owner solely in an effort to detect discrepancies and defects as early as possible, when they can be most readily corrected, and the work thereby expedited. No acceptance of equipment or materials will be construed to result from such shop inspections by the Engineer and Owner Any inspections or tests or waivers thereof will not relieve the Trade Contractor of responsibility for meeting all requirements of these contract documents.

F. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Trade Contractor shall provide proper facilities for such access and observation of the work and also for any inspection or testing thereof.

G. In case of disputes between the Trade Contractor and the Engineer as to materials furnished or manner of performing the work, the Owner will have authority to reject materials or suspend the work until the question at issue can be decided by the Owner. The Owner is authorized to revoke, alter, enlarge, relax or release any requirements of these specifications, and to approve or accept any portion of the work, and to issue instructions contrary to the drawings and specifications.

Section 6. Construction Review

A. The Engineer will periodically observe the construction of all work covered by this Contract. The Engineer, on behalf of the Owner, shall be authorized to determine the amount or quantities of the several items of work which are to be paid for under this Contract; to order field changes within the scope of the Contract and to render decisions on any questions which may arise relative to the execution of the work covered by this Contract. The Engineer does not have authority to suspend work on the project. The Trade Contractor shall not suspend any portion of the work nor resume suspended work without the written authority of the Owner.

B. Neither Engineer's authority to act under the Contract nor any decision made by Engineer in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of the Engineer to the Trade Contractor, any subcontractor, any supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

C. Whenever in the drawings, plans or Contract Documents the terms "as ordered", "as directed", 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 judgment of 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. The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility for the project. Neither the Owner nor the Engineer will be responsible for the acts or omissions of Contractor or any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

D. Periodic observation of the work in progress by the Engineer will be done whenever the Contractor is performing work that requires review as determined by the Engineer. The normal working time shall be during a regular 5-day, 40-hour work week, Monday through Friday. If the Trade Contractor elects to work more than 40 hours per week and observation is required during this overtime work as determined by the Engineer, the Engineer shall be paid by the Trade Contractor at the rate as specified herein for all review time required over the normal 5-day, 40-hour week. If the Engineer or his authorized representative is called to the job site to address problems created by the Trade Contractor, he will be paid by the Trade Contractor at the same rate as for overtime review as stated above. This payment shall be made by a credit to the Owner, and then the Engineer shall bill the Owner for the same.

E. If any work has been covered which the Engineer has not been specifically requested to observe prior to its being covered, or if the Engineer considers it necessary or advisable that covered work be inspected or tested by others, the Trade Contractor at the Engineer's request shall uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the work in question, furnishing all necessary labor, materials, tools and equipment. If it is found that such work is defective, the Trade Contractor shall bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective, the Trade Contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate change order will be issued.

Section 7. Surveys, Permits and Regulations.

A. The Owner will furnish any existing land surveys in the Owner’s possession. Provided however, the Trade Contractor shall perform all necessary land surveys to complete the work required by this Agreement. The Trade Contractor shall provide detailed construction staking.

B. At the beginning of the construction or as the work progresses, the Trade Contractor shall be responsible for the installation of property corners and the setting of benchmarks.

C. Benchmarks and survey stakes shall be preserved by the Trade Contractor and in case of their destruction, or removal by him, his employees, or others, they shall be replaced at the Trade Contractor's expense and his Sureties shall be liable therefor.

D. The Trade Contractor shall be responsible for elevations used in computing his bid.

E. The Trade Contractor shall secure and pay for all necessary permits, fees and licenses in connection with the performance of its work and shall pay all municipal and other governmental fees in connection therewith except those expressly provided by the specifications as being the responsibility of the Owner, and shall furnish at its expense any and all bonds and cash or other deposits required by law or required by any lawful body having the right to make demand therefor.

F. The Owner will provide rights-of-way and permanent and temporary easements as shown on the plans for construction purposes. Any additional land actually needed by the Trade Contractor for the performance of the work, proper location of his plant and equipment, or the storage of materials and supplies for the work, shall be furnished by the Trade Contractor.

Section 8. Protection of Work, Property and Persons.

A. The Trade Contractor shall be responsible for initiating and maintaining all safety precautions and programs in connection with the work. Neither the Owner nor the Engineer will be responsible for Trade Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto. The Trade Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to all employees on the work who may be affected thereby, all the work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and 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 Trade Contractor shall at all times consult with and obtain the approval of the Owner for the storage of material, operation of equipment, placing of temporary structures or dispositions of any surplus or waste materials upon property of the Owner anywhere outside the limits of construction. The Trade Contractor shall comply with all state, federal and local laws related to the storage or placement of any supplies, equipment, structures, or any other materials.

C. The Trade Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. He shall erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. He shall notify owners of adjacent utilities when prosecution of the work may affect them. The Trade Contractor shall remedy at his expense all damage, injury, or loss to any property or person caused, directly or indirectly, in whole or in part, by the Trade Contractor, any subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except damage or loss attributable to the fault of the contract documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Trade Contractor. Notwithstanding the provisions of C.R.S. § 13-20-802.5(2), for purposes of this Contract, the measure of damages shall never be deemed to be the fair market value of the real property without an alleged construction defect.

D. The Trade Contractor shall observe all rules and regulations of the health department

having jurisdiction and shall take precautions to avoid creating unsanitary conditions.

E. In emergencies affecting the safety of persons or the work or property at the site or adjacent thereto, the Trade Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss.

F. The Trade Contractor shall at all times conduct and work in such a manner as to cause the least inconvenience and greatest protection to the general public. The Trade Contractor shall furnish and maintain barricades, warning signs, red flags, lights, and temporary passageways as may be necessary to protect the work and to safeguard the public. The cost of furnishing and maintaining the above facilities shall be incidental to the contract and no extra compensation for it will be allowed.

G. Throughout the performance of the work or in connection with this Contract, the Trade Contractor shall construct and adequately maintain suitable and safe crossings over trenches and such detours as are necessary to care for public and private traffic. The material excavated from trenches shall be compactly deposited along the sides of the trench or elsewhere in such a manner as shall give as little inconvenience as possible to the traveling public, to adjoining property owners, to other trade contractors, or to the City.

H. In performing the work, the Trade Contractor shall take the necessary action, including making arrangements with the owners or operators of existing power, cable and telephone lines, fiber-optic and telemetry lines, gas, water, sewer and other utilities or installations that may be encountered, whether privately or publicly owned, to prevent interference with the conditions, operations and maintenance of the respective utilities in a manner satisfactory to the owners, or operators of the respective utilities. Relocation or repair of utilities encountered even though not shown on the plans, shall be the responsibility of the Trade Contractor. The cost of the above measures, including maintaining of guards, watchmen, signals, barricades and temporary structures, making any necessary repairs and other cooperative or corrective work shall be borne by the Trade Contractor and shall be included in the prices bid in the Proposal for the related items of work. Neither the Owner nor the Engineer shall be responsible to the Contractor for the existence of utilities not shown on the plans or drawings and the Trade Contractor remains obligated under this paragraph for all hidden utilities.

I. The Trade Contractor shall be responsible for the preservation of all private or public property along and adjacent to the work and shall take all necessary precautions to prevent damage or injury thereto. Such preservation and protection shall include but not be limited to, trees, stone walls, fences, mailboxes, monuments, irrigation ditches, driveways, road access culverts, underground pipelines and structures. Such preservation and protection shall apply to all underground pipelines and utilities whether public, private or individually owned that are in or adjacent to the right-of-way. When direct or indirect damage is done to public or private property on account of the act, omission, neglect or misconduct in the prosecution or non-prosecution of the work on the part of the Trade Contractor, such property shall be restored by the Trade Contractor at the Trade Contractor's expense to a condition similar or equivalent to that which existed before such damage or injury was done, and brought up to current codes if applicable. The Trade Contractor shall be responsible for making all arrangements at his own expense for moving and operating equipment at temporary crossings of telephone and transmission lines, railroad tracks, irrigation ditches and pipelines.

Section 9. Communication with the Owner.

The Trade Contractor shall designate a responsible member of its organization at the site, whose duty shall be designated as the contact person for all communication between the Owner and the Trade Contractor. Said designated representative shall also be responsible to attend such meetings, as may be required to insure coordination and adequate performance of the work.

Section 10. Scope of Work.

The scope of work is described in the contract documents which are appended hereto and incorporated herein by this reference.

Section 11. Trade Contractor's Responsibility.

A. The Trade Contractor shall be responsible for all the work under this Contract until completion and final acceptance by the Owner.

B. The Trade Contractor shall supervise and direct the work. He shall be solely responsible for the means, methods, techniques, sequences and procedures of construction.

C. The Trade Contractor shall employ on the work only such persons who are competent and skilled in their assignments. Any employee who obstructs the progress of the work through incompetence or other means or conducts himself improperly shall be discharged or removed from the work when so requested by the Owner**.** This section shall not create a duty for the Owner to evaluate or assess the competence or skills of the Trade Contractors employees.

D. The Trade Contractor warrants that all materials and equipment furnished and incorporated by him in the project shall be new, unless otherwise specified, and that all work under this Trade Contract shall be of good quality, free from fault and defects and in conformity with the contract documents. All work not conforming to these standards shall be considered defective. The warranty provided herein shall be in addition to and not in limitation of any other warranty or remedy required by law or by the contract documents.

E. The Trade Contractor agrees that if he should fail or neglect to prosecute the work diligently and properly, or fail to perform any provisions of this Trade Contract, that the Owner, after three (3) days written notice to said Trade Contractor may, without prejudice to any other remedy, make good such deficiencies and may deduct the cost thereof from the payments then or thereafter due to the Trade Contractor pursuant to this Contract.

F. Tools furnished with any equipment may be used when approved by the Owner and shall be turned over to the Owner after completion of the work in a condition acceptable to the Owner. In case of rejection by the Owner, the Trade Contractor shall replace the tool or tools at no extra cost to the Owner.

G. Upon completion and before final acceptance of the work, the Trade Contractor shall remove from the site of the work and property of the Owner, all machinery, equipment, surplus materials, rubbish, barricades, signs and temporary structures and shall leave the premises in a condition which is satisfactory to the Owner.

H. The Trade Contractor shall keep one record set of the contract documents annotated to show all changes made during construction.

I. The Trade Contractor shall be responsible for the acts and omissions of all his employees and all subcontractors, their agents and employees and all other persons performing any of the work under a contract with the Trade Contractor.

J. Upon completion of the work, the Trade Contractor shall, at his or its expense, remove from the vicinity of the work, all plant, buildings, rubbish, unused materials, concrete forms and other like material, belonging to him or used under his direction during construction, and in the event of his failure to do so, the same may be removed by the Owner and the Trade Contractor, his Surety or Sureties, shall be liable for the cost thereof. Also during the construction of the work, the site, partially

finished structures, and material stockpiles shall be kept in a reasonable state of order and cleanliness.

Section 12. Changes in the Work.

A. CHANGES. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, only by Change Order, Construction Change Directive, or Order for a Minor Change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

1. A Change Order shall be based upon agreement among the Owner, Contractor, and Engineer; a Construction Change Directive requires agreement by the Owner and Engineer and may or may not be agreed to by the Contractor; an Order for a Minor Change in the Work may be issued by the Engineer alone.

2. Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive, or Order for a Minor Change in the Work.

3. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if the quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to the quantities of work proposed will cause substantial inequity to the Owner or the Contractor, the applicable unit prices shall be equitably adjusted; provided however, that Owner may increase the number of units without change in the unit price if reasonable.

B. CHANGE ORDERS. The Contract Sum and the Contract Time may be changed only by Change Order. Methods used in determining adjustments to the Contract Sum may include those listed in Subsection C below. A Change Order is a written order to the Contractor, signed by the Contractor, the Owner and the Engineer, stating their agreement upon all of the following:

1. A change in the Work;

2. The amount of the adjustment in the Contract Sum, if any; and

3. The extent of the adjustment in the Contract Time, if any.

C. CONSTRUCTION CHANGE DIRECTIVES. A Construction Change Directive is a written order directed to the Contractor and signed by the Owner and Engineer, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

1. A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

2. If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

a. By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

b. By unit prices stated in the Contract Documents or subsequently agreed upon;

c. By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

d. By the method provided in Subparagraph (C)(3)(5).

3. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the work involved and advise the Engineer and Owner of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

4. A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

5. If the Contractor does not respond promptly to the Construction Change Directive or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the Engineer on the basis of reasonable expenditures and savings of those performing the work attributable to the change, including, in case of an increase in the Contract Sum, a percentage fee for overhead and profit not to exceed five percent (5%) of such work's actual cost for Contractor and ten percent (10%) of such work's actual cost to be apportioned between any and all subcontractors and sub-subcontractors. For work performed by Contractor's own forces, Contractor's mark-up shall be limited to actual cost plus a percentage fee for overhead and profit not to exceed ten percent (10%). In such case, the Contractor shall keep and present, in such form as the Engineer may prescribe, an itemized accounting of actual costs together with appropriate supporting data. For the purposes of this Subparagraph, actual costs shall be defined as and limited to the following:

a. Costs of labor, including Social Security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

b. Costs of materials, supplies, and equipment, including costs of transportation, whether incorporated or consumed;

c. Reasonable rental costs of machinery and equipment, exclusive of hand tools, obtained and used specifically for such work, whether rented from the Contractor or others; and

d. Costs of premiums for all bonds (if any), permit fees, and sales, use or similar taxes directly attributable to such work. Actual cost does not include any item which could be deemed to be a general conditions cost or overhead, such as but not limited to, the cost of Contractor and Subcontractor supervisory personnel assigned to the Work, and field office and related expenses.

6. Pending final determination of actual cost to the Owner, amounts not in dispute may be included in applications for payment. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Engineer. When both additions and credits covering related work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

7. If the Owner and Contractor do not agree with the adjustment in Contract Time or the method for determining it, the adjustment or the method shall be determined in accordance with Article 5 hereof.

8. When the adjustments in the Contract Sum and Contract Time are determined as provided herein, such determination shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

D. MINOR CHANGES IN THE WORK

1. The Engineer will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be affected by written order, and shall be binding on the Owner and the Contractor. The Contractor shall carry out such written orders promptly.

2. The Owner may at any time as the need arises, order changes within the scope of work without invalidating the Agreement. If such changes increase or decrease the amount due under the contract documents or in the time required for performance of the work, and equitable adjustment will be authorized by change order.

3. The Owner also may, at any time, by issuing a field order, make changes in the details of the work. The Trade Contractor shall proceed with the performance of any changes in the work so ordered by the Owner unless the Trade Contractor believes that such field order entitles him to a change in contract price or time, or both, in which event he shall give the Owner written notice thereof within ten (10) days after the receipt of the ordered change, and the Trade Contractor shall not execute such changes pending the receipt of an executed change order or further instruction from the Owner.

Section 14. Contract Documents.

In case of conflict between this Contract, the general conditions of the contract for construction, and the supplementary conditions, this Contract will govern.

ARTICLE 4 – TRADE CONTRACTOR'S CONSTRUCTION SCHEDULE

Section 1. Preconstruction Conference.

A preconstruction conference shall be scheduled at the time the Notice of Award is issued. The Trade Contractor, at the preconstruction conference, shall prepare and submit for the Owner's and the Engineer's review and approval a Trade Contractor's construction schedule for the Work, in such and form and detail as the Owner may require. The schedule shall not exceed time limits under the Contract Documents, shall be revised as required herein and at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire project to the extent required by the Contract Documents, and shall provide for the expeditious and practicable execution of the Work. The schedule shall indicate the proposed starting and completion dates for the various subdivisions of the Work as well as the totality of the Work. The schedule shall be updated every fourteen (14) days for submitted to Engineer with Trade Contractor's applications for payment. Each schedule shall contain a comparison of actual progress with the estimated progress for such time stated in the original schedule. If any schedule submitted sets forth a date for Substantial Completion for the Work or any phase of the Work beyond the date(s) of Substantial Completion established in the Contract (as the same may be extended as provided in the Contract Documents), the Trade Contractor shall submit to Engineer and Owner for their review and approval, a narrative description of the means and methods which Trade Contractor intends to employ to expedite the progress of the Work to ensure timely completion of the various phases of the Work as well as the totality of the

Work. To ensure such timely completion, Trade Contractor shall take all necessary action including, without limitation, increasing the number of personnel and labor on the Project and implementing overtime and double shifts. In that event, Trade Contractor shall not be entitled to an adjustment in the Contract Sum or the Schedule.

Section 2. Schedule of Submittals.

The Contractor shall prepare and keep current, for the Engineer's approval, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows the Engineer reasonable time to review submittals.

Section 3. Conformance to Schedule.

The Contractor shall conform to the most recent schedules.

ARTICLE 5 - TIME FOR COMPLETION AND LIQUIDATED DAMAGES

A. The date of beginning and the time for completion of the work are essential conditions of the contract documents and the work embraced shall be commenced on a date specified in the notice to proceed.

B. The Trade Contractor shall proceed with the work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the Trade Contractor and the Owner, that the contract time for the completion of the work described herein is a reasonable time, If Trade Contractor is delayed in the progress of the Work by fire, unusual delay in transportation, unanticipated adverse weather conditions, or other unavoidable casualties beyond Trade Contractor's control other than unanticipated adverse weather conditions, the Contract Time shall be extended for a reasonable period of time. "Weather" means precipitation, temperature, or wind, and an "adverse weather condition" means weather that on any calendar day varies from the average weather conditions for that day by more one hundred percent (100%) as measured by the National Oceanic and Atmospheric Administration. The term "unanticipated adverse weather conditions" means the number of days in excess of the anticipated adverse weather days per month as set forth below:

MONTHLY ANTICIPATED ADVERSE WEATHER DAYS

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
7	4	4	4	6	3	4	2	3	3	2	5

By reason of example only, if in March there are two (2) days when the snowfall exceeds the average snowfall for that day by one hundred percent (100%), those two (2) days will have experienced an adverse weather condition. However, there will have been no unanticipated adverse weather condition in March, because there are four (4) anticipated adverse weather days in March, which should be accounted for in the schedule. If, however, there are five (5) days in which the snowfall exceeds the average snowfall by one hundred percent (100%), an unanticipated adverse weather condition will have occurred, and Trade Contractor shall be entitled to request an extension of time.

C. If the Trade Contractor shall fail to complete the work within the Contract Time, or extension of time granted by the Owner, then the Trade Contractor shall pay to the Owner the amount of liquidated damages and not as penalty the sum of ($) for each calendar day that the Trade Contractor shall be in default after the time stipulated in the contract documents.

D. The Owner will charge the Trade Contractor, and may deduct from the partial and final payment for the work, all architectural, engineering and construction management expenses incurred by the Owner in connection with any work accomplished after the specified completion date.

E. The Trade Contractor will not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following, and the Trade Contractor has promptly given written notice of such delay to the Owner.

1. To any preference, priority or allocation order duly issued by the Owner.

2. To unforeseeable causes beyond the control and without the fault or negligence of the Trade Contractor, including, but not restricted to, unforeseen conditions, acts of God, or of the public enemy, acts of the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

3. To any delays of subcontractors occasioned by any of the causes specified in subparagraphs 1 and 2 of this paragraph E.

F. The Trade Contractor waives any right of recovery or reimbursement or by whatever name, as against the Owner or the Engineer, as a result of any delay or increase on overhead cost incurred by the Trade Contractor's association with any action or inaction on the part of any other trade contractor or supplier.

G. Any request for extension of the Contract Time shall be made in writing to the Project Manager not more than seven (7) days after commencement of the delay; otherwise it shall be waived. Any such request shall contain an estimate of the probable effect of such delay on the progress of the Work.

H. In strict accordance with C.R.S. § 24-91-103.5, the City shall not amend the Contract Price to provide for additional compensation for any delays in performance which are not the result of acts or omissions of the City or persons acting on behalf of the City.

ARTICLE 6 - CONTRACT SUM

Section 1. Monthly or Progress Payments.

A. The City Council of the City of Northglenn has appropriated the money necessary to fund this project. The Owner shall pay the Trade Contractor in current funds for the performance of the work, subject to any additions and deletions, by written change order, the total sum not to exceed ($) (the "Original Contract Amount"). Notwithstanding anything to the contrary contained in this Agreement, no change order or other form of directive by the Owner requiring additional compensable work to be performed, which causes the aggregate amount payable under this Agreement, to exceed the amount appropriated for the Original Contract Amount, unless the Trade Contractor is given written assurance by the City of Northglenn that lawful appropriations have been made by the City Council of the City of Northglenn to cover the cost of the additional work.

B. The Engineer has, by separate agreement with the Owner, agreed to include in its monthly work estimate to the Owner, a review of the Trade Contractor's estimates of the value of all work, labor, and materials of the Trade Contractor incorporated into the Project. The Trade Contractor hereby agrees that estimates provided to the Engineer for review for the Owner shall be for work actually performed upon the project and that all such work, including labor and materials, have been paid. The determination of the amount of work completed on each application for payment by the Trade Contractor shall be made by the Engineer and shall thereafter be subject to approval by the Owner. Such determination, however, by the Engineer or approval by the Owner shall not be construed as acceptance of the work.

1. Before the first application for payment, the Trade Contractor shall submit to the Engineer and Owner a schedule of values to be allocated to the various portions of the Work, which in the aggregate equals the total Contract Sum, divided so as to facilitate

payments to subcontractors, supported by such evidence of correctness as the Engineer may direct. This schedule, when approved by the Engineer, shall be used to monitor the progress of the Work and as a basis for making progress payments hereunder. Application for monthly progress payments shall be made in writing in accordance with this Contract and shall be submitted on approved forms provided by the Owner and shall be submitted to the Owner on or before the twentieth (20th) day of each month. Applications received on time will be paid on the twentieth (20th) day of the following month, providing that the Owner approves such recommendations of the Engineer. Applications received after the twentieth (20th) day of each month shall paid after the Owner's next pay period.

2. Pursuant to Colo. Rev. Stat. § 24-91-103, as may be amended, where the Original Contract Amount exceeds one hundred fifty thousand dollars ($150,000.00), the Owner may retain up to five percent (5%) of the calculated value of completed work from each progress payment up until the contract is completed satisfactorily and finally accepted by the Owner. If the Owner finds satisfactory progress is being made in any phase of the contract, the Trade Contractor may make written request of the Owner for final payment of the withheld percentage. The Owner may agree to final payment of the withheld percentage if the Owner finds satisfactory and substantial reasons exist for the payment. The Trade Contractor must provide written approval to the Owner from any surety furnishing bonds for the contract work in order to receive said payment of the withheld percentage.

3. Upon receipt of written notice from the Trade Contractor that his work is ready for final inspection and acceptance by the Owner and upon receipt of final application for payment, the Owner will promptly make such final field review subject to the final payment requirements contained in Colo. Rev. Stat. § 38-26-107, as amended. If the Owner finds that the work is acceptable under the contract documents, he will recommend to the Owner that a final certificate of payment be issued. Neither final payment nor the remaining retention shall become due until the Trade Contractor submits to the Engineer an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the work, have been paid or otherwise satisfied. Likewise, final payment shall not be made until the consent of the surety to final payment has been obtained, and if required by the Owner, such other data establishing payment or satisfaction of all obligations, including releases, final lien waivers, and receipts and warranties, if any, have been provided to the Engineer for the use and benefit of the Owner. Should any subcontractor of the Trade Contractor or supplier of said Trade Contractor refuse to furnish any warranty and/or release or waiver, the Owner in its sole discretion, may refuse to certify final payment. The Trade Contractor may then furnish sufficient bonds satisfactory to the Owner to indemnify the Owner against any such liens.

4. Notwithstanding anything else to the contrary contained herein, such final payment by the Owner shall not be construed as a waiver of any claims affecting or arising from:

a. Unsettled liens;

b. Faulty or defective work appearing after substantial completion;

c. Failure of the work to comply with the requirements of the contract documents;

d. Terms of any special warranties required by the contract documents.

5. The acceptance by the Trade Contractor of final payment shall be and shall operate as a release to the Owner from all claims and all liability to the Trade Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and others relating to or arising out of the work other than claims in stated amounts as may be specifically expected by the Trade Contractor with the consent of the Owner. Any

payment, however, final or otherwise, will not release the Trade Contractor or his sureties from any obligations under the contract documents or the performance bond and labor and material payment bond.

ARTICLE 7 - CORRECTION OF WORK

A. During the life of the Contract and for a period of two (2) years after final acceptance, the Trade Contractor shall promptly remove from the premises all work rejected by the Owner for failure to comply with the contract documents, whether incorporated in the construction or not, and the Trade Contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the Owner and shall bear the expense of making good all work of other trade contractors destroyed or damaged by such removal or replacement. The Owner, however, may at its discretion elect to accept an equitable reduction in price or a refund instead of correction of the condemned work.

B. All removal and replacement work shall be done at the Trade Contractor's expense. If the Trade Contractor does not take action to remove such rejected work within ten (10) days after receipt of written notice, the Owner may remove such work and store the materials all at the expense of the Trade Contractor.

ARTICLE 8 - TEMPORARY FACILITIES AND SERVICES

Unless otherwise provided in this Contract, the Trade Contractor shall furnish and make available, at no cost, all temporary facilities, including all power needed for heating and protection of facilities and work. It is the expressed intent of the parties that the Trade Contractor shall be responsible for and at its sole cost all heating and protection of facilities and work.

ARTICLE 9 - INDEMNIFICATION AND INSURANCE

Section 1. Indemnification.

The Contractor, to the fullest extent permitted by law, shall defend, indemnify and hold harmless the City, its officers, employees, agents and their insurers, from and against all liability, claims and demands on account of injury, loss or damage, including without limitation, claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage or any other loss of any kind whatsoever, which arises out of or is in any manner connected with this Contract, to the extent that such injury, loss or damage is attributable to the act, omission, error, professional error, mistake, negligence or other fault of the Contractor, the Contractor's employees, subcontractors or anyone else employed directly or indirectly by the Contractor, Contractor's employees or subcontractor.

The Contractor, to the fullest extent permitted by law, shall defend, investigate, handle, respond and provide defense for and defend against any such liability, claims or demands at the sole expense of the Contractor, or at the option of the City, Contractor agrees to pay the City or reimburse the City for defense costs incurred by the City in connection with any such liability, claims, or demands. The Contractor, to the fullest extent permitted by law, shall defend and bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not such liability, claims or demands alleged are groundless, false or fraudulent.

This indemnification provision is intended to comply with C.R.S. § 13-21-111.5(6), as amended, and shall be read as broadly as permitted to satisfy that intent.

Section 2. Insurance.

A. The Contractor agrees to obtain and maintain during the life of this Contract, a policy

or policies of insurance against all liability, claims, demands and other obligations assumed by the Contractor pursuant to Section 1 above. Such insurance shall be in addition to any other insurance requirements imposed by this Contract or by law. The Contractor shall not be relieved of any liability, claims, demands, or other obligations assumed pursuant to Section 1 above, by reason of its failure to obtain and maintain during the life of this Contract insurance in sufficient amounts, durations, or types.

B. Contractor shall obtain and maintain during the life of this Contract, and shall cause any subcontractor to obtain and maintain during the life of this Contract, the minimum insurance coverages listed below. Such coverages shall be obtained and maintained with forms and insurers acceptable to the City. All coverages shall be continuously maintained to cover all liability, claims, demands and other obligations assumed by the Contractor pursuant to Section 1 above. In the case of any claims-made policy, the necessary retroactive dates and extended reporting periods shall be procured to maintain such continuous coverage.

1. Worker's Compensation Insurance to cover obligations imposed by applicable law for any employee engaged in the performance of the work under this Contract, and Employers Liability Insurance with minimum limits of five hundred thousand dollars ($500,000) each incident, five hundred thousand dollars ($500,000) disease—policy limit, and five hundred thousand dollars ($500,000) disease—each employee.

2. General Public Liability Insurance to be written with a limit of liability of not less than one million dollars ($1,000,000) for all damages arising out of bodily injury, personal injury (including coverage for employee and contractual acts), including death, at any time resulting therefrom, sustained by any one person and not less than two million dollars ($2,000,000) for all damages arising out of bodily injury, including death, at any time resulting therefrom, sustained by two or more persons in any one accident. This policy shall also include coverage for blanket contractual and independent contractor risks. The limits of General Public Liability Insurance for broad form property damage (including products and completed operations) shall be not less than one million dollars ($1,000,000) for all damages arising out of injury to or destruction of property in any one (1) accident and not less than two million dollars ($2,000,000) for all damages arising out of injury to, or destruction of property, including the City's property, during the policy period. The General Public Liability Insurance policy shall include coverage for explosion, collapse and underground hazards. The policy shall contain a severability of interests provision.

3. Protective Liability and Property Damage insurance covering the liability of the Owner, including any employee, officer or agent of the Owner with respect to all operations under the Contract by the Trade Contractor or his sub-contractors shall be obtained and maintained during the life of the contract. The limits of the Owner's Protective Liability Policy, to be provided by the Trade Contractor, as described in this Section 2, shall be increased to the same limits as described above for the Trade Contractor's General Public Liability Insurance.

4. Comprehensive Automobile Liability Insurance with minimum combined single limits for bodily injury and property damage of not less than one million dollars ($1,000,000) each occurrence and one million dollars ($1,000,000) aggregate with respect to each of the Trade Contractor's owned, hired, and non-owned vehicles assigned to or used in performance of the services. The policy shall contain a severability of interests provision. If the Trade Contractor has no owned automobiles, the requirements of this paragraph shall be met by each employee of the Trade Contractor providing services to the Owner under this contract.

C. To the extent that liability results from the acts or omissions of the Trade Contractor, all Insurance Policies and Certificates of Insurance issued for this project shall name as additional

insured(s), the Owner, whether private or governmental, the Owner's officers and employees, and the Engineer and its agents and employees, and any other person(s), company(ies), or entity(ies) deemed necessary by the Owner. The Trade Contractor shall be solely responsible for any deductible losses under any policy required herein.

D. The insurance provided by the Trade Contractor shall be primary to insurance carried by the Owner, the Engineer, and all other additional insureds, and the principal defense of any claims resulting from the Trade Contractor's obligations under the Contract shall rest with the Trade Contractor's Insurer.

Section 3. Certificates of Insurance.

A. The certificate of insurance provided by the Trade Contractor shall be completed by the Trade Contractor's insurance agent as evidence that policies providing the required coverages, conditions, and minimum limits are in full force and effect, and shall be reviewed and approved by the Owner prior to commencement of the contract. No other form of certificate shall be used. The certificate shall identify this Contract and shall provide that the coverages afforded under the policies shall not be cancelled, terminated or materially changed until at least thirty (30) days prior written notice has been given to the Owner. The completed certificate of insurance shall be sent to:

City of Northglenn
Att: Kathy Kvasnicka
11701 Community Center Drive
Northglenn, Colorado 80233-8061

B. Failure on the part of the Trade Contractor to procure or maintain policies providing the required coverages, conditions, and minimum limits shall constitute a material breach of contract upon which the Owner may immediately terminate this contract, or at its discretion the Owner may procure or renew any such policy or any extended reporting period thereto and may pay any and all premiums in connection therewith, and all monies so paid by the Owner shall be repaid by the Trade Contractor to the Owner upon demand, or the Owner may offset the cost of the premiums against any monies due to the Trade Contractor from the Owner.

C. The Owner reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

D. The parties hereto understand and agree that the Owner is relying on, and does not waive or intend to waive by any provision of this contract, the monetary limitations (presently three hundred fifty thousand dollars ($350,000) per person and nine hundred ninety thousand dollars ($990,000) per occurrence) or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, 24-10-114 et seq., C.R.S., as from time to time amended, or otherwise available to the Owner, its officers or employees.

ARTICLE 10 - PERFORMANCE, LABOR AND MATERIAL PAYMENT BONDS

The Trade Contractor shall within ten (10) days after the receipt of a notice of award, furnish the Owner with a performance bond and a payment bond in penal sums equal to the amount of the contract price, conditioned upon the performance by the Trade Contractor of all undertakings, covenants, terms, conditions and agreements of the contract documents, and upon the prompt payment by the Trade Contractor to all persons supplying labor and materials in the prosecution of the work provided by the contract documents. Such bonds shall be executed by the Trade Contractor and a corporate bonding company licensed to transact such business in the state in which the work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these bonds shall be borne by the Trade Contractor. If at any time a surety on any such bond is declared a

bankrupt or loses its right to do business in the state in which the work is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, the Trade Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Trade Contractor. No further payments will be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable bond to the Owner.

ARTICLE 11 – CLAIMS AND DISPUTES

A. Definition. A claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment of contract terms, payment of money, extension of time, or other relief with respect to the terms of the Contract. The term "claim" also includes other disputes between the Owner and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate claims shall rest with the party making the claim.

B. Decision of Engineer or Architect. Claims may, upon request of both the Contractor and the Owner, be referred initially to the Engineer or Architect for action as provided in Article 3, Section 12.

C. Time limits on Claims. Claims by either party must be made within twenty one (21) days after occurrence of the event giving rise to such claim or within twenty one (21) days after the claimant first recognizes, or reasonably should have recognized, the condition giving rise to the claim, whichever is later. An additional claim made after the initial claim has been implemented by change order will not be considered unless submitted in a timely manner.

D. Continuing Contract Performance. Pending final resolution of a claim, including litigation, unless otherwise directed by Owner in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

E. Waiver of Claims: Final Payment. The making of Final Payment shall constitute a waiver of claims by the Owner except those arising from:

1. Liens, claims, security interests, or encumbrances arising out of the Contract and unsettled;

2. Failure of the Work to comply with the requirements of the Contract Documents;

3. Terms of special warranties required by the Contract Documents; or

4. Faulty or defective work appearing after Substantial Completion.

F. Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than seven (7) days after first observance of the conditions. Site conditions which an experienced and prudent contractor could have anticipated by visiting the site, familiarizing himself with the local conditions under which the Work is to be performed and correlating his observations with the requirements of the Contract Documents shall not be considered as claims for concealed or unknown conditions, nor shall the locations of utilities which differ from locations provided by the

utility companies. The Engineer or Architect will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or the required time for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Engineer or Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Engineer or Architect shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within twenty-one (21) days after the Engineer or Architect has given notice of the decision. If the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Engineer or Architect for initial determination, subject to further proceeding pursuant to these Contract Documents.

G. Claims for Additional Cost. If the Contractor wishes to make claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the work. Said notice shall itemize all claims and shall contain sufficient detail and substantiating data to permit evaluation of same by Owner and Engineer or Architect. No such claim shall be valid unless so made. Prior notice is not required for claims relating to an emergency endangering life or property. If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Engineer or Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Engineer or Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension, or (7) other reasonable grounds, claim shall be filed in accordance with the procedure established herein Any change in the Contract Sum resulting from such claim shall be authorized by change order or construction change directive.

H. Claims for additional time. If the Contractor wishes to make claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one claim is necessary.

I. Injury or damage to person or property. Subject to the Parties' obligations and responsibilities under the Contract Documents in general and Article 8 hereof in particular, if either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding ten (10) days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a claim for additional cost or time related to this claim is to be asserted, it shall be filed as provided in Article 3, Section 12.

ARTICLE 12 - RESOLUTION OF CLAIMS AND DISPUTES

A. The Engineer (if the matter is referred to the Engineer for initial decision) will review claims and take one or more of the following preliminary actions within ten (10) days of receipt of a claim: (1) request additional supporting data from the claimant; (2) submit a schedule to the parties indicating when the Engineer expects to take action; (3) reject the claim in whole or in part, stating the reasons for rejection; (4) recommend approval of the claim by the other party; or (5) suggest a compromise. The Engineer may also, but is not obligated to, notify the surety, if any, of the nature and amount of the claim.

B. If a claim has been resolved, the Engineer (or at the Owner's option, Owner), will prepare or obtain appropriate documentation.

C. If a claim has not been resolved, the party making the claim shall within ten (10) days after the Engineer's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Engineer; (2) modify the initial claim; or (3) notify the

Engineer that the initial claim stands.

D. If a claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Engineer, the Engineer will notify the parties in writing that the Engineer's decision will be made within seven (7) days, which decision will be considered advisory only and not binding on the parties in the event of litigation in respect of the claim. Upon expiration of such time period, the Engineer will render to the parties the Engineer's written decision relative to the claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Trade Contractor's default, the Engineer may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

E. The dispute clause does not preclude the considerations of questions of fact or law in connection with decisions provided for in Paragraph A above. Nothing in this Agreement, however, shall be construed as making final a decision of an administrative official, representative or City Council on a question of fact or law.

F. As between the parties of this Agreement, as to all acts or failure to act by either party of this Agreement, any applicable statute of limitation shall commence to run from the date of the agreed party's discovery of such act or failure to act.

G. The Trade Contractor shall give written notice to the Owner within ten (10) days of any dispute/claim arising under this Contract upon which the Trade Contractor seeks compensation or change of contract documents, otherwise the Trade Contractor's dispute/claim shall be deemed waived. Said ten (10) days written notice shall not be deemed to run from the date of discovery in this instance but from the date the dispute/claim has arisen.

ARTICLE 13- TERMINATION

A. This Agreement may be terminated in whole or in part in writing by either party in the event of substantial failure by the other party to fulfill its obligations under this Agreement through no fault of the terminating party; provided that no such termination may be effected unless the other party is given (1) not less than ten (10) days written notice (delivered by certified mail, return receipt requested) of intent to terminate; and (2) an opportunity for consultation with the terminating party prior to termination.

B. This Agreement may be suspended or terminated in whole or in part, in writing, by the Owner for its convenience; provided that no such termination may be effected unless the Trade Contractor is given (1) not less than ten (10) days written notice (delivered by certified mail, return receipt requested) of intent to suspend or terminate; and (2) an opportunity for consultation with the Owner prior to suspension or termination.

C. Suspension for Convenience: The Owner, for its own convenience, may suspend the contract in whole or in part at any time by written notice to the Trade Contractor. Such notice shall state the extent and the effective date of such suspension, and on the effective date thereof the Trade Contractor shall promptly suspend such work to the extent specified, and during the period of such suspension shall properly care for and protect all work and materials, housing and equipment on hand for construction under the contract. The Trade Contractor also shall promptly supply the Owner with copies of all outstanding orders for materials, equipment and services, and shall take such action relative to such orders as may be directed by the Owner. If the performance of the work is thus suspended, the Trade Contractor shall be entitled to be reimbursed for all additional expense incurred by reason of such suspension as agreed upon by the Trade Contractor and the Owner.

D. Termination for Convenience:

1. The Owner may for its own convenience terminate work under the contract in whole or in part at any time by written notice to the Trade Contractor. Such notice shall state the extent and effective date of such termination and on the effective date thereof, the Trade Contractor will, and as to the extent directed, stop work under the contract and the placement of further orders of subcontracts under the contract, terminate work under order and subcontracts under the contract, and take any necessary action to protect property in the Trade Contractor's possession in which the Owner has or may acquire an interest.

2. In the event of such termination, the Owner shall pay to the Trade Contractor: (1) its direct costs (excluding overhead) for all work done in conformity with the Contract to the effective date of such termination and (2) other costs pertaining to the work which the Trade Contractor may incur as a result of such termination, all as approved by the Owner plus ten percent (10%) of such costs (excluding costs under (2) above) for overhead and profit, provided, however, that in no event shall the total amount to be paid under this Article 11, Section D.(2) plus payments previously made, exceed the lesser of (a) the total aggregate contract price specified in the Trade Contract; or (b) that proportion of the aggregate total contract price specified in the date of termination bears to the entire work to be performed hereunder. Any payment under this Article 11, Section D.(2) shall be made upon the expiration of the period within which liens may be filed under the laws of the state of Colorado, subject, however, to withholding by the Owner for the reasons and in the manner provided in those provisions pertaining to withholding of payments for liens.

E. Termination for Default:

1. The Owner shall have the right to terminate the employment of the Trade Contractor after giving ten (10) days written notice of the termination to the Trade Contractor in the event of any default by the Trade Contractor. In the event of such termination, the Owner may take possession of the work and of all materials, tools and equipment thereon and may finish the work by whatever method and means he may select. It shall be considered a default by the Trade Contractor whenever he shall:

a. Disregard or violate important provisions of the contract documents or the Owner's instructions, or fail to prosecute the work according to the agreement schedule of completion, including extensions thereof;

b. Fail to provide a qualified representative, competent workmen or subcontractors, or proper materials, or fail to make prompt payment therefor; and

c. Fail to submit a completion schedule within fourteen (14) days after award of contract.

2. Upon termination of the contract by the Owner for default by the Trade Contractor, no further payments shall be due to the Trade Contractor until the work is completed. If the unpaid balance of the contract amount shall exceed the cost of completing the work including all overhead costs, the excess shall be paid to the Trade Contractor. If the cost of completing the work shall exceed the unpaid balance, the Trade Contractor shall pay the difference to the Owner. The amount of the cost incurred by the Owner in implementing the work, and the damage incurred through the Trade Contractor's default, shall be approved by the Owner.

3. The provisions of this Article 11, Section D.(2) shall not apply in the event of default of the Trade Contractor; provided, however, that the provisions of Article 11, Section D.(2) shall apply in the event of substantial failure by the Owner to fulfill its obligations under this Agreement.

ARTICLE 14 - SIMULTANEOUS WORK BY OTHERS

A. The Owner reserves the right to let other contracts in connection with this project. The Trade Contractor shall afford other trade contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

B. If the proper execution or results of any part of the Trade Contractor's work depends upon the work of any other trade contractor, the Trade Contractor shall inspect and promptly report to the Engineer any defects in such work that render it unsuitable for such proper execution and results. Failure of the Trade Contractor to so inspect and report defects shall constitute an acceptance of the other trade contractors' work as fit and proper for the addition of his work thereto, except as to defects which may develop in the other trade contractors' work after the execution of his work.

C. The Trade Contractor shall coordinate his operations with those of other trade contractors. Cooperation will be required in the arrangement for the storage of materials and in the detailed execution of the work.

D. The Trade Contractor, including his subcontractors, shall keep informed of the progress and the detail work of other trade contractors and shall notify the Engineer immediately of lack of progress, defective workmanship, or lack of coordination on the part of other trade contractors. Failure of the Trade Contractor to keep informed of the work progressing on the site and failure to give notice of lack of progress, defective workmanship, or lack of coordination by others shall be construed as acceptance by him of the work and the status of work as being satisfactory for proper execution of his own work.

E. All materials and labor shall be furnished at such times as shall be for the best interest of all trade contractors concerned, to the end that the combined work of all may be properly and fully completed on contract time.

F. Nothing herein shall be construed in any way as giving the Trade Contractor a claim as against the Owner and the Engineer resulting in any revised schedule based upon delay caused by any other trade contractor or supplier.

ARTICLE 15 - SUBCONTRACTING

A. The Trade Contractor may utilize the services of specialty subcontractors on those parts of the work which, under normal contracting practices, are performed by specialty subcontractors.

B. Before execution of the contract, the Trade Contractor shall submit the names of all subcontractors, including contact persons, phone numbers, and addresses to the Engineer or Architect and Owner. The Trade Contractor shall also promptly notify all parties of any changes in subcontractors or subcontractor contact information.

C. The Trade Contractor shall be fully responsible to the Owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

D. The Trade Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Trade Contractor by the terms of the contract documents insofar as applicable to the work of subcontractors and to give the Trade Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Trade Contractor under any provision of the contract documents.

E. Nothing contained in this Contract will create any contractual relation between any subcontractor and the Owner.

ARTICLE 16 - GUARANTY

A. The Trade Contractor shall guarantee all materials and equipment furnished and work performed for a period of two (2) years from the date of final acceptance of the contract by the Owner that the work is free from all defects due to faulty materials or workmanship and that the Trade Contractor shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Trade Contractor should fail to make such repairs, adjustments, or other work that may be made necessary by such defects, the Owner may do so and charge the Trade Contractor the cost thereby incurred. The performance bond shall remain in full force and effect through the guarantee period.

B. Whenever in the specifications a guarantee or maintenance bond is required to be furnished for any item of equipment, material or portion of the work, such guarantee shall be submitted to the Owner and a written approval will be issued to the Trade Contractor before any such equipment, material or construction is ordered and incorporated in work by the Trade Contractor.

ARTICLE 17 - SALES TAX

The Trade Contractor and all of his subcontractors must make application to the Colorado State Department of Revenue for a certificate of exemption to permit the purchase of building materials for the construction of this project without payment of the sales tax. Prior to the start of construction, the Trade Contractor shall furnish copies of such certificates to the Owner. Applications and certificates must be on forms provided by the Department of Revenue.

ARTICLE 18 - MISCELLANEOUS PROVISIONS

A. This Agreement is made and entered into subject and conformable to the laws of the State of Colorado and the Home Rule Charter of the City of Northglenn. To the extent any provision hereof is inconsistent with said laws and Charter, said laws and Charter shall control.

B. The Trade Contractor shall comply with all federal and state laws and local ordinances and regulations which affect those engaged or employed in the work or which affect the conduct of the work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same, and shall at all times observe and comply with all such existing laws, ordinances, regulations and decrees, and shall protect and indemnify the Owner and the Engineer against any claim or liabilities arising solely from or based solely on the violations of such law, ordinance, regulation, order or decree, whether by itself, its subconsultants, agents, or employees.

C. The Trade Contractor will take affirmative action to not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex or handicap, if otherwise qualified.

D. In the event any provision of this Agreement is held invalid and unenforceable, the remaining provisions shall be valid and binding upon the parties.

E. One or more waivers by either party of any provision, term, condition or covenant shall not be construed by the other party as a waiver of a subsequent breach of the same by the other party.

F. The Owner and the Trade Contractor each binds itself and its partners, successors,

executors, administrators, and assigns to this Agreement. Neither the Owner nor the Trade Contractor will assign, sublet, or transfer its interest in this Agreement without the written consent of the other.

G. Nothing herein shall be construed as creating any personal liability on the part of any officer or agent of any public body which may be a party hereto, nor shall it be construed as giving any rights or benefits hereunder to anyone other than the Owner and the Trade Contractor.

H. Keep Jobs in Colorado Act: Pursuant to the Keep Jobs in Colorado Act, C.R.S. 8-17-101 *et seq.* (the "Act") and the rules adopted by the Division of Labor of the Colorado Department of Labor and Employment implementing the Act (the "Rules"), the Contractor shall employ Colorado labor to perform at least eighty percent (80%) of the work and shall obtain and maintain the records required by the Act and the Rules. For purposes of this Section "Colorado labor" means any person who is a resident of the state of Colorado at the time of this Project, without discrimination as to race, color, creed, sex, sexual orientation, marital status, national origin, ancestry, age, or religion except when sex or age is a bona fide qualification. A resident of the state is a person who can provide a valid Colorado driver's license, a valid Colorado state-issued photo identification, or documentation that he or she has resided in Colorado for the last thirty (30) days. Contractor represents that it is familiar with the requirements of the Act and the Rules and will fully comply with same. This Section shall not apply to any project for which appropriation or expenditure of moneys may be reasonably expected not to exceed five hundred thousand dollars ($500,000) in the aggregate for any fiscal year.

ARTICLE 19 - ATTACHMENTS, SCHEDULES AND SIGNATURES

It is further mutually agreed that this Agreement and the contract documents constitute the entire Agreement between the Owner and the Trade Contractor and supersede all prior or oral understandings. This Agreement may only be amended, supplemented, modified, or cancelled by a duly executed written amendment.

IN WITNESS WHEREOF the parties hereto each herewith subscribe the same in triplicate.

CITY OF NORTHGLENN, COLORADO

By: _____

Name: _____

Title: Mayor

ATTEST:

_____
Johanna Small, CMC, City Clerk

APPROVED AS TO FORM:

_____
Corey Y. Hoffmann, City Attorney

TRADE CONTRACTOR

By: _____

Name: _____

Title: _____

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The foregoing instrument was acknowledged before me this _____ day of _____, 20___ by _____, as _____ of _____.

My commission expires: _____

Witness my hand and official seal.

_____
Notary Public

City of Northglenn
11701 Community Center Drive
Northglenn, Colorado 80233

BOND FORM

PERFORMANCE, PAYMENT, MAINTENANCE AND WARRANTY BOND

KNOWN ALL MEN BY THESE PRESENTS, that _____, as Principal, herein called Contractor, and _____, as surety, herein called Surety, are hereby held and firmly bound unto the **City of Northglenn**, as Obligee, herein called the Owner, the amount of _____ Dollars ($_____) for the payment whereof Contractor and Surety find themselves their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written Agreement dated _____, 20____, entered into a Contract with the Owner for the _____.

Project Number _____ in accordance with Plans and Specifications prepared by _____ _____ which Contract is by reference made a part hereof, and is herein referred to as the Contract.

WHEREAS, Contractor and Surety are jointly and severally liable under the provisions hereof and action against either or both may proceed without prior action against the other, and both may be jointed in one action.

WHEREAS, the Surety hereby waives notice of any alteration of the Contract or extension of time made by Owner.

NOW, THEREFORE, the conditions of this obligation are as follows:

FIRST. The Contractor shall: (1) faithfully perform all requirements and obligations of the Contract, and other applicable law, and satisfy all claims and demands incurred for the same; and (2) fully indemnify and save harmless the City from all costs and dames which the City may incur in making good any default.

SECOND. To the extent permitted by law, the Contractor shall protect, defend, indemnify and save harmless the City and its officers, agents, servants and employees, from and against suits, actions, claims, losses, liability or damage of any character, and from and against costs and expenses, including, in part, attorney fees incidental to the defense of such suits, actions, claims losses, damages or liability on account of injury, disease, sickness, including death, to any person, or damage to property, including, in part, the loss of use, resulting therefrom, based upon or allegedly based upon any act, omission or occurrence of the Contractor, or his employees, servants, agents, subcontractors or suppliers, or anyone else under the Contractor's direction and control (regardless of whether or not cause in part by a party indemnified hereunder), and arising out of, occurring in connection with, resulting from, or caused by the performance or failure of performance of any Work called for by the Contract, or from conditions created by the performance or non-performance of said Work.

Whenever Contractor shall be, and declared by Owner to be in default under Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

1. Complete the Contract in accordance with its terms and conditions or

2. Obtain a Bid or Bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible Bidder, or if the Owner elects upon determination by the Owner and the Surety Jointly of the lowest responsible bidder, arrange form a Contract between such Bidder and Owner, and make available as Work progresses (even though there should be a default or succession of defaults under Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the Contract price but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph, shall mean the total amount payable by Owner to Contractor under Contract and any Contract Change Orders thereto, less the amount properly paid by Owner to Contractor.

THIRD. The Contractor shall pay all persons, firms and corporations, all just claims due them for the payment of all laborers and mechanics for labor performed, for all materials and equipment used or rented in the performance of the work covered by the Contract subject, however, to the following conditions.

1. A claimant is defined as one having a direct Contract with the Principal, or with a Subcontractor of the Principal for labor material or both, used or reasonably required for use in performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's Work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be due the claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

    a. Unless claimant, other than one having a direct Contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the Work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the Work or labor was done or performed. Such notice shall be served by mailing same by registered mail or certified, postage prepaid, in an envelope addressed to the Principal, Owner, or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid Project is located, save that such service need not be made by a public officer.

    b. After expiration of six (6) months following the date on which Principal ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the Project, or any part thereof is situated, or in the United States District Court for the District in which the Project, or any part thereof, is situated, and not elsewhere.

FORTH. The Contractor and Surety shall guarantee and warrant that all Work shall remain in good order and repair for a period of **two (2) years** from date of probationary acceptance from all causes arising from defective workmanship and materials, and shall make all repairs arising from said causes during such period without further compensation, and shall guarantee the Facilities and Work and areas within the public rights-of-way affected by such Facilities in good order and repair without further compensation for a period of two (2) years from and after final acceptance thereof by the City. The determination of the necessity for the repair or replacement of any Work or Facilities shall rest entirely with the City, and the City's decision upon the matter shall be final and obligatory upon the Contractor, subject to judicial review pursuant to applicable law.

The Surety shall be deemed and held, notwithstanding any Contract provision, or other agreement to the contrary, to consent without notice to:

1. Any extension of time to the Contractor in which to perform any Work, Permit conditions or obligations.

2. Any change in the Permit or other Permit documents.

Further, the Surety shall pay to the City all costs and attorney fees necessary to enforce the provisions of the bond provisions contained herein.

Unless prohibited by law, an action on this bond may be brought by the City or any person entitled to the benefits of this bond at any time with two (2) years from the date of final acceptance of the Work performed pursuant to the Permit.

Upon full compliance with all the obligations of the Contract, the City shall release this bond, in writing. This bond shall remain in effect until released by the City or the City consents in writing to acceptance of a substitute bond.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

Signed and sealed this _____ day of _____, 20 ___.

_____	_____
Witness	Contractor
_____	_____
Title	Title
_____	_____
Witness	Surety
_____	_____
Title	Title

City of Northglenn
11701 Community Center Dr.
Northglenn, CO 80233

NOTICE OF AWARD

TO: _____

_____

_____

PROJECT NAME: _____

PROJECT NUMBER: _____ **PROJECT MANAGER:** _____

The **City of Northglenn (CITY)** has considered the BID submitted by you for the above described work in response to its Invitation For Bid dated _____ and Instructions to Bidders.

You are hereby notified that your BID has been accepted for items in the amount of _____, and two executed Agreements were presented to the Northglenn City .

You are required by the Instructions to Bidders to furnish the required Certificate of Insurance within ten (10) calendar days from the date of this Notice to you.

You are required to return an acknowledged copy of this NOTICE OF AWARD to CITY at the attention of the Engineering Department.

Dated this _____ day of _____, 20_____.

CITY of Northglenn, Colorado

By _____

Name _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged:

CONTRACTOR:

_____
(Name of Contractor)

By _____

Name _____
(Please Type or Print)

Title _____

Consultant:
Return one signed original to:
City of Northglenn
Engineering Division
11701 Community Center Dr.
Northglenn, CO 80233

City of Northglenn
11701 Community Center Dr.
Northglenn, CO 80233

NOTICE TO PROCEED

TO: _____ **DATE:** _____

_____

_____

PROJECT NAME: _____

PROJECT NUMBER: _____ **PROJECT MANAGER:** _____

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20_____, on or before _____ 20_____, and you are to complete the WORK within _____ days thereafter. The date of completion of all work is therefore _____, 20_____.

CITY of Northglenn, Colorado

By _____

Name _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged this _____ day of _____, 20_____.

CONTRACTOR:

_____
(Name of Contractor)

By _____

Name _____
(Please Type or Print)

Title _____

Return one signed original Notice To Proceed to:

City of Northglenn
Engineering Division
P.O. Box 330061
Northglenn, CO 80233-8061

Owner: City of Northglenn
11701 Community Center Drive
Northglenn, CO 80233-8061

Payment Application and Certification

Project: Project Name
Address
City, State Zip

Contractor: Company
Address
City, State Zip

Payment Application No.: 1
Period From:
Period To:
Project Number: #
Contract Date:

Project Manager: Company
Address
City, State Zip

Distribution:

- ☐ Owner
- ☐ Construction Manager
- ☐ Project Manager
- ☐ Contractor

Application for Payment Summary

1. Original Contract Sum		$ -
2. Net Change By Change Orders		**$ -**
a. Total changes approved in previous months		
Additions	$ -	
Deductions	$ -	
b. Total changes approved this month		
Additions	$ -	
Deductions	$ -	
3. Contract Sum To Date (Line 1 + Line 2)		$ -
4. Total Completed and Stored (Column G, page 2)		$ -
5. Total Retainage		**$ -**
a. Completed Work Retainage (Retainage for Column D + Column E, page 2)	$ -	
b. Stored Material Retainage (Retainage for Column F, page 2)	$ -	
6. Total Completed and Stored Less Retainage (Line 4-Line 5)		$ -
7. Less Previous Payment Applications (Line 6 of previous application)		$ -
8. Current Payment Due (Line 6 less Line 7)		$ -
9. Balance to Finish, Including Retainage (Line 3 less Line 6)		$ -

Certification for Payment

Contractor certifies that the amount requested on this Payment Application is based on work completed in accordance with the terms of the contract for Project No. #

Contractor Signature:

By: _____ Date: _____

Amount Certified: $ -

Project Manager Signature:

By: _____ Date: _____

Construction Manager Signature:

By: _____ Date: _____

Notary Signature:

By: _____ Date: _____

Owner: City of Northglenn
11701 Community Center Drive
Northglenn, CO 80233-8061

Payment Application Detail Sheet

A	B	C	D	E	F	G	H	I	J
Item No.	Description of Work	Scheduled Value	Previous Work	Work Completed This Period	Presently Stored Materials (Not in D or E)	Total Completed and Stored to Date (D+E+F)	Percent Complete (G/C)	Balance to Finish (C-G)	Total Retainage 0%
1		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
2		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
3		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
4		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
5		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
6		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
7		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
8		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
9		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
10		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
11		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
12		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
13		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
14		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
15		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
16		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
17		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
18		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
19		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
20		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
21		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
22		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
23		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
24		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
25		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
26		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
27		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
28		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
29		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
30		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
31		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
32		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
33		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
34		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
35		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
36		$ -	$ -	$ -	$ -	$ -	0.00%	$ -	$ -
Total			**$ -**	**$ -**	**$ -**	**$ -**	**0.00%**	**$ -**	**$ -**

City of Northglenn
11701 Community Center Drive
Northglenn, CO 80233-8061

REQUEST FOR INFORMATION

Project No.:	**RFI Number:**
Project Name:	**Date Received:**
Project Manager:	**Date Required:**
Project Engineer:	**Forwarded To:**
Contractor:	**Date Responded:**

Specification No.: **Page No.:**

check one: ☐ **RFI** ☐ **Design Modification** ☐ **Proposed VE**

check one: ☐ **Standard Specification** ☐ **Supplemental Specification** ☐ **Special Provision**

Plan Sheet No.: **Detail:**

REQUEST:

PROPOSED SOLUTION (If applicable):

By: **Signature:** **Date:**

RESPONSE:

By: **Signature:** **Date:**

After reviewing the response, does the contractor anticipate:

That a change order will be required? ☐ **Yes** ☐ **No**

That there will be an increase in the cost of the project? ☐ **Yes** ☐ **No**

City of Northglenn
11701 Community Center Drive
Northglenn, CO 80233-8061

Field Change Directive

Project: Project Name
Address
City, State Zip

To: Company
Address
City, State Zip

Field Change Directive:
Date:
Number: Project Number
Contract Date:

YOU ARE HEREBY DIRECTED TO MAKE THE FOLLOWING CHANGES TO THE ABOVE NAMED CONTRACT:

Item #	Description	Amount
1	Description	$0.00
	Total	**$0.00**

Contract Status Per This Change Order

The Time To Complete The Contract Is:

Unchanged x *Increased By* _____ *Days* *Decreased By* _____ *Days*

The Date Of Completion Is Now: _____

City of Northglenn	Company
Owner	Contractor
Name	Name
Title	Title
Signature	Signature
Date	Date

City of Northglenn
11701 Community Center Drive
Northglenn, CO 80233-8061

Change Order

Project: Project Name

Change Order #: 1
Date:

To: Company
Address
City, State Zip

Contract Number: Project Number
Contract Date:

YOU ARE HEREBY DIRECTED TO MAKE THE FOLLOWING CHANGES TO THE ABOVE NAMED CONTRACT:

Item #	Description	Amount
1	Description	
	Total	**$0.00**

Contract Status Per This Change Order	
Original Contract Sum	
Net Change By Previous Change Orders	$0.00
Contract Sum Prior To This Change Order	$0.00
Net Change Made By This Change Order	$0.00
New Contract Sum	$0.00

The Time To Complete The Contract Is:

Unchanged x *Increased By* _____ *Days* *Decreased By* _____ *Days*

The Date Of Completion Is Now: _____

City of Northglenn	Company	City of Northglenn
Owner	Contractor	Engineer
Heather Geyer		Kent Kisselman, P.E.
Name	Name	Name
City Manager		Director of Public Works
Title	Title	Title
Signature	Signature	Signature
Date	Date	Date

KIWANIS OUTDOOR POOL – PHASE 2
WTI #22232.02

Table of Contents

KIWANIS OUTDOOR POOL – PHASE 2
LIST OF DRAWINGS

PL001	COVER
D100	DEMOLITION PLAN
D101	DEMOLITION DETAILS
PL100	OVERALL AQUATIC PLAN
PL101	ADA AND DECK CLEARANCE
PL102	GENERAL DETAILS AND SCHEDULES
PL110	POOL A - EXISTING POOL PLAN
PL111	POOL A - EXISTING POOL DIMENSION PLAN
PL112	POOL A - EXISTING POOL SECTIONS
PL113	POOL A - EXISTING POOL SECTIONS
PL114	POOL A - EXISTING POOL DETAILS
PL120	POOL B - EXISTING WADING POOL
PL200	STRUCTURAL NOTES, PLAN(S) AND SCHEDULE
PL210	STRUCTURAL DETAILS
PL300	OVERALL PIPING PLAN
PL301	MECHANICAL NOTES
PL310	POOL A SKIMMER AND SUCTION PIPING PLAN
PL311	POOL A FILTRATION, FILL AND SENSOR PIPING PLAN
PL400	MECHANICAL EQUIPMENT PLAN
PL401	MECHANICAL DETAILS
PL402	MECHANICAL DETAILS
PL403	PIPE SUPPORT DETAILS
PL411	DEFENDER DETAILS (ALTERNATE)
PL500	MECHANICAL SCHEMATIC
PL501	ELECTRICAL SCHEMATIC
PL502	POOL A ELECTRICAL SCHEMATIC (ALTERNATE)
PL600	PIPE PENETRATIONS
SD100	OVERALL DECK PLAN
SD200	DECK PLAN
SD300	GRADING PLAN
SD400	FENCING AND SHADE PLAN
SD500	SITE DETAILS
A-101	PLANS AND ELEVATIONS
A-301	SECTIONS AND DETAILS
A-302	SECTIONS AND DETAILS
S-001	GENERAL NOTES
S-002	GENERAL INFORMATION
S-003	GENERAL STRUCTURAL DETAILS
S-101	FOUNDATION AND FRAMING PLANS, DETAILS, SCHEDULES
P-001	PLUMBING SYMBOLS, SCHEDULES, DETAILS, & ABBREVIATIONS

P-101	PLUMBING PLAN - SANITARY & VENT
P-111	PLUMBING PLAN - DOMESTIC WATER
M-001	MECHANICAL SYMBOLS AND ABBREVIATIONS
M-101	MECHANICAL PLANS
M-601	MECHANICAL SCHEDULES AND DETAILS
ED-100	SITE DEMOLITION PLAN - ELECTRICAL
ED-101	DEMOLITION PLAN - ELECTRICAL
E-001	ELECTRICAL SYMBOLS, ABBREVIATIONS & SHEET INDEX
E-100	SITE PLAN - ELECTRICAL
E-101	FLOOR PLAN - ELECTRICAL
E-111	POOL A - ELECTRICAL POOL PLAN
E-501	ELECTRICAL DETAILS
E-601	ELECTRICAL SCHEDULES
E-701	ELECTRICAL ONE-LINE POWER DIAGRAM & PANEL SCHEDULES

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork, shoring, bracing, and anchorage.

B. Floors and slabs on grade.

C. Concrete foundation walls.

D. Concrete reinforcement and accessories.

E. Joint devices associated with concrete work.

F. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.

G. Concrete curing.

H. Admixtures.

1.02 RELATED REQUIREMENTS

A. Division 07 - Thermal and Moisture Protection: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015).

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete 1991 (Reapproved 2009).

C. ACI 301 - Specifications for Concrete Construction 2020.

D. ACI 302.1R - Guide to Concrete Floor and Slab Construction 2015.

E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).

F. ACI 305R - Guide to Hot Weather Concreting 2020.

G. ACI 306R - Guide to Cold Weather Concreting 2016.

H. ACI 308R - Guide to External Curing of Concrete 2016.

I. ACI 318 - Building Code Requirements for Structural Concrete 2019, with Errata (2021).

J. ACI 347R - Guide to Formwork for Concrete 2014 (Reapproved 2021).

K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.

L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.

M. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.

N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2021.

O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.

P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.

Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

R. ASTM C150/C150M - Standard Specification for Portland Cement 2022.

S. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete 2020.

T. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

U. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.

V. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).

W. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2022.

X. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete 2021.

Y. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

Z. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete 2010a (Reapproved 2015).

AA. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures 2020.

BB. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2018.

CC. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) 2018.

DD. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting 2015.

EE. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

FF. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs 2017.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Submit shop drawings of reinforcing steel under provisions of Division 01 – General Requirements.
   1. Initial submittal of reinforcement shop drawings shall be complete. No partial submittals will be accepted.
   2. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel, and wire reinforcement, bending and cutting schedules, splicing, supporting and spacing devices.
   3. Reinforcement placement shop drawings for foundations and walls shall conform to ACI SP-66 providing full wall elevations.

C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements: Aggregates.

E. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.

F. Samples: Submit samples of underslab vapor retarder to be used.

G. Test Reports: Submit report for each test or series of tests specified.

H. Cement Replacement Design Reporting: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.
   1. Placement and curing of concrete subject to a combination of (1) rising air temperature (generally greater than 75 degrees F) and (2) wind and low relative humidity shall be in accordance with ACI 305R.
   2. Contractor shall provide plan for minimizing exposure of concrete to adverse conditions due to combinations of high air temperature, direct sunlight, drying winds, and high concrete temperature.
   3. Protect concrete from rapid temperature drop.
   4. Pre-wet subgrade and forms.

C. Follow recommendations of ACI 306R when concreting during cold weather.

1. Placement and curing of concrete where (1) average daily temperature for three consecutive days is less than 40 degrees F, and (2) air temperature is not greater than 50 degrees F for more than one-half of a 24-hour period from midnight to midnight shall be in accordance with ACI 306.1.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   2. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

C. Plywood Forms: Douglas Fir or Spruce-Pine-Fir species: Sound, undamaged sheets with clean true edges, exterior glue, facing material to provide finish specified.

D. Lumber: Douglas Fir or Spruce species; construction grade or better; with grade stamp clearly visible.

E. Preformed Steel Wall Forms: Minimum 16 gage thick, Vertically and horizontally matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and surface appearance.

F. Tubular Column Type: Round, spirally wound laminated fiber material; inside surface treated with release agent.

G. Form Ties For Exposed Surfaces: Plastic cone snap ties with 1-inch outside diameter by 1-inch (nominal) long cones, with no metal within 1-inch of concrete face after removal;
   1. Manufacturers:
      a. Advance Concrete Formwork, Inc.
      b. Dayton Superior.
      c. Symons - A Dayton Superior Company.
      d. Williams Form Engineering Corporation.
      e. Substitutions: As approved by Engineer.

H. Form Ties For Hidden Surfaces: Metal spreader type, removable to a depth of 1-inch from concrete face;
   1. Manufacturers:
      a. Advance Concrete Formwork, Inc.
      b. Dayton Superior.
      c. Williams Form Engineering Corporation.
      d. Substitutions: As approved by Engineer.
   2. Contractor shall use formwork, form components and accessories provided by a single manufacturer. Intermixing of formwork, components and accessories shall not be allowed.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.
   3. Reinforcing bars to be welded shall conform to ASTM A706.

B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

C. Fly Ash: ASTM C618, Class C or F.

D. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

F. Structural Fiber Reinforcement: ASTM C1116/C1116M, Type III.
   1. Fiber Type: Alkali-resistant synthetic macro fibers.
   2. Products:
      a. Euclid Chemical Company; TUF-STRAND SF: www.euclidchemical.com/#sle.
      b. Forta Corporation; FORTA-FERRO (2-1/4"): www.forta-ferro.com/#sle.
      c. GCP Applied Technologies; STRUX 90/40: www.gcpat.com/#sle.
      d. Propex Concrete Systems Corporation - Fibermesh 650
      e. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ADMIXTURES

A. Chemical Admixture: ASTM C494

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Admixtures shall be used in accordance with manufacturer's written recommendations.

D. Admixtures containing chlorides, sulfides, or nitrides are not permitted.

E. Admixtures permitted shall be supplied by a single manufacturer for project.

F. Air Entrainment Admixture: ASTM C260/C260M.
   1. Manufacturers:
      a. BASF Admixtures, Inc.
      b. Grace Construction Products.
      c. The Euclid Chemical Company.
      d. Substitutions: As approved by Engineer/Architect.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
   1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
   3. Products:
      a. Henry Company; Moistop Ultra 10: www.henry.com/#sle.
      b. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com/#sle.
      c. Americover - Vapor Block VB 10.
      d. Stego Industries - Stego Wrap 10-mil.

B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   3. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

A. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
   1. Size: 1/2 inch throat, 1/2 inch deep.
   2. Manufacturers:
      a. Fry Reglet Company – “CO” Concrete Reglet.
      b. Heckman Building Products, Inc. - #231 Stay Put Reglet.
      c. Hohmann & Barnard - CR - Concrete Reglet.
      d. Substitutions: As approved by Engineer.

B. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
   1. Material: ASTM D1751, cellulose fiber.
   2. Products:
      a. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option: www.nomaco.com/#sle.
      b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 CURING MATERIALS

A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Products:
      a. Dayton Superior Corporation; AquaFilm: www.daytonsuperior.com/#sle.
      b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
      c. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
   1. Products:
      a. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W): www.daytonsuperior.com/#sle.
      b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com/#sle.
      c. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.

C. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
   1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
   2. Comply with ASTM C309, Type 2, Classes A and B.
   3. Products:
      a. Dayton Superior Corporation; Dayton Superior - Day-Chem City White Cure (J-8): www.daytonsuperior.com/#sle.
      b. Euclid Chemical Company; KUREZ VOX WHITE PIGMENTED: www.euclidchemical.com/#sle.

D. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C309.
   1. Products:
      a. Dayton Superior Corporation; Safe Cure & Seal (J-18): www.daytonsuperior.com/#sle.
      b. W. R. Meadows, Inc; VOCOMP-20: www.wrmeadows.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

E. Curing Paper: ASTM C171;
   1. Manufacturers:
      a. Fortifiber - Orange Label Sisalkraft 280.
      b. Substitutions: As approved by Engineer.

F. Burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free of cuts, tears, broken or missing areas.

G. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.

H. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Fiber Reinforcement: Add to mix at rate of 4.0 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.

E. Maximum Aggregate Size: 3/4 - inch.

2.09 SCHEDULE OF MIXES

A. Footings: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): 4000 psi.
   2. Maximum Aggregate Size: 1-1/2 inches.
   3. Maximum Water-Cement Ratio: 0.50.

B. Foundation Walls, Grade Beams: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): 4000 psi.
   2. Maximum Aggregate Size: 3/4 - inch.
   3. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent.

C. Structural Slab: Proportion normal weight concrete mix as follows:
   1. Compressive Strength (28 Days): 4000 psi.
   2. Maximum Aggregate Size: 3/4 - inch.
   3. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent.

D. Slab-on-Ground, Equipment Pads: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): 4000 psi.
   2. Maximum Aggregate Size: 3/4 - inch.
   3. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent.

2.10 MIXING

A. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
   1. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
   2. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits stated below.
   3. Verify lines, levels, and measurement before proceeding with formwork.
   4. Earth forms are not permitted.
   5. Align form joints.
   6. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.
   7. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
   8. Provide chamfer strips for all exposed concrete corners of formwork.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

D. Locate reinforcing splices as shown on Drawings.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Place pumped concrete in accordance with ACI 304.2R. Line coating mix to initiate pumping shall not be used in pour but shall be wasted.

D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

F. Concrete with excessive honeycomb or embedded debris shall be rejected and replaced at no cost to Owner.

G. Application of surface retarders and sawcutting of joints shall be planned in advance.

H. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

I. Placing During Hot Weather:
   1. Place concrete during hot weather conditions in accordance with ACI 305R.

J. Placing During Cold Weather:
   1. Place concrete during cold weather conditions in accordance with ACI 306.1.

K. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.05 SLAB JOINTING

A. Locate joints as indicated on drawings.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

3.06 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

E. Where a schedule of finishes is not included in this Section, or finishes are not shown on Drawings, the following finishes shall be used as applicable: Rough Form Finish for all concrete surfaces not exposed to public view; Smooth Form Finish with Smooth Rubbed Finish for all concrete surfaces exposed to public view.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

D. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Due to latent residual moisture issues, wet curing is not an acceptable method when a under slab vapor barrier is present and adhesive flooring will be installed.
   3. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
      a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
      b. Spraying: Spray water over floor slab areas and maintain wet.
      c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   4. Final Curing: Begin after initial curing but before surface is dry.
      a. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.
   5. Apply a liquid hardener and sealer with a damp or moist cure where no floor covering material is specified and floor is subject to moderate traffic and composition or rubber wheels.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect, Engineer, and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect and Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect and Engineer for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 03 30 00

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Common brick.

C. Mortar and grout.

D. Reinforcement and anchorage.

E. Lintels.

F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortaring and Grouting.

B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.

C. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

B. ASTM A580/A580M - Standard Specification for Stainless Steel Wire 2018.

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.

D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.

E. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement 2016, with Editorial Revision (2018).

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.

G. ASTM C55 - Standard Specification for Concrete Building Brick 2017.

H. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale) 2017.

I. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2016a.

J. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2017.

K. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2021.

L. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.

M. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.

N. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

O. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 PERFORMANCE REQUIREMENTS

A. Concrete Masonry Compressive Strength (f'm): 2,000 psi; determined by unit strength method.
   1. Concrete Masonry Units: 2,000 psi minimum net area compressive strength.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

E. Installer's Qualification Statement.

1.07 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
   1. Maintain one copy of each document on project site.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

B. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than eight (8) mph.

1.10 COORDINATION

A. Coordinate concrete unit masonry work with installation of window and door anchors.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Load-Bearing Units: ASTM C90, normal weight.
      a. Hollow block, as indicated.

2.02 BRICK UNITS

A. Building (Common) Brick: ASTM C62, Grade SW; cored units.
   1. Nominal size: Match existing building size.

2.03 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in Section 04 05 11.

2.04 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.

B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss or ladder.
   2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
   3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

E. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment; galvanized finish.
   1. Hot-Dipped Galvanizing: ASTM A153.
   2. Mechanical Galvanizing: ASTM B695; Class 55.

F. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

G. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.

H. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.05 LINTELS

A. Steel Lintels: Size as indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

D. Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches.
   3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

F. Interlock intersections and external corners, except for units laid in stack bond.

G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches.

F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.07 LINTELS

A. Install loose steel lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

C. Maintain minimum 8 inch bearing on each side of opening.

3.08 GROUTED COMPONENTS

A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.09 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

H. Maximum Variation for Steel Reinforcement:
   1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
   2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
   3. Plus or minus 1 inch when distance is between 8 and 24 inches.
   4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
   5. Plus or minus 2 inches from location along face of wall.

3.11 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.13 CLEANING

A. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.

B. Remove excess mortar and mortar droppings.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.14 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

C. Protect base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of concrete unit masonry work exposed to weather, with waterproof coverings secured in place without damaging masonry.

F. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION 04 20 00

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Free-standing railings at steps.

D. Balcony railings and guardrails.

1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting: Paint finish.

B. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.

F. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.

H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).

J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel 2018.

K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.
   1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
   2. Intermediate Rails (OSHA): 1-1/2 inches diameter, round.
   3. Posts: 1-1/2 inches diameter, round, schedule 80 unless noted otherwise.
   4. Balusters: 1/2 inch round solid bar.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. Steel Tube (Railing): ASTM A501/A501M hot-formed structural tubing.

B. Steel Pipe (Post): ASTM A53/A53M Grade B Schedule 80, black finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

E. Straight Splice Connectors: Steel concealed spigots.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by continuous welds.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.
   1. Weld in accordance with AWS D1.1/D1.1M.
   2. Match shop welding and bolting.
   3. Clean welds, bolted connections, and abraded areas.
   4. Touch up shop primer and factory-applied finishes.
   5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with OSHA Standards at applicable locations.

D. Anchor railings securely to structure.

E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 05 52 13

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Rough opening framing for doors, windows, and roof openings.

C. Roof-mounted curbs.

D. Roofing nailers.

E. Roofing cant strips.

F. Preservative treated wood materials.

G. Fire retardant treated wood materials.

H. Communications and electrical room mounting boards.

I. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).

D. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

H. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings 2018, with Errata (2019).

I. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.

J. ICC-ES AC380 - Acceptance Criteria for Termite Physical Barrier Systems 2014, with Editorial Revision (2017).

K. PS 1 - Structural Plywood 2009 (Revised 2019).

L. PS 20 - American Softwood Lumber Standard 2020.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Spruce-Pine-Fir (South), unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Lumber used in Type 1 and 2 construction does not need to be fire treated when used in the following applications;

1. Blocking such as for handrails, millwork, cabinets and window and door frames.
2. Nailing and furring strips as directed by the Architect.

B. Stud Framing (2 by 2 through 2 by 6):
1. Grade: No. 2.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
1. Lumber: S4S, No. 2 or Standard Grade.
2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Other Applications:
1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

A. Fasteners and Anchors:
1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
3. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

E. Termite-Resistant Sill Plate Barrier: Self-adhesive, film-backed barrier with release sheet; adheres to concrete substrates and blocks termite access.
1. Use limited southern states where termites are prevalent.
2. Thickness: 68 mils (0.068 inch).
3. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
4. Water Vapor Permeance: 0.035 perm, maximum, when tested in accordance with ASTM E96/E96M.

F. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.

G. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Do not use treated wood in direct contact with the ground.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with roofing, flashing, or waterproofing.
      d. Treat lumber in contact with masonry or concrete.
      e. Treat lumber less than 6 inches above grade.
      f. Treat lumber in other locations as indicated.
   2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      b. Treat plywood in contact with roofing, flashing, or waterproofing.
      c. Treat plywood in contact with masonry or concrete.
      d. Treat plywood less than 6 inches above grade.
      e. Treat plywood in other locations as indicated.
   3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.

a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

A. Install sill gasket under exterior sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.

F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.

H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of

solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Chalkboards and marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.

B. Subflooring: Glue and nail to framing; staples are not permitted.

C. Underlayment: Secure to subflooring with screws.
   1. At locations where resilient flooring will be installed, fill and sand splits, gaps, and rough areas.
   2. Place building paper between floor underlayment and subflooring.

D. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges use sheathing clips where joints occur between roof framing members.
   2. Nail panels to framing; staples are not permitted.

E. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches, measured horizontally.
   2. Provide inlet diagonal bracing at corners.

3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

F. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.09 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 07 54 00

THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Insulation, flat and tapered.

C. Vapor retarder.

D. Cover boards.

E. Flashings.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2022.

C. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing 2021.

D. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces 2011 (Reapproved 2019).

E. FM (AG) - FM Approval Guide current edition.

F. FM DS 1-28 - Wind Design 2016.

G. NRCA (RM) - The NRCA Roofing Manual 2022.

H. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, and fasteners.

C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Sustainable Design Documentation: Test report showing solar reflectance index of membrane.

J. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 10 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 105 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Material Warranty: Provide No Dollar Limit membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 20 years after installation.

C. System Warranty: Provide manufacturer's No Dollar Limit system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Exceptions are not Permitted:
      a. Damage due to roof traffic.
      b. Damage due to wind speed greater than 56 miles per hour but less than 90 miles per hour.

PART 2 PRODUCTS

2.01 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and insulation.

B. Roofing Assembly Requirements:
   1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
      a. Calculate SRI in accordance with ASTM E1980.
      b. Field applied coating may not be used to achieve specified SRI.
   2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
   3. Insulation Thermal Resistance (R-Value): 7 per inch, minimum; provide insulation of thickness required.

C. Acceptable Insulation Types - Constant Thickness Application: Any of types specified.
   1. Minimum 2 layers of polyisocyanurate board.

D. Acceptable Insulation Types - Tapered Application: Any of types specified.
   1. Tapered polyisocyanurate board.

E. Primer, Roof Coating: Water-based primer with high-tack finish that promotes adhesion for elastomeric roof coatings.

2.02 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. PVC: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, Type II, sheet contains reinforcing fibers or reinforcing fabrics.
      a. Thickness: 60 mil, 0.060 inch, minimum.
   2. Sheet Width:
      a. Adhered Application: Limit width to 120 inches, maximum, when ambient temperatures are less than 40 degrees F for extended period of time during installation.
   3. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.03 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
   1. Thickness: 1/2 inch, fire-resistant.

2.04 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 1, 16 psi (110 kPa), minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F.
   2. Board Size: 48 by 96 inches.
   3. Board Thickness: As noted on drawings.
   4. Board Edges: Square.

2.05 ACCESSORIES

A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.

B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

F. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

G. Insulation Adhesive: As recommended by insulation manufacturer.

H. Roofing Nails: Galvanized, hot-dipped type, size and configuration as required to suit application.

I. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.

J. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing over ballast.

K. Sealants: As recommended by membrane manufacturer.

L. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.

1. Composition: Roofing membrane manufacturer's standard.
2. Size: Manufacturer's standard size.
3. Surface Color: White.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during cold or wet weather conditions.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.03 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Attachment of Insulation:
   1. Adhere first layer of insulation to deck in accordance with roofing manufacturer's instructions.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

C. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards perpendicular to flutes with insulation board edges bearing on deck flutes.

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.

I. Do not install more insulation than can be covered with membrane in same day.

3.04 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate at rate recomended by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 8 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Coordinate installation of roof drains and sumps and related flashings.

3.05 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 54 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.

1.03 REFERENCE STANDARDS

A. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2018.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   6. Sample product warranty.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Exterior wall to adjacent pavement.
      f. Floor slab to exterior pavement
      g. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
      c. Joints between different exposed materials.
      d. Exposed interior wall to floor slab joint.
      e. Joints between painted trim and different materials
      f. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
d. Joints where installation of sealant is specified in another section.
e. Joints between suspended panel ceilings/grid and walls, unless such joints are objectionable.

B. Type JSE - Exterior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Type 1 - Single component, polyurethane sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT, A, G, O and M; Federal Specivation TT-S-00230, Class A, Type II; with joint movement capability of 25 percent for the following vertical exterior applications;
a. Precast concrete wall control and expansion joints.
b. Isolation joints.
c. Electrical and mechanical sleeves, chases, conduit and piping entries.
d. Manufacturers:
1) BASF Corporation Building Systems: Sonneborn Sonolastic NP1.
2) Bostik, Inc.: Chem-Calk 900.
3) Pecora Corporation: DynaTrol I-XL.
4) Sika Corporation: Sikaflex - 1a.
5) Tremco Commercial Sealants & Waterproofing:
a) Dymonic.
b) Vulkem 116.
2. Type 2 - Single component, silicone sealant, ASTM C920, Type S, Grade NS, Class 50 minimum, Use NT, A, O, G and M; Federal Specification TT-S-00230C, Class A, Type II; with jint movement capability of 50 percent for the followin vertical exterior applications;
a. Precast concrete wall control and expansion joints.
b. Cast-in-place concrete wall control and expansion joints.
c. Metal frame perimeters to concrete or masonry.
d. Coping joints and coping to facade joints.
e. Sheet metal flashings.
f. Reglet joints.
g. Dissimilar material joints, including metal-to-concrete.
h. Through-wall electrical and mechanical sleeves, chases, conduit and piping entries.
i. Manufacturers:
1) C.R. Laurence Co.: 95C Silicone.
2) Dow Corning Corporation: 795 Silicone.
3) GE - Mometive Performance Materials: SCS9000 SiPruf NB.
4) May National Associates, INC.: Bondaflex Sil 265 LTS.
5) Pecora Corporation: 864 NST.
6) Tremco Commercial Sealants and Waterproofing: Spectrem 3.
3. Type 3 - Single component, polyurethane sealant, ASTM C920, Type S, Grade P, Class 25, Use T, NT, and M; Federal Specification TT-S-00230C, Type I, Class A; with joint movement capability of 25 percent for the following horizontal exterior concrete expansion and control applications;
a. Building entrance pavement.
b. Ramps.
c. Exterior wall to adjoining pavement.
d. Manufacturers;
1) BASF Corporation Building Systems: Sonneborn Sonolastic SL1.
2) Bostik, Inc.: Chem-Calk 955-SL

3) Pecora Corporation: NR-201.
4) Sika Corporation: Sikaflex - 1c SL.
5) Tremco Commercial Sealants & Waterproofing: Vulkem 45.

4. Type 4 - Multi-component, polyurethane sealant, ASTM C920, Type S, Grade P, Class 25, Use T, NT, O and M; with joint movement capability of 25 percent for the following horizontal exterior applications;
   a. Industrial and commercial driveways and approaches.
   b. Manufacturers;
      1) BASF Corporation Building Systems: Sonneborn - Sonomeric 1.
      2) Pecora Corporation: Urexpan NR-200.
      3) Sika Corporation: Sikaflex -2c SL.
      4) Tremco Commercial Sealants & Waterproofing: THC900-901.

C. Type JSI - Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
   1. Type 1 - Single component, polyurethane sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT, A, G, O and M; with joint movement capability of 25 percent for the following vertical interior wall applications;
      a. Precast concrete wall panel control and expansion joints.
      b. Cast-in-place concrete wall control and expansion joints.
      c. Metal door and window frame perimeters to concrete or masonry.
      d. Joints at underside of precast concrete beams and planks.
      e. Dissimilar material joints, including metal-to-concrete.
      f. In-wall electrical and mechanical sleeves, chases, conduit and piping entries.
      g. Manufacturers:
         1) BASF Corporation Building Systems: Sonneborn - Sonolastic NP1.
         2) Bostik, Inc.: Chem-Calk 900.
         3) Pecora Corporation: DynaTrol I-XL.
         4) Sika Corporation: Sikaflex - 1a.
         5) Tremco Commercial Sealants & Waterproofing:
            a) Dymonic.
            b) Vulkem 116.
   2. Multi-component, polyurethane sealant, ASTM C920, Type S, Grade NS, Class 25, Use T, NT, O and M; with joint movement capability of 25 percent for the following horizontal interior floor applications;
      a. Industrial and commercial concrete floor joints.
      b. Manufacturers;
         1) BASF Corporation Building Systems: Sonneborn - Sonomeric 1.
         2) Percora Corporation: Urexpan NR-200.
         3) Sika Corporation: Sikaflex - 2c SL.
         4) Tremco Commercial Sealants & Waterproofing: THC900-901.
   3. Single component, butyl sealant, ASTM C1311, non-drying, non-skinning; with joint movement capbility of 25 percent for the following interior applications;
      a. Thresholds at exterior doors.
      b. Exterior flashings at concealed locations.
      c. Manufacturers;
         1) Bostik, Inc.: Chem-Calk 300.
         2) Pecora Corporation: BC-158 Butyl.
         3) Tremco Comercial Sealants & waterproofing: Tremco Butyl Sealant.

2.02 SELF-LEVELING SEALANTS

A. Type SL - Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
   1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
   2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
   3. Color: Limestone.
   4. Service Temperature Range: Minus 40 to 180 degrees F.
   5. Manufacturers:
      a. Dow Chemical Company; DOWSIL SL Parking Structure Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
      b. Pecora Corporation; Pecora 300 SL (Self-Leveling): www.pecora.com/#sle.
      c. Sika Corporation; Sikasil 728RCS: www.usa-sika.com/#sle.
      d. Sika Corporation; Sikasil 728SL: www.usa-sika.com/#sle.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 900SL: www.tremcosealants.com/#sle.

2.03 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

B. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

D. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION 07 92 00

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 09 91 13 - Exterior Painting: Field painting.

C. Section 09 91 23 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2020.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

J. ASTM C476 - Standard Specification for Grout for Masonry 2020.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.

M. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

N. ITS (DIR) - Directory of Listed Products Current Edition.

O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

Q. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.

R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2019.

W. UL (DIR) - Online Certifications Directory Current Edition.

X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

Y. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

F. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Hinged edge square, and lock edge beveled.
   5. Typical Door Face Sheets: Flush.
   6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   7. Zinc Coating for Typical Interior and Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for Corrosive locations and Exterior locations.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.

1) Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.

b. Level 3 - Extra Heavy-duty.

1) Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

2) Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.

c. Model 1 - Full Flush.

d. Zinc Coating: G90/Z275 galvanized coating; ASTM A653/A653M.

2. Door Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density.

a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.

3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate.

4. Door Thickness: 1-3/4 inches, nominal.

5. Top Closures for Outswinging Doors: Flush with top of faces and edges.

6. Door Face Sheets: Flush.

7. Weatherstripping: Refer to Section 08 71 00.

C. Fire-Rated Doors:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 1 - Standard-duty.

b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.

e. Zinc Coating: A 40 /ZF 120 galvannealed coating; ASTM A653/A653M.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").

3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.

4. Provide units listed and labeled by UL (DIR) or ITS (DIR).

a. Attach fire rating label to each fire rated unit.

5. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.

b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.

c. Label: Include the "S" label on fire-rating label of door.

6. Door Core Material: Mineral board.

7. Glazing Type: As dictated by door rating and opening size.

8. Door Thickness: 1-3/4 inches, nominal.

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
   2. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.
   3. Reinforcements:
      a. Strike: 16 gauge x 2" x 1-1/2" with 3 spot welds.
      b. Hinge: 3/16" x 9" x 1-1/2" with 6 spot welds each.
      c. Closer and holder: 12 gauge x 1-3/4" x 20" with 4 spot welds each.
      d. Floor clip angles: 12 gauge x 2" x 3-1/2" with 4 spot welds each.
      e. Spreader: 16 gauge channel, arc-welded.
   4. Weatherstripping: Separate, see Section 08 71 00.

D. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
   3. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

E. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.

F. Transom Bars: Fixed, of profile same as jamb and head.

G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities, applied to bottom 6 inches of concealed surfaces at exterior door frames.
   1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.05 ACCESSORIES

A. Removable Stops: 16 gauge, Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

B. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
   1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
   2. Astragal Type: Overlapping, flat-shaped, with coordinator for proper door closing sequence, and with automatic locking, cutouts for other door hardware, and sealing

gasket.

3. Edge Type: Beveled edge
4. Material: Stainless steel.
5. Provide non-corroding fasteners at exterior locations.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place. Plaster grout is prohibited. Use of thinner pumpable grout limited to frames retrofitted into existing openings.

E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 71 00.

1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

F. Touch up damaged factory finishes.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 11 13

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights 2017.

B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.

C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.

D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, information on glass and glazing, and internal drainage details.

C. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 ALUMINUM WINDOWS

A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
   1. Frame Depth: 3-1/2 inch.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
   3. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
   5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

2.02 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
   1. Performance Class (PC): R.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.04 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Install sill and sill end angles.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

3.03 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION 08 51 13

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for hollow metal doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.

B. Section 08 11 13 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. BHMA (CPD) - Certified Products Directory Current Edition.

C. BHMA A156.1 - American National Standard for Butts and Hinges 2016.

D. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches 2017.

E. BHMA A156.3 - American National Standard for Exit Devices 2014.

F. BHMA A156.4 - American National Standard for Door Controls - Closers 2013.

G. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks 2014.

H. BHMA A156.6 - American National Standard for Architectural Door Trim 2015.

I. BHMA A156.7 - American National Standard for Template Hinge Dimensions 2016.

J. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders 2015.

K. BHMA A156.16 - American National Standard for Auxiliary Hardware 2018.

L. BHMA A156.18 - American National Standard for Materials and Finishes 2016.

M. BHMA A156.21 - American National Standard for Thresholds 2014.

N. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor 2017.

O. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems 2018.

P. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.

Q. BHMA A156.115W - American National Standard for Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.

R. DHI (KSN) - Keying Systems and Nomenclature 1989.

S. ITS (DIR) - Directory of Listed Products Current Edition.

T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

U. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.

V. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.

W. UL (DIR) - Online Certifications Directory Current Edition.

X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

D. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
   5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
   6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. List groups and suffixes in proper sequence.
   2. Provide complete description for each door listed.
   3. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   4. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
   1. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
   2. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

G. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
   1. Closers: Five years, minimum.

2. Locksets and Cylinders: Three years, minimum.
3. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
2. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
3. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
4. Listed and certified compliant with specified standards by BHMA (CPD).
5. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
6. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

D. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
a. Aluminum fasteners are not permitted.
b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall wing inserts for hollow wall construction.
5. Fire-Rated Applications: Comply with NFPA 80.
a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
6. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.02 HINGES

A. Manufacturers:
1. Hager Companies: www.hagerco.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Hinges: Comply with BHMA A156.1, Grade 1.
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
a. Provide hinge width required to clear surrounding trim.
2. Provide hinges on every swinging door.

3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
4. Provide ball-bearing hinges at each door.
5. Provide non-removable pins on exterior outswinging doors.
6. Provide following quantity of butt hinges for each door:
    a. Doors up to 60 inches High: Two hinges.
    b. Doors From 60 inches High up to 90 inches High: Three hinges.

2.03 FLUSH BOLTS

A. Manufacturers:
1. Hager Companies; [_____]: www.hagerco.com/#sle.
2. Ives, an Allegion brand; [_____]: www.allegion.com/us/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 3/4 inch, minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
    a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

2.04 LOCK CYLINDERS

A. Manufacturers:
1. Best, dormakaba Group: www.bestaccess.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
1. Provide standard, electronic, conventional, full size interchangeable core (FSIC), and small format interchangeable core (SFIC) type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
2. Provide cylinders from same manufacturer as locking device.
3. Provide cams and/or tailpieces as required for locking devices.
4. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.05 CYLINDRICAL LOCKS

A. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
1. Bored Hole: 2-1/8 inch diameter.
2. Latchbolt Throw: 1/2 inch, minimum.
3. Backset: 2-3/4 inch unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
    a. Finish: To match lock or latch.
    b. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
    c. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.

5. Provide a lock for each door, unless otherwise indicated that lock is not required.
6. Provide an storage lockset for swinging door where hardware set is not indicated.
7. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.06 DOOR PULLS AND PUSH BARS

A. Door Pulls and Push Bars: Comply with BHMA A156.6.
   1. Bar Type: Bar set, unless otherwise indicated.
   2. Material: Stainless steel, unless otherwise indicated.

2.07 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Corbin Russwin, Norton, Rixson, Sargent, or Yale; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. DORMA USA, Inc; 7400 Series, 8600 Series, 8900 Series, and TS93: www.dorma.com/#sle.
   3. Hager Companies: www.hagerco.com/#sle.
   4. LCN, an Allegion brand: www.allegion.com/us/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide cushioned door closer on each exterior door.
   3. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
   4. At corridor entry doors, mount closer on room side of door.
   5. At outswinging exterior doors, mount closer on interior side of door.

2.08 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
   1. Rixson or Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. DORMA USA, Inc; 900 Series: www.dorma.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
   1. Provide stop for every swinging door, unless otherwise indicated.
   2. Overhead stop is not required if positive stop feature is specified for door closer or if floor/wall stop is provided.

2.09 PROTECTION PLATES

A. Manufacturers:
   1. Hager Companies: www.hagerco.com/#sle.
   2. Ives, an Allegion brand; [_____]: www.allegion.com/us/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Protection Plates: Comply with BHMA A156.6.

C. Metal Properties: Stainless steel.

1. Metal, Standard Duty: Thickness 0.05 inch, minimum.

D. Edges: Beveled, on four sides unless otherwise indicated.

E. Fasteners: Countersunk screw fasteners.

F. Drip Guard: Provide at head of exterior doors unless covered by roof or canopy.

2.10 ARMOR PLATES

A. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface.
   1. Size: 48 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.

2.11 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.12 DOOR HOLDERS

A. Door Holders: Comply with BHMA A156.16, Grade 1.
   1. Provide surface mounted door holders when wall or floor stop is not applicable and hold-open device is mounted on door.
   2. Type: Lever, or kick down stop, with rubber bumper at bottom end.
   3. Material: Stainless steel.

2.13 FLOOR STOPS

A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
   2. Type: Manual hold-open, with pencil floor stop.
   3. Material: Stainless steel housing with rubber insert.

2.14 ASTRAGALS

A. Astragals: Comply with BHMA A156.22.
   1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
   2. Type: Overlapping, flat type, with coordinator for proper door closing sequence, and with sealing gasket.
   3. Material: Stainless steel, with neoprene weatherstripping.
   4. Provide non-corroding fasteners at exterior locations.

2.15 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.

2. Provide threshold at each exterior door, unless otherwise indicated.
3. Type: Flat surface.
4. Material: Aluminum.
5. Threshold Surface: Fluted horizontal grooves across full width.
6. Field cut threshold to profile of frame and width of door sill for tight fit.
7. Provide non-corroding fasteners at exterior locations.
8. Bed threshold in sealant at exterior locations.
9. Provide thermally broken thresholds at exterior locations.

2.16 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
1. Head and Jamb Type: Adjustable.
2. Door Sweep Type: Encased in retainer.
3. Material: Aluminum, with brush weatherstripping.
4. Provide gasketing for smoke and draft control doors (Indicated as "S" on Drawings) that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
5. Provide frame-applied intumescent gasketing on wood doors that are labeled as smoke and draft control doors (Indicated as "S" on Drawings), unless otherwise indicated.
6. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
7. Provide door bottom sweep on each exterior door, unless otherwise indicated.
8. Provide door head drip on each exterior door, unless otherwise indicated.

2.17 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
1. Single Door: Provide three on strike jamb of frame.
2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
3. Material: Rubber, gray color.

2.18 KEY CONTROL SYSTEMS

A. Key Control Systems: Comply with guidelines of BHMA A156.28.
1. Provide keying information in compliance with DHI (KSN) standards.
2. Keying: Grand master keyed.
3. Include construction keying and control keying with removable core cylinders.
4. Key to existing keying system.
5. Supply keys in following quantities:
    a. 1 each Grand Master keys.
    b. 6 each Construction Master keys.
    c. 15 each Construction keys.
    d. 2 each Construction Control keys.
    e. 2 each Control keys if new system.
6. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
7. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.

8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
9. Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.
10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
11. Install permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

2.19 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 630; satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D); BHMA A156.18.
   2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
      a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Do not install surface mounted items until application of finishes to substrate are fully completed.

F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.
   1. Mounting heights in compliance with ADA Standards:
      a. Locksets: 40-5/16 inch.
      b. Push Plates/Pull Bars: 42 inch.
      c. Exit Devices: 40-5/16 inch.

G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

1. Refer to Section 07 92 00 for additional requirements.

3.03 ADJUSTING

A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.05 PROTECTION

A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 71 00

SECTION 09 90 00

PAINTING AND COATING - COMMERCIAL FACILITY GUIDE SPECIFICATION - SHERWIN-WILLIAMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Interior painting and coating systems.

C. Exterior painting and coating systems.

D. Scope:
   1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
      a. Exterior:
         1) Concrete: Common brick, precast, and poured-in-place cement.
         2) Masonry: Concrete masonry units (CMU), cinder or concrete block.
         3) Metal: Aluminum, galvanized.
         4) Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
      b. Interior:
         1) Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
         2) Concrete Ceilings: Poured concrete, precast concrete, cement board, cast-in-place concrete, and plaster.
         3) Masonry CMU: Concrete, split face, scored, smooth, high density, low density, and fluted.
         4) Metal: Aluminum and galvanized.
         5) Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
         6) Concrete: Floors, non-vehicular.

1.02 REFERENCE STANDARDS

A. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

B. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

C. SSPC-SP 2 - Hand Tool Cleaning 2018.

D. SSPC-SP 3 - Power Tool Cleaning 2018.

E. SSPC-SP 6 - Commercial Blast Cleaning 2007.

F. SSPC-SP 13 - Surface Preparation of Concrete 1997 (Reaffirmed 2003).

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Product characteristics.
   2. Surface preparation instructions and recommendations.
   3. Primer requirements and finish specification.
   4. Storage and handling requirements and recommendations.
   5. Application methods.
   6. Clean-up information.

C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

D. Applicator's qualification statement.

E. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.

C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.

B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.

B. Comparable Products: Products of approved manufacturers will be considered in accordance with 01 60 00 - Product Requirements, and the following:
   1. Products are approved by manufacturer in writing for application specified.

2. Products that meet or exceed performance and physical characteristics of basis of design products.

2.02 PAINTINGS AND COATINGS

A. General:
   1. Provide factory-mixed coatings unless otherwise indicated.
   2. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.

B. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - EXTERIOR

A. Concrete: Common brick, precast concrete lintel, and poured-in-place cement.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer LX02W50: www.sherwin-williams.com/#sle.
            a) 5.3 to 8 mils wet, 2.1 to 3.2 mils dry.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
            a) 6 to 12 mils wet, 2 to 4 mils dry per coat.

B. Masonry: Concrete masonry units (CMU), cinder or concrete block.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams PrepRite Block Filler, B25W25: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 series: www.sherwin-williams.com/#sle.

C. Metal: Aluminum, galvanized.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st and 2nd Coats: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.
            a) 2 to 4 mils dry per coat.

D. Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss, B66-650 Series: www.sherwin-williams.com/#sle.

2.04 PAINT SYSTEMS - INTERIOR

A. Concrete, Walls and Ceilings: Poured concrete, precast concrete, unglazed brick, cement board, tilt-up, cast-in-place concrete, and plaster.
   1. Epoxy Systems, Water Based:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Loxon Concrete and Masonry Primer Sealer, LX02W50: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46 Series: www.sherwin-williams.com/#sle.

B. Concrete Ceilings: Poured concrete, precast concrete, cement board, cast-in-place concrete, and plaster.
   1. Dryfall Waterborne Topcoats:
      a. Semi-Gloss Finish:
         1) 1st and 2nd Coat: Sherwin-Williams Pro Industrial Waterborne Acrylic Dryfall, B42-83 Series: www.sherwin-williams.com/#sle.

C. Masonry CMU: Concrete, split face, scored, smooth, high density, low density, and fluted.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams PrepRite Block Filler, B25W25: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series: www.sherwin-williams.com/#sle.

D. Metal: Aluminum and galvanized.
   1. Epoxy Systems, Water Based:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46 Series: www.sherwin-williams.com/#sle.

E. Metal: Structural steel columns, joists, trusses, beams, miscellaneous and ornamental iron, structural iron, and ferrous metal.
   1. Epoxy Systems, Water Based:
      a. Semi-Gloss Finish:
         1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
         2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46 Series: www.sherwin-williams.com/#sle.

F. Concrete: Floors, non-vehicular.
   1. Latex Systems:
      a. Semi-Gloss Finish:
         1) 1st and 2nd Coat: Sherwin-Williams Tread-Plex Acrylic Floor Coating, B90 Series: www.sherwin-williams.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk.
   2. Fill bug holes, air pockets, and other voids with cement patching compound.
   3. Prepare concrete according to SSPC-SP 13.

D. Masonry: Remove efflorescence and chalk.

E. Concrete Floors and Traffic Surfaces: Prepare concrete according to SSPC-SP 13.

F. Aluminum: Remove surface contamination and oil; wash with solvent according to SSPC-SP 1.

G. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.

3.04 PRIMING

A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

END OF SECTION 09 90 00

SECTION 10 73 00

SHADE STRUCTURES

PART 1 - GENERAL

1.01 Related Documents

A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Division 01 Specification Sections and Division 32 Specification Sections, apply to this Section.

1.02 Summary

A. This Section specifies the furnishing of all labor, materials, tools, equipment, and incidentals necessary to provide the shade structures, but not limited to:
   1. Modular shade structures.

1.03 Related Sections

A. Section 01 33 00 – Submittal Procedures
B. Section 32 13 14 – Concrete Decks and Walks

1.04 Submittals

A. Product Data for all items specified under this section.
B. Fabric Samples for Initial Selection: For each type provide manufacturer color samples.
C. Quality Assurance/Control Submittals
   1. Manufacturer Installation Recommendations

1.05 Quality Assurance

A. Qualifications
   1. provide at least one person who is thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of the work described for this section, and who shall be present at all times during progress of the work of this section and shall direct all work performed under this section.

1.06 Delivery, Storage, and Handling

A. Storage and Protection:
   1. Use all means necessary to protect shade structure and other materials before, during and after installation and to protect the installed work and materials of all other trades.
B. Replacement:
   1. In the event of damage to the site furnishings, immediately make all repairs or replacements necessary to the approval of the Aquatic Consultant and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 Concrete

A. Where required shall conform to ASTM C-94 for redi-mixed concrete, 3000psi.

2.02 Pre-engineered Structure: 25’x25’ or similar size, installed per manufacturers specifications.

A. Roof Type of HR-36 or comparable with a wind load of 135 or greater, live load of 30 or greater, and a pitch of 4:12 or comparable
B. Fascia of 24 Ga. Trim.
C. Surface mount 4 columns.
D. Eave Heights of 7’-6” or greater
E. Frame finish of Zinc rich primer w/TGIC powder Coat or equivalent.

2.03 Structure amenities:

A. Two 8’ steel picnic table, black, ADA accessible picnic tables (DuMor, table 443 Series Accessible Table with 5 ft. benches, or equibalent).
B. One trash receptacle (DuMor, receptacle 287, silver or equivalent).

PART 3 - EXECUTION

3.01 Installation

A. Install all shade elements in location as indicated on the drawing.
B. Aquatic Designer reserves the right to make minor field adjustments to best fit the exact field conditions.
C. Footings
1. Shall be installed in a plumb condition per the manufacturer's recommendation for proper height.

3.02 Construction
A. Framework
1. Shall be assembled per the manufacturer's recommendations.
B. Metal Roof
1. Shall be installed on the framework assembly and secured per the manufacturer's recommendations.

3.03 Cleaning
A. Concrete and debris shall be removed from the structures in a manner that will not damage the finish before being turned over to the owner.

3.04 Demonstration
A. Demonstrate operation of completed units to owner's satisfaction.

END OF SECTION

SECTION 13 11 13

POOL GENERAL

1. GENERAL

1.01 SECTION INCLUDES

A. Project administrative requirements that relate to Division 13 11 Pools.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

B. The following contain requirements that relate in Division 13 11:
   1. Mechanical/Electrical/Equipment Coordination: General Conditions, Supplementary General Conditions and Division 01 General Requirements
   2. Earth Work and Pool Excavation: Division 31
   3. Concrete Deck Work: Division 03
   4. Mechanical: Plumbing Systems - Division 22, HVAC Systems and Equipment - Division 23
   5. Electrical: Division 26

C. Applicable requirements of the following Codes and Standards apply to Work in Division 13 11:
   1. Association of Pool and Spa Professionals (APSP)
      a. Minimum Standard for Public Swimming Pools
   2. National Electrical Code (NEC)
   3. National Sanitation Foundation (NSF): Seal of Approval Program
   4. American Society for Testing and Materials (ASTM): Specifications referenced herein.
   5. Governmental Health and Building Codes
   6. ADA Accessibility Guidelines for Buildings and Facilities
   7. American National Standards Institute

1.03 REFERENCES

A. Refer to individual Division 13 11 sections.

1.04 DESCRIPTION OF WORK

A. Work of Division 13 11 includes, but is not limited to, the following:
   1. Layout of all pool(s) and pool related work required under Division 13 11.
   2. Project benchmarks and control points.
   3. Excavation and stone fill as required for pool tank structure and pipe trenching. Refer to Division 01 and 31 for special conditions.
   4. Pool vessels, as detailed on Contract Drawings and Shop Drawings.
   5. Pool mechanical systems, including piping, recirculation system, filtration system, and water chemical treatment system.
   6. Heating system for swimming pool. Coordinate venting and interlocking for pool heater(s) with HVAC Contractor.
   7. Waterslide and water activity mechanical systems including all piping.
   8. Interior pool finishes.

9. Pool deck equipment and accessory equipment shown and/or specified, including required anchors embedded within the pool deck and coordination with Deck Contractor.
10. Coordination of all electrical interlocks for pool and pool related equipment.
11. Miscellaneous pool testing, safety and control equipment.
12. Low voltage wiring for pool and pool related equipment is installed and connected by the Swimming Pool Contractor unless required otherwise by code. Where code requires that low voltage wiring is installed by a licensed electrical contractor, low voltage wiring is specified in Electrical Documents.

B. Definitions
1. The term "pool" as used in Division 13 11 shall refer to the following:
   a. Pool A – Existing Pool: “L” shaped pool
   b. Pool B – Existing Wading Pool:
2. The term "concrete" as used in Division 13 11 refers to concrete for swimming pool construction only.
3. The term "Architect/Engineer" as used in Division 13 11 refers to the swimming pool designer only.
4. The term "Contractor" as used in Division 13 11 refers to the swimming pool contractor only.
5. The term “Low Voltage Wiring” as used in Division 13 11 includes wiring <= 24V. All Low Voltage Wiring is Provided with the Equipment. Low voltage wiring is shown in Low Voltage Wiring Diagram included in the pool drawings except where specified by Electrical Consultant.
6. The term “Control Wiring” as used in Division 13 11 refers to connections from individual equipment components to the Building Management System (BMS).

C. Applicable Code Permit and Inspection Responsibilities.
1. State and/or County Health Department permit fees by Owner.
2. Local Departments of Health inspection fees by Contractor.
3. Other permits/fees required paid by Contractor.
4. Scheduling of Required Inspections – Contractor
5. Documentation and Submission of accepted modifications to approved plans to Permit Authorities – Contractor.

D. Related Work Not in Division 13 11 Specified Elsewhere
1. Pool deck construction, including finishes, sealants, and drains.
2. Potable water or fresh water: Fresh water connection to auto fill and wastewater connections (see Contract Drawings).
3. Pool electrical work: Electrical connections shall be by the General Construction Contract Electrical Sub-Contractor. The Pool Contractor shall provide the filter pumps, motors, solenoids, relays, water level probes (with housing), motorized valves, etc., as shown on Contract Drawings and required by pool systems equipment manufacturer. The Electrical Contractor shall install and wire electrical equipment furnished by the Pool Contractor and shall provide motor starters and disconnect switches as indicated or required by Codes. The Electrical Contractor shall provide grounding and bonding per NEC Article 680.
4. Control Wiring for all electrical and HVAC equipment shall be by the control system sub-contractor.
5. Heating system for pools, heater by the Pool Contractor; venting and controls by Division 23.

1.05 QUALITY ASSURANCE

A. Qualifications of Pool Contractor:

1. Work of Division 13 11 shall be performed by a Pool Contractor who has a minimum of five (5) projects with a proven five (5) year record of competence and experience in the construction of similar facilities of this size and complexity.
2. Pool Contractor prequalification is required prior to bid. This must be received by the Architect fourteen prior to the bid date on the appropriate AIA form. (AIA A305)
3. Pool Contractor shall meet all Local and State Certifications and License requirements prior to bidding. Copies of the required Certificates and Licenses shall be made available upon request.

B. Performance Criteria: Certain sections of Division 13 11 contain performance criteria rather than product descriptions. It shall be the obligation of the Pool Contractor to ensure that all criteria are satisfied and the burden of proof of conformance shall rest with the Pool Contractor. The Architect/Engineer shall require complete calculations, past performance records and, if required, inspection trips of similar facilities to substantiate conformance with these criteria. The Architect/Engineer shall be sole judge of conformance, and the Pool Contractor is cautioned that he will be required to provide a finished product meeting all stated criteria and meeting or exceeding Department of Public Health requirements.

C. All work of Division 13 11 shall be performed by the qualified Pool Contractor or a Subcontractor to the qualified Pool Contractor unless otherwise pre-approved in writing by the Architect/Engineer. A representative of the Pool Contractor shall oversee work subcontracted by the Pool Contractor.

D. The following shall be performed during construction of the project.
1. Refer to General Conditions, Division 01, and other Division 13 11 sections for further requirements.

1.06 SUBMITTALS

A. Submittals Required
1. Refer to General Conditions, Division 01, and individual Division 13 11 sections for number required.
2. The Contractor shall submit for approval to the Architect/Engineer complete lists, including descriptions, catalogs, product cut sheets, etc., and where applicable dimensioned shop drawings of all material, fixtures, and equipment to be furnished and installed as part of Division 13 11.
3. Submittals shall adequately and completely describe the equipment, including where necessary or requested complete construction and installation dimensions, complete capacity and performance data, all accessories and auxiliary equipment and all pertinent details of manufacture.
    a. Submittals shall be provided in Adobe PDF electronic file format via email file size (10 MB max.). Create PDFs at native size and right-side up; illegible, partial, unlabeled, or unorganized submittal sections will be returned rejected. Contractor shall make their own copies from the original returned by the Architect.

B. Product Data: Provide manufacturer's/installer's written installation instructions.

C. Shop Drawings
1. The drawings accompanying this Specification are diagrammatic in nature and show the general arrangement of all equipment, piping, ductwork, services, etc. Because of the small scale of the drawings, it is not possible to show all offsets, fittings and accessories that may be required. The Contractor shall carefully investigate the structural and finish conditions of his work and shall arrange such work accordingly; furnishing all fittings, pipe and accessories that may be required to meet such conditions. Where conditions necessitate a rearrangement, the Contractor shall obtain the Architect/Engineer's approval.

2. Shop drawings for equipment shall be submitted, and Engineer's review of shop drawing shall be obtained before proceeding with fabrication. Shop drawings shall not be "doctored" reproductions of Architect/Engineer's drawings.

D. Samples: Submit samples of materials, finishes, and trim as requested by the Architect/Engineer.

E. Schedule of Values
   1. Provide Architect/Engineer with a copy of the Schedule of Values developed for this project relevant to Division 13 11 for approval.

F. Valve Charts: Submit two (2) copies of valve charts for each piping system, consisting of Isometric Drawings or piping layouts showing and identifying each valve and describing its function to the Architect/Engineer for approval.
   1. Upon completion of the Work, one (1) copy of each chart sealed to rigid backboard with clear lacquer placed under glass and framed, shall be hung in a conspicuous location in the equipment room.

G. Furnish to the Architect/Engineer the following:
   1. Refer to individual Division 13 11 sections for additional requirements.
   2. Submittals
      a. Shotcrete Nozzle Man Qualifications and Certifications
      b. Pool Finish Experience/Qualification Requirements
      c. Concrete Mix Design
      d. Non-shrink Grouts
      e. PVC and Pre-formed Plastic Adhesive Waterstop
      f. Expansion/Construction Joint Materials
      g. Caulking/Sealants
      h. Pumps and Strainers
      i. Heater
      j. Chemical Controller
      k. Chemical Feeders
      l. Bulk Chemical Storage Tanks
      m. Valves
      n. Gauges
      o. Flow Meters
      p. Thermometers
      q. Inlets
      r. Grating
      s. Pre-fabricated Submerged Outlets
      t. Under Water Pool Lighting
      u. Deck Equipment
      v. Safety Equipment
      w. Maintenance Equipment
      x. Piping Materials (pipe, fittings, solvents, cements)
      y. Wall Sleeves and Seals for Piping
      z. Tile Setting Materials and Joint Fillers
   3. Shop Drawings
      a. Reinforcing Steel
      b. Water Activities
      c. Filters
      d. Precast Pool Coping Stone
   4. Test Results
      a. Water Treatment Analysis
      b. Compaction
      c. Piping Pressure Testing

5. Samples
    a. Special Aggregate – Factory and Field Applied
    b. Tile
    c. Gratings
6. Guarantees/Warranties
    a. Standard 1-Year
    b. Standard 5-Year on Quartz Aggregate Finish
    c. Standard 2-Year on Pool Finish Application
    d. Special Equipment – Standard Manufacturer's Warranty
    e. Future 3-Days of Instruction and Operational Checkout
7. Close Out Documents
    a. & M Manuals
    b. Record Drawings
    c. Owner's Certification of Instruction
    d. Extra Materials

1.07 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

B. Along with the Shop Drawings, the Contractor shall submit, in duplicate, a certificate properly attested, stating the material, equipment, and construction comply with the requirements of the Contract Documents, for all equipment and materials proposed as a Substitute for the specified equipment and materials.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

B. Deliver all materials and equipment to the work site in original packages, fully identified with manufacturer's label. Store off ground and protect from weather with a suitable covering.

C. Protect plastic pipe from exposure to chemicals (aromatic hydrocarbons, halogenated hydrocarbons and other esters and keytones) that might attack the material. Protect all pipes from mechanical damage and long exposure to sunlight during storage.

1.09 WARRANTIES

A. Warranty: Provide one (1) year warranty covering all pool workmanship, materials, and equipment. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

B. All standard manufacturer's warranties shall apply to all equipment and products provided by this Contractor.

2. PRODUCTS

2.01 NOT USED

3. EXECUTION

3.01 EQUIPMENT BASES AND SUPPORTS

A. Provide for major equipment, reinforced concrete housekeeping bases poured directly on structural floor slabs (or as required by equipment manufacturer) 4 inches thick minimum; unless noted otherwise on plans, extended 4 inches beyond machinery bedplates. Provide templates, anchor bolts, vibration isolators, and accessories required for mounting and anchoring equipment. Anchorage system shall be in accordance with the equipment manufacturer's specifications and local code requirements. Consult with equipment manufacturer for length and installation of anchor bolts.

3.02 CLEAN UP AND PROTECTION

A. After work of Division 13 11 has been completed, cleanup work areas and remove all equipment, excess materials, and debris. Protect pool from damage until substantial completion. Remove and replace equipment and finishes that are chipped, cracked, abraded, improperly adhered, or otherwise damaged.

B. At turnover to Owner, Contractor shall be responsible for, but not limited to, the following:
   1. Vacuuming and cleaning all pool floors, steps, and walls.
   2. Cleaning all depth marker tiles, pool tile and gutter grating.
   3. Cleaning and waxing of all pool deck equipment, water features and stainless-steel products per Manufacturer’s instructions.
   4. See also Division 01 Specification requirements.

END OF SECTION

SECTION 13 11 14

POOL START-UP, MAINTENANCE & OPERATIONS TRAINING

1. GENERAL

1.01 SECTION INCLUDES

A. Pool start-up and chemical balancing of water.

B. Training of the Owner's personnel in pool operations procedures.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 DESCRIPTION OF WORK

A. Water treatment and balancing.

B. Operations and maintenance instruction and manuals.

1.04 SUBMITTALS

A. Operations and Maintenance (O&M) Manual
   1. Pool Contractor shall deliver to the Architect/Engineer water sample location, analysis test results, SI calculation, and chemical adjustment calculations per Part 3.03.
   2. Pool Contractor shall deliver to the Architect/Engineer, bound together in a three-ring binder a complete manual, four (4) complete sets of operating and maintenance instructions for the swimming pool structure(s), finishes, and all component equipment. O&M Manual shall include, but is not limited to, the following:
      a. Table of contents.
      b. All equipment cut sheets.
      c. Accurate parts lists.
      d. Pool start-up, emptying, and winterization instructions.
      e. Pool equipment commissioning certifications.
      f. Pool and equipment operation and maintenance training certifications.
      g. Pool cleaning instructions.
      h. Pool maintenance requirements, divided into the following:
         1) Daily
         2) Weekly
         3) Monthly
         4) Seasonally
         5) Annually
      i. Narrative on the pool operation through all sequences.
      j. A DVD of complete start-up and shut-down procedures and training session.
      k. Trouble shooting information and procedures.
      l. A schematic of piping as installed.
      m. Valve charts for each piping system, consisting of isometric drawings or piping layouts showing and identifying each valve and describing its function.
      n. Copy of Measurement Certification of Permanent Racing Course
      o. Record Drawings
      p. Warranties

2. MATERIALS

2.01 NOT USED

3. EXECUTION

3.01 EQUIPMENT START-UP & COMMISSIONING

A. Provide pool equipment start-up and commissioning services. See individual pool equipment specification sections and provide services in accordance with all specification requirements. Provide Equipment Commissioning Certifications. Certifications to include date/s of commissioning activities, a summary of the commissioning work performed, signature of commissioning agent/s, and a Certification statement that equipment has been properly installed and commissioned per the manufacturer's requirements. Include copies of all equipment Commissioning Certifications in the Owner's Operation and Maintenance Manual, and as a Submittal to the Engineer/Architect.

3.02 OPERATIONS & MAINTENANCE INSTRUCTION

A. Provide an experienced swimming pool operator-instructor (NSPF Certified Pool Operator, or equivalent certification) for a period of not less than three (3) days (two (2) full days operations and start-up, and one (1) full day shut-down assistance) after the pool has been filled and initially placed into operation.
   1. During this period, the Owner's designated representative(s) shall be thoroughly instructed in all phases of pool and pool equipment operation and maintenance (O&M).
   2. At a minimum, the swimming pool training and O&M Manuals must include the following:
      a. General pool operations,
      b. Pool materials and deck equipment maintenance,
      c. Pool fill and operating water level
      d. Pool/Equipment start-up, shut-down, emptying, and winterizing procedures.
      e. Circulation pumping, pipe, fittings, valves, and ancillary equipment,
      f. Filtration equipment,
      g. Heating/cooling equipment,
      h. Chemical treatment & monitoring systems,
   3. Equipment training must be provided by the certified swimming pool operator-instructor and qualified equipment manufacturer representatives. See individual Specification sections for pool materials/equipment training and O&M requirements.

B. Contractor shall obtain written certification from the Owner's designated representative acknowledging that all O&M instructions/training and materials have been provided. Certification shall include the detailed listing of equipment above with training completion and delivery dates, instructor contact information, and Owner representative's signatures.

C. Include the cost of three (3) additional days of instruction and operational checkout/verification by an experienced swimming pool operator-instructor during the first year's operation. Written reports of each of these three (3) visits outlining the pool's operation, competence and performance of the pool's operating personnel and other pertinent comments shall be submitted to the Owner and Architect/Engineer within one week after each visit.

D. Provide a DVD documenting training and operational requirements, including start-up, emptying, and winterizing procedures.

E. In addition to initial pool instruction listed, the Pool Contractor shall perform the first season pool closing (winterizing) and the following season pool start-up, including all labor and materials required.

3.03 WATER TREATMENT AND BALANCING

A. Obtain a chemical analysis of the source/pool make-up water supply from a location as close as possible to the actual pool autofill. Conduct laboratory testing for the following parameters:
   1. Total Alkalinity [Parts per Million (ppm)]
   2. pH
   3. Calcium Hardness [ppm]
   4. Free Chlorine [ppm] & Combined Chlorine [ppm]
   5. Total Dissolved Solids (TDS) [ppm]
   6. Iron (Must test to a lower detectable limit of <=0.05 ppm)
   7. Manganese (Must test to a lower detectable limit of <=0.01 ppm)
   8. Copper (Must test to a lower detectable limit of <=0.1 ppm)

B. The following are ideal ranges for the water analysis test results. If results fall outside these ranges the Contractor shall make chemical adjustments to the water during the pool filling process until values within the ideal ranges are obtained.
   1. Total Alkalinity: 80-100 ppm (for high pH disinfectants) 100-120 ppm (for low pH disinfectants)
   2. pH: 7.4-7.6
   3. Calcium Hardness: 200-400 ppm (Pools), 150-250 ppm (Spas)
   4. Free Chlorine: 2.0-4.0 ppm & Combined Chlorine: 0.0-0.2 ppm
   5. Total Dissolved Solids: Acceptable Start-up Range is not applicable (Maintain future TDS levels to within 1200 ppm above the start-up measurement)
   6. Temperature: Ideal Range is +-2 degrees F from the desired pool operating water temperature.
   7. Iron: <=0.05 ppm
   8. Manganese: <=0.01 ppm
   9. Copper: <=0.1 ppm

C. Contractor shall calculate the Langlier Saturation Index (LSI) using values from the water analysis. The formula for LSI is shown below. Calculations may be made easier using through use of Orenda Technologies Mobil App, or a similar calculator. The LSI values shall fall within an acceptable “balanced” range of -0.3 to +0.3. If the LSI is outside this range OR test values are outside the ideal range listed above, the Pool Contractor shall prepare to add chemicals to the pool water volume as required until all parameters are within the ideal ranges previously listed, and the LSI is considered “balanced”, Contractor is responsible for calculating required chemical additions and for adding all adjustment chemicals up until the time of project completion. Owner is responsible for providing the chemicals.

LSI Equation:
(pH) + (Temperature ºF) + (Calcium Hardness) + [(Total Alkalinity) – (CYA correction factor @ current pH)] – (TDS factor) = LSI

Equivalent Factors - Langelier Saturation Index (LSI)

Temperature (°F)	Temperature Factor	Calcium Hardness (PPM)	Calcium Hardness Factor	Alkalinity (PPM)	Alkalinity Factor	Cyanuric Acid (if present)	Cyanurate Correction Factor	Total Dissolved Solids	TDS Factor
32	0.0	5	0.3	5	0.7	**pH**	**Factor**	< 1000 ppm	12.10
37	0.1	25	1.0	25	1.4	7.0	0.23	1000 ppm	12.19
46	0.2	50	1.3	50	1.7	7.2	0.27	2000 ppm	12.29
53	0.3	75	1.5	75	1.9	7.4	0.31	3000 ppm	12.35
60	0.4	100	1.6	100	2.0	7.6	0.33	4000 ppm	12.41
66	0.5	150	1.8	150	2.2	7.8	0.35		
76	0.6	200	1.9	200	2.3	8.0	0.36		
84	0.7	300	2.1	300	2.5	Note: Only use if CYA is used in your pool. Only applies to >7.0pH. If so, select correction factor based on pool pH.		Note: most calculators assume **12.1** for under 1000ppm, or **12.2** for anything over 1000.	
94	0.8	400	2.2	500	2.6				
105	0.9	800	2.5	800	2.9				

D. Contractor shall provide a submittal to the Engineer/Architect after receiving the water analysis. Submittal shall include the following:
   1. Water sample location and analysis test results,
   2. SI Calculation,
   3. Chemical adjustment calculations indicating the following:
      a. Pool Volume
      b. Chemical Parameters requiring adjustment
      c. Chemicals required to make the adjustments
      d. Calculations showing amounts of each chemical addition that is required

E. Contractor shall provide list of required balancing chemicals with quantities to the Owner for Owner purchase immediately after receiving the approved submittal from the Engineer/Architect.

F. The Owner shall be responsible for payment of water required to fill each pool one time for leak testing and a second time for the final pool start-up process. The Contractor shall be responsible for payment of any additional water and chemicals required due to draining and refilling of pools as needed for pool or pool piping repairs.

G. Contractor shall make chemical adjustments to the pool water during the pool startup process based on calculations provided in the approved submittal. It is critical to keep the pool water clean and balanced during the initial fill and while the pool plaster finish is curing. Follow all recommendations of the National Pool Plasterers Council for initial adjustments required during the plaster cure time. See additional requirements in Pool Finish Specification Section/s.

H. Stabilize pool water to within a range of 5 to 15 ppm maximum of cyanuric acid.

I. Heat pool water to within 5 degrees Fahrenheit of the desired pool operating temperature. Once this temperature is attained, the Pool Contractor shall enter the chemical controller settings for all chemical parameters. Do not enter chemical controller settings prior to reaching the desired pool operating temperature range.

END OF SECTION

SECTION 13 11 18

POOL CONCRETE

1. GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cast-in-Place Concrete to be used for pool floor and wall construction and related structures including surge/collector/balance tanks.
   2. Shotcrete alternate to pool wall construction only if Contractor's qualifications have been pre-approved by Architect/Engineer.
   3. Admixtures.
   4. Curing and Treatment Requirements.
   5. Formwork, shoring, bracing, and anchorage.
   6. Concrete reinforcement and accessories.

B. Related Sections:
   1. Applicable provisions of Division 01 – General Requirements shall govern all work under this Section

1.02 REFERENCES

A. Incorporated Guides and References:
   1. American Concrete Institute (ACI):
      a. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
      b. ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
      c. ACI 304.2R - Placing Concrete by Pumping Methods.
      d. ACI 305R - Hot Weather Concreting.
      e. ACI 309R – Guide for the Consolidation of Concrete.
      f. ACI 347 – Guide to Formwork for Concrete.
      g. ACI SP-66 – ACI Detailing Manual.
   2. Concrete Reinforcing Steel Institute (CRSI):
      a. CRSI Manual of Standard Practice
      b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars.
   3. National Electric Code (NEC):
      a. Article 680 – Swimming Pools, Fountains, and Similar Installations.

B. Specifications & Standards:
   1. American Concrete Institute (ACI):
      a. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
      b. ACI 301 - Specifications for Structural Concrete.
      c. ACI 305.1 – Specification for Hot Weather Concreting.
      d. ACI 306.1 – Standard Specification for Cold Weather Concreting.
      e. ACI 308.1 – Specification for Curing Concrete.
      f. ACI 315 - Details and Detailing of Concrete Reinforcement.
      g. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
      h. ACI 350.1 – Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
      i. ACI 506.2 – Specification for Shotcrete
   2. ASTM International (ASTM):
      a. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

b. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
c. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
d. ASTM C33 – Standard Specification for Concrete Aggregates.
e. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
f. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
g. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
h. ASTM C150 – Standard Specification for Portland Cement.
i. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
j. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
k. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
l. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
m. ASTM C321 – Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
n. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
o. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.
p. ASTM C672 – Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
q. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
r. ASTM D1037 – Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
s. ASTM D4541 – Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
t. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

3. Corps of Engineers:
   a. CRD C-527 - Corps of Engineers Specification for Polyvinylchloride Water Stop.
4. NSF International (NSF)
   a. NSF/ANSI Standard 61 – Drinking Water System Components

1.03 SUBMITTALS

A. Submit proposed mix design of each class of concrete to Engineer/Architect not later than 10 days after Notice to Proceed or twenty-one (21) days prior to the first concrete placement, whichever comes first.

B. Submit shop drawings of reinforcing steel under provisions of Division 01 – General Requirements.
   1. Initial submittal of reinforcement shop drawings shall be complete. No partial submittals will be accepted.
   2. Indicate reinforcement sizes, spacing, locations and quantities of reinforcing steel, bending and cutting schedules, splicing, supporting and spacing devices. Include additional reinforcement for opening through concrete structures.
   3. Reinforcement placement shop drawings shall conform to ACI SP-66 providing full wall elevations.

A. Material Certificates: For each of the following, signed by the manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Waterstops.
   4. Non-shrink grouts.
   5. Expansion Joint Materials.

6. Sealants.
7. Waterproof Bondcoat
8. Concrete Densifier

B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates.
   2. Concrete Testing
   3. Compaction

C. Shotcrete Nozzleman Qualifications.

D. Pool Finish Experience/Qualification Requirements.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, 305.1, and 306.1.

B. Maintain copy of ACI 301 on site.

C. Qualifications of Pool Contractor
   1. Work of this Section shall be performed by a Contractor who has a proven record of competence and experience in the construction of similar facilities of this size and complexity for not less than five (5) years. Contractors shall have an established record of reliability.

D. Qualifications of Nozzleman and Gunman
   1. Except when shotcrete is applied under a fully automated process, the quality of shotcrete depends largely on the skill of nozzleman and gunman, and the Contractor shall satisfy the Architect/Engineer that the nozzleman has had a minimum of two years' continuous experience on shotcreting of this type of work, and that the gunman has handled the gun for a period of at least six months. The nozzleman shall show proof of good quality successful shotcreting work similar to that required for this project. Experience gained on shotcrete and ditch construction will not be considered as experience for qualifying the nozzleman.

E. Concrete Testing: The following tests shall be performed during construction of the project. Refer to General Conditions and Division 01 for further requirements.
   1. Tests to measure slump, entrained air content and compressive strength shall be conducted by independent testing laboratory employed by the Contractor unless noted otherwise in front-end specifications.
      a. Provide minimum of two 6 by 12 in. cylinders or three 4 by 8 in. cylinders per 150 cubic yard or fraction thereof for each class of concrete poured each day. Comply with ACI 318 (samples secured - ASTM C172, cylinders prepared and cured - ASTM C31, and tested - ASTM C39). Identify samples moist cure at 70 degrees F for five (5) days and ship samples to laboratory.
   2. Slump and Air Content Tests
      a. Perform on concrete from same batch as sampled for strength tests and whenever there is consistency of concrete. Slump tests shall be made in accordance with ASTM C143. Air content tests shall be made in accordance with ASTM C231. If measured slump or air content falls outside specified limits, check shall be made immediately on another portion of same sample. In event of second failure, concrete shall not be used in Work.
   3. Compliance

a. Average of any three (3) consecutive strength tests for each class of concrete shall be equal to or greater than specified strength, and no individual test shall fall more than 500 psi below specified strength.
b. When tests results are below specified requirements or when tests of field cured cylinders indicate deficiencies in protection and curing, Architect/Engineer may require additional tests in accordance with ACI 318.

F. Wet Mix Process Cylinder Sample
1. Where automated wet mix equipment is used, shotcrete cylinders shall be taken from the mixer or ready-mix truck and tested in accordance with the requirements specified in this Section. Wet mix processes shall only be used with approved automated equipment.

G. Pools, surge tanks, and gutters shall have a water tightness performed per ACI 350.1. Documentation of testing and results shall be submitted for review. Refer to Water Tightness Test section of this specification.

1.05 REGULATORY REQUIREMENTS

A. Conform to requirements of local, state and federal rules and regulations applicable to Work and Project location.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Concreting
1. Placement and curing of concrete where (1) average daily temperature for three consecutive days is less than 40 degrees F, and (2) air temperature is not greater than 50 degrees F for more than one-half of a 24-hour period from midnight to midnight shall be in accordance with ACI 306.1.

B. Hot Weather Concreting
1. Placement and curing of concrete subject to a combination of (1) rising air temperature (generally greater than 75 degrees F) and (2) wind and low relative humidity shall be in accordance with ACI 305.1.
2. Contractor shall provide plan for minimizing exposure of concrete to adverse conditions due to combinations of high air temperature, direct sunlight, drying winds, and high concrete temperature.
3. Protect concrete from rapid temperature drop.
4. Pre-wet subgrade and forms.

1.07 WARRANTIES

A. Special 2-Year on Concrete Structure: The Pool Contractor shall guarantee for two (2) years repair of the concrete pool structure.

2. PRODUCTS

2.01 SUBGRADE, SUBBASE AND BACKFILL MATERIALS

A. Pool Subgrade:
1. In-situ soils meeting the Project Geotechnical Report requirements for materials and preparation.
2. Subgrade soils must meet the soil parameters for pool structural design as stated in the Pool Structural Drawings for:
a. Net allowable soil bearing capacity in pounds per square foot (PSF),
b. Stated equivalent fluid pressure in pounds per square foot per foot (PSF/FT),

c. Ground water elevation
3. Pool subgrade materials shall be free of large rocks, organic matter, and other deleterious substances.

B. Filter Fabric:
1. MIRAFI 140N: Nonwoven polypropylene geotextile barrier, 4.8 oz/yd2, by Tencate Geosynthetics.

C. Pool Subbase & Backfill Materials:
1. Existing subsoil materials shall not be used for pool subbase.
2. ASTM D 2487 Class IA Manufactured Aggregate:
a. Aggregate containing little or no fines (clear), including angular, crushed stone or rock, crushed slag, cinders, or shell.
b. Gradation: Open graded, clean: < = 10% Passing No.4 sieve, < 5% Passing No. 200 sieve.
c. Pool Subbase: ¾" to 1" nominal sized aggregate.
d. Pool backfill: ¾" nominal sized aggregate.

2.02 FORM MATERIALS

A. Plywood Forms: Douglas Fir or Spruce-Pine-Fir species: Sound, undamaged sheets with clean true edges, exterior glue, facing material to provide finish specified.

B. Lumber: Douglas Fir or Spruce species; construction grade or better; with grade stamp clearly visible.

C. Preformed Steel Wall Forms: Minimum 16 gage thick, Vertically and horizontally matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and surface appearance.

D. Tubular Column Type: Round, spirally wound laminated fiber material; inside surface treated with release agent.

E. Form Ties for Exposed Surfaces: Plastic cone snap ties with 1-inch outside diameter by 1-inch (nominal) long cones, with no metal within 1-inch of concrete face after removal;
1. Manufacturers:
a. Advance Concrete Formwork, Inc.
b. Dayton Superior.
c. Symons - A Dayton Superior Company.
d. Williams Form Engineering Corporation.
e. Substitutions: As approved by Engineer/Architect.

2.03 SHOTCRETE

A. Mix Design
1. Wet-mix design only. Dry mix, mixed at the nozzle, shall not be allowed.
2. A proven mix design shall be used for all Shotcrete applications.
3. In addition to cylinders, testing of shotcrete shall be done per ACI 506.2.

B. Rebound
1. Rebound materials shall not be reused in any form for shotcrete work and shall never be worked into the construction by the nozzleman.

2.04 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade carbon steel deformed bars; uncoated, finish.

B. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete. Supports shall have a minimum 2" concrete cover on waterside of pool concrete.

2.05 CONCRETE MATERIALS

A. Cementitious Materials
   1. Portland Cement: ASTM C150, gray color, Type I except as specified below.
   2. Fly Ash: ASTM C618, Class C.
   3. Limit cement replacement to 20%.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: ASTM C1602, clean and not detrimental to concrete.

D. Admixtures
   1. Admixtures to be used in the concrete mixture shall be submitted to the Engineer for approval as part of the mixture proportions.
   2. Admixtures containing intentionally-added chlorides, sulfides, or nitrides are not permitted.
   3. Admixtures shall be certified to NSF/ANSI 61.
   4. Air-Entraining Admixture: ASTM C260.
   5. Water Reducing Admixture: ASTM C494, Type A.
   6. Retarding Admixture: ASTM C494, Type B or Type D.
   7. Accelerating Admixture: ASTM C494, Type C or Type E.
   8. High-Range Water-Reducing Admixture: ASTM C494, Type F.
   9. Workability-Retaining Admixture: ASTM C494, Type S.
   10. Shrinkage-Reducing Admixture: ASTM C494, Type S.
   11. Crystalline Waterproofing Admixture: ASTM C494, Type S.
   12. The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations.
   13. Admixtures permitted shall be supplied by a single manufacturer for project.
   14. Approved Manufacturers:
      a. Axim Italcementi Group.
      b. Master Builders Solutions
      c. Grace Construction Products.
      d. The Euclid Chemical Company.
      e. Xypex
   15. Substitutions: As approved by Engineer/Architect.

2.06 ACCESSORIES

A. Pool Concrete PVC Waterstop
   1. Center bulb type, as shown on Drawings, extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinyl chloride (PVC). The size shall be as shown. Specific gravity shall be approximately 1.37, and the Shore durometer Type A hardness approximately 80. No reclaimed PVC shall be used in the compound. Meet the performance requirements of CRD C-572.
   2. Waterstop shall have a constant thickness from the edge of the bulb to the outside edge. All waterstops shall have a number of parallel ribs or protrusions on each side of the center of the strip. Corrugated type or tapered waterstops are not acceptable. The

minimum weight per foot for waterstop shall be 1.62 pounds for 3/8-inch by 6-inch and 2.30 pounds for 3/8-inch by 9-inch.

3. Manufacturers and suppliers who have provided samples meeting the specified geometry and who have the specified waterstop readily available are listed below. Other products shall not be used without prior review and acceptance by the Architect/Engineer.
    a. Sika Greenstreak Waterstops, P.O. Box 7139, St. Louis, Missouri 63177, phone: (314) 225-9400 or fax: (314) 225-9854. Style 717 for the 6-inch by 3/8-inch and Style 735 for the 9-inch by 3/8-inch.
    b. BoMetals, Inc., 141 Hammond Street, Carrollton, GA. Phone 770-832-2000 or fax (770-832-2095.Style RCB638NT for the 6-inch by 3/8" and style RCB938NT for the 9-inch by 3/8".
    c. Paul Murphy Plastics Company, Wirestop Waterstop, 15301 Eleven Mile Road, Roseville, Michigan, 48066, phone 800-544-2200 fax 586-774-9146. Style CR-6380 for the 6-inch x 3/8" and Style CR-9380 for the 9-inch by 3/8".

B. Pool Concrete Compressible Waterstop
1. Use as illustrated in drawing details for the following:
    a. Sealing non-moving cold joints and construction joints between structural elements against penetration of water from wet-face of structure with less than 30-foot hydrostatic head.
    b. Sealing pool piping penetrations against water penetration from wet-face of structure with less than 30-foot hydrostatic head.
2. Product Description: The product shall be a 0.59" x 0.39" compressible hydrophilic sponge rubber strip composed of vulcanized rubber and urethane polymer as the hydrophilic agent.
3. Product & Manufacturer:
    a. Adeka KBA-1510FP waterstop, manufactured by Adeka Corporation and distributed by OCM, Inc., Chicago, IL. USA.
    b. Website: www.adeka.com
    c. Physical & Swelling Property Requirements: The product shall at a minimum meet the physical properties as shown in the official Adeka literature as follows.
    d. Expansion Pressure: The product shall not produce more than 0.03MPa (4.35 psi) expansion pressure when fully hydrated.
    e. Tensile Strength: At least 0.78 MPa (113 psi),
    f. % Elongation: No greater than 350% when fully hydrated.
    g. Volume (thickness) % Change: No greater than 30% volume change or increase in thickness when fully hydrated.
    h. Alternative Products:
        1) General: Drawing documents have been completed using the specified Adeka waterstop product as a basis of design. Alternative compressible waterstops shall not be used without approval from Engineer/Architect. Considerations such as concrete coverage requirements and wall thicknesses must be considered when substituting alternative products. Contractor will be responsible for any structural changes required due to alternate product concrete coverage requirements.
        2) Product Requirements: Compressible waterstop alternatives may not contain bentonite materials and may not have swelling properties that exceed the specified product.
        3) Acceptable Alternative: An acceptable alternative may be Synko-Flex SF302 Preformed Plastic Adhesive Waterstop with Synko-Flex SF311 primer or equal, but it must be approved prior to use. Manufacturer: Henry Company, Houston, TX. Website: http://henry.com

C. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 2400 psi.

1. Upcon High Flow, the Upco Company, Cleveland, Ohio; MasterFlow 713, Master Builders Solutions, Cleveland, Ohio; Duragrout, L & M Construction Chemicals, Inc., Omaha, Nebraska.

D. Joint Materials:
   1. Waterstop: See Pool Concrete PVC Waterstop.
   2. Expansion Joint Dowel Sleeves: PVC or molded plastic sleeve with end cap/plug. Size sleeve to allow movement of dowel.
   3. Pre-molded Expansion Joint Filler: Multicellular, closed cell, flexible polyethylene plastic foam as manufactured by Dow Chemical Co., Midland, MI. Ethafoam expanded polyethylene closed-cell foam, W.R. Meadows, Elgin, IL, Ceramar or a pre-approved equal.
   4. Backer Rod Joint Backing Material: Closed cell, polyethylene, flexible, rope-like foam joint backing material. Material shall be fully compatible with polysulfide sealant and for use in swimming pools. Product shall be Kool-Rod as Manufactured by W.R. Meadows, Elgin, IL, or pre-approved equal.
   5. Gun Grade Sealant: Two-part polysulfide sealant and primer certified by Manufacturer as suitable for use in pools including submerged locations. “Deck-O-Seal Gun Grade” and “P/G” solvent based primer as manufactured by W.R. Meadows or equal. Color shall be white.

E. Adhesive Waterproof Bondcoat
   1. Provide adhesive waterproof bondcoat where indicated on drawings.
      a. Impact strength: 19 lbs / 8.6 kg
      b. Compressive strength: 7050 psi / 48.61 MPa
      c. Tensile strength: 732 psi / 5.05 MPa
      d. Flexural strength: 2380 psi / 16.41 MPa
      e. Adhesive strength (concrete): 1372 psi / 9.46 MPa
      f. Shear bond adhesion: 720 psi / 4.96 MPa
      g. ASTM C321
      h. ASTM C672
      i. ASTM D4541
      j. ASTM E96
   2. Materials
      a. Basecrete or equal.
   3. Accessories
      a. Fiberglass mesh reinforcing, 4.5 oz/sq.yd., impact resistance 75-100 in lbs. per ASTM D1037 modified.

F. Concrete Densifier
   1. Provide concrete densifier under tile pool installations and where indicated on drawings.
      a. Basecrete + or equal.

2.07 CURING AND TREATMENT MATERIALS

A. Water: Potable and clean.

B. Burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free of cuts, tears, broken or missing areas.

C. Polyethylene Film: ASTM C171, 6 mil thick, clear.

D. Curing Paper: ASTM C171;
   1. Manufacturers:
      a. Fortifiber – Orange Label Sisalkraft 280.
      b. Substitutions: As approved by Engineer.

2.08 CONCRETE MIXTURE

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture of field test data, or both, according to ACI 301.

B. Mix concrete in accordance with ASTM C94.

C. Concrete mix designs shall be designed and submitted in accordance with Division 01 and included as part of cost of this Work.

D. Mix designs shall be prepared by a qualified agency acceptable to Engineer/Architect. Electronic copies of mix designs shall be submitted for Engineer/Architect's review prior to placing any concrete.

E. Mix design shall indicate brands, types, and quantities of admixtures included, compressive strength, slump, sieve analysis for fine and coarse aggregate, quantities of all ingredients, type and brand of cement, source of aggregate, whether fine aggregate is natural or manufactured.

F. Design of mix shall assure placing and finishing characteristics that meet Project requirements.

G. Mix designs contained in the Schedule of Mixes may be modified and submitted to Engineer for approval, by use of mid or high range water reducing admixtures to control slumps required for pumping of concrete. Strength, placing and finishing requirements shall be maintained.

H. Concrete mixtures shall be designed to have low shrinkage characteristics and designed to minimize slab curling.

I. Initial and final set times of concrete mix designs shall be coordinated between the contractor and concrete supplier.

2.09 SCHEDULE OF MIXES

A. Pool Structures: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): 4500 psi.
   2. Maximum Aggregate Size: 1 inch.
   3. Maximum Slump (Inch): 3
   4. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent. Required for pool structures subject to freeze/thaw cycles.
   5. Maximum Water-Cementitious Materials Ratio: 0.45.
   6. Additional admixtures may be required as indicated on Structural Drawings.

B. Shotcrete: Proportion normal-weight concrete mix as follows:
   1. Compressive Strength (28 Days): 5000 psi.
   2. Wet-mix design only. Dry mix, mixed at the nozzle, shall not be allowed.
   3. Maximum Aggregate Size: 3/8 - inch.
   4. Air Entrainment: 6 percent air content is required with an acceptable air content of plus or minus 1.5 percent. Required for pool structures subject to freeze/thaw cycles.
   5. Additional admixtures may be required as indicated on Structural Drawings.

3. EXECUTION

3.01 SUBGRADE, SUBBASE AND BACKFILL PLACEMENT

A. Prepare pool subbase using in-situ soils in compliance with the Project Geotechnical Report placement methods and testing requirements. Materials shall be graded to proper elevations, free of large rocks, organic matter, and other deleterious substances.

B. Place geotextile barrier below entire pool and up the sides of the pool walls separating the subbase aggregates and pool backfill aggregates from the subgrade and remaining backfill or in-situ soils to prevent mitigation of fines.

C. Place pool subbase & backfill aggregate materials in 6” compacted lifts to minimize void spaces and eliminate potential future settlement. Compact materials using walk-behind plate compactors properly sized and operated to prevent damage to pool pipes.

3.02 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance per ACI 117.

C. Verify lines, levels, and measurement before proceeding with formwork.

D. Earth forms are not permitted.

E. Align form joints.

F. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.

G. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.03 REINFORCEMENT

A. Place, support, and secure reinforcement against displacement.

B. Locate reinforcing splices as shown on Drawings.

C. Place reinforcing steel in conformance with the information on the drawings and CRSI 63 and CRSI, except as modified herein. Minimum length of splices shall be as shown in table on drawings. Tie splices with 18-gauge annealed wire as specified in the referenced CRSI standard. All tie wires shall be “made tight” for electrical bonding purposes, as required by NEC, Article 680.

3.04 WATERSTOP

A. PVC Waterstop
   1. Split formwork is generally required for slab-to-slab, slab-to-wall and wall-to-wall joints where ribbed style waterstops are used. The centerline of the waterstop should be aligned with the center of the joint. The split form shall firmly hold the waterstop in position to prevent misalignment of waterstop during concrete placement. Secure waterstop with hog rings or integral wire loops prior to concrete placement. Loop tie wires through the hog ring/wire loops and tie off to adjacent reinforcing steel to prevent

displacement of the waterstop during concrete placement. Fasteners through the body of the waterstop are not permitted.

2. Lapping of the waterstop is not permitted. PVC waterstop may be butt spliced in the field with Teflon coated, thermostatically controlled splicing iron. Direct exposure to a flame is not permitted. Factory fabricated fittings are recommended for ells, tees and crosses.
    a. The following defects at splices will not be acceptable:
        1) Use of adhesives, solvents, or free lap joints
        2) Misalignment of center bulb greater than 1/16”
        3) Misalignment that reduces waterstop cross section area more than 15%.
        4) Bond failure at joint, deeper than 1/16” or 15% of material thickness.
        5) Combination misalignment and bond failure with net reduction of waterstop cross-section area greater than 15%.
        6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of ½” in 10 feet.
        7) Visible porosity in the weld joint, including pinholes
        8) Charred or burnt material
        9) Bubbles or inadequate bonding detectable with a penknife
        10) Visible signs of splice separation when cooled splices are bent at a sharp angle.
        11) Edge welding
3. Thoroughly consolidate the concrete around the waterstop to prevent voids or honeycombing next to the waterstop. Maintain adequate clearance between reinforcing steel and the waterstop. Typical clearance should be twice the maximum aggregate size. Maintain continuity of the entire waterstop system. Properly store PVC waterstops prior to installation to prevent UV degradation.

B. Compressible Waterstop – Adeka KBA-1510FP
1. Non-moving Joint Installation:
    a. Consult manufacturer and follow all recommended installation instructions.
    b. Allow concrete to cure a minimum of 24 hours.
    c. Concrete must be dry and free from form oils, release agents, curing compounds, laitance and other dirt or debris prior installation. Use a wire brush to remove contaminants prior to installation of waterstop.
    d. Use butyl tape to attach KBA-1510FP to a dry and clean substrate. The butyl tape comes in a 3/4" X 1/8" X 82-foot roll (1 roll per roll of KBA-1510FP). Press the butyl strip onto the substrate and remove the release paper. Press the KBA-15010FP firmly onto the butyl tape.
    e. Check for any gaps between the product and the substrate. If gaps are present, fill in using Adeka P-201 applied to the side of the strip. Use P-201 on corner joints and on side-by-side splice joints.
    f. Once installed, keep the product covered, clean, and dry prior to concrete placement. For best results, place the waterstop product immediately before pouring concrete. Check to make sure the waterstop is firmly adhered before placing concrete.
    g. During concrete placement, assure that the concrete is well consolidated around the waterstop at all locations with no voids or gaps.
2. Penetration Installation:
    a. Consult manufacturer and follow all recommended installation instructions.
    b. Pipe must be dry and free from form oils, release agents, curing compounds, laitance, and other dirt or debris prior to installation.
    c. Press the butyl strip onto the clean pipe completely around the pipe diameter and remove the release paper. Press the KBA-15010FP firmly onto the butyl tape. Tightly butt strip ends together with 1” overlap or side lap.
    d. Once installed, keep the product covered, clean, and dry prior to concrete placement. For best results, place the waterstop product immediately before pouring concrete. Check to make sure the waterstop is firmly adhered before placing concrete.
    e. During concrete placement assure that the concrete is well consolidated around the waterstop at all locations with no voids or gaps.

3. Alternative Products Installation:
    a. Drawing documents have been completed using the specified Adeka waterstop product as a basis of design. Alternative flexible adhesive waterstops shall not be used without approval from Engineer/Architect. See Section 2 for additional information.
    b. If Synko-Flex has been approved during the submittal process, the following installation requirements shall be met, as well as all manufacturer's installation instructions.
        1) Allow concrete to cure a minimum of 24 hours before priming with Synko-Flex primer.
        2) Concrete must be dry and free from form oils, release agents, curing compounds, laitance and other dirt or debris prior to priming. Use a wire brush to remove contaminants prior to installation of primer.
        3) Apply Synko-Flex SF311 primer.
        4) Apply Synko-Flex SF302 Preformed Plastic Adhesive Waterstop over primed areas. Place Synko-Flex to primed areas at an approximately 5/8" thickness and approximately 1 ½" width.
        5) Tightly butt strips together with 1" overlap or side lap.

3.05 PLACING CONCRETE

A. Notify Engineer/Architect a minimum of 48 hours prior to commencement of concreting operations.

B. Failure to notify Engineer/Architect may result in rejection of concrete placed without observation.

C. Place concrete in accordance with ACI 301.

D. Place pumped concrete in accordance with ACI 304.2R. Line coating mix to initiate pumping shall not be used in pour but shall be wasted.

E. Ensure reinforcement and embedded items are not disturbed during concrete placement.

F. Concrete with excessive honeycomb or embedded debris shall be rejected and replaced at no cost to OWNER.

G. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.

H. Placing During Hot Weather:
    1. Place concrete during hot weather conditions in accordance with ACI 305.1.

I. Placing During Cold Weather:
    1. Place concrete during cold weather conditions in accordance with ACI 306.1.

J. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.06 POOL WALL SHOTCRETE

A. Wet Mix Process
    1. The delivery equipment shall be of an approved design and size that has given satisfactory results in similar previous work.

2. The equipment must be capable of discharging mixed material into the hose under close control, and it must be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.
3. The nozzle shall be of a design and size that will ensure a smooth and uninterrupted flow of materials.
4. Delivery equipment shall be thoroughly cleaned at the end of each shift.

B. Surface Preparation
1. Verify forms are true to line and dimensions, adequately braced against vibration, and constructed to permit escape of air and rebound during gunning operations.
2. Do not place shotcrete on any surface which is frozen, spongy, or where there is free standing water.

C. Alignment Control
1. Provide alignment wires to establish thickness and plane surface.
2. Install alignment wires at corners and offsets not established by form work.
3. Verify alignment wires are tight, true to line, and placed to allow further tightening.

D. Application
1. Ensure correct placement of reinforcement. Ensure sufficient clearance around reinforcement to permit complete encasement.
2. Allow easy access to shotcrete surfaces for screeding and finishing, permitting uninterrupted application.
3. Determine operating procedures for placement in close quarters, extended distances, or around unusual obstructions where placement velocities and mix consistency must be adjusted.
4. In shotcreting walls, begin application at bottom. Ensure work does not sag.
5. Hold nozzle as perpendicular to surface as work will permit, to secure maximum compaction with minimum rebound.
6. Follow routine that will fill and completely encase reinforcement, using maximum layer thickness.
7. Build up layers by making several passes of nozzle over work area. Completely encase reinforcement with first layer.
8. After initial set, remove excess material outside of forms and alignment lines.
9. Allow each layer of shotcrete to take initial set before applying succeeding layers.
10. Remove laitance that has taken final set, by sandblasting. Clean with air-water jet.
11. Sound work with hammer for voids. Cut out voids and replace with succeeding layers.
12. Keep rebound, and other loose or porous material out of new construction.
13. Remove rebound that does not fall clear to work. Discard salvaged rebound.
14. Remove trapped rebound at construction and expansion joints.

E. Protection of adjacent surfaces
1. Contractor shall take every possible precaution to protect adjacent concrete surfaces, equipment, etc., from being damaged by overshooting concrete. Overshot concrete and rebound materials deposited shall be removed at the Contractor's expense.

3.07 EXPANSION & CONTROL JOINTS

A. All control and expansion joints require PVC waterstop.

B. Installation of Joint Filler: At locations where joint sealant is to be applied, the pre-molded joint filler shall be installed in the joint accurately as detailed. Precut the pre-molded expansion joint filler to the required depth. Filler material shall be of sufficient width to completely fill the joint and shall be accurately cut to butt tightly against the waterstop and the side forms. Attach filler material to concrete with a bonding agent. Bonding agent shall be approved in writing by the joint sealant and joint filler manufacturer for compatibility.

C. Concrete shall be thoroughly vibrated along the joint form to produce a dense, smooth surface. Surface irregularities along the joint sealant cavity, due to improper concrete consolidation or faulty form removal, shall be repaired with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.

D. All expansion and control joints require gun grade sealant. Cavities for joint sealant shall be formed with precut or pre-molded joint filler that can be removed as needed for sealant. Circular backer rod shall be used in joints as detailed to provide accurate shape for sealant.

3.08 CONSTRUCTION JOINTS

A. Construction joints shall be located as required for the contractor's scheduling, means and methods.

B. All construction joints require waterstop.

C. Contractor shall provide a submittal showing construction joint locations and detailing for review and approval.

3.09 ADHESIVE WATERPROOF BONDCOAT PLACEMENT

A. Clean and prepare surfaces and apply all products in accordance with manufacturer's recommendations.

B. Pool Renovations: Apply concrete densifier to all pool concrete surfaces receiving a tile finish and where indicated on drawings.

C. Apply adhesive waterproof bondcoat beneath gutter grating on the exposed sides and bottom of all concrete gutter trenches, and where indicated on drawings. Apply material in two coats (one horizontal and one vertical). Each layer shall be 1/16 inch in thickness.

D. Pool Renovations: Provide fiberglass mesh to bridge over cold joints and cracks in accordance with product manufacturer's recommendations.

E. Do not apply materials to frozen substrates or when temperatures are below 40 or above 105 degrees Fahrenheit.

3.10 CURING AND TREATMENT

A. Curing shall begin promptly to prevent drying of concrete. Curing shall continue for seven (7) days after placing.

B. Provide a moist cure for a full seven (7) days in accordance with ACI 308.1. Keep concrete slabs and walls continuously wet for a 7-day period. Intermittent wetting is not acceptable. Material shall completely cover the concrete surface and shall be weighted down to prevent shifting due to wind or other factors.

3.11 REPAIR OF VERTICAL SURFACE DEFECTS

A. Upon stripping of forms, vertical surfaces shall be inspected for defects caused by surface air voids, honeycombing, form tie holes, peeling, and fins.

B. Surface air voids shall be repaired with a unit packaged mixture of sand and cement mixed on job site with water and a unit of acrylic. Mixture shall be brushed uniformly on to surface

and into voids. Where surface is to be exposed, surface finish of repair shall match adjacent surface.

C. Honeycombed and other defective concrete shall be removed down to sound concrete and patched to match adjacent surfaces. Cut edges perpendicular to surface at least 1 inch deep – no feathered edges allowed.
   1. Areas not subject to water shall be repaired similar to surface air voids as indicated above. A bonding agent shall be used prior to filling the holes. Patches shall be kept moist for a minimum of 7 days.
   2. Areas subject to water shall be moist for a period of 24 hours prior to patching. Holes shall be filled with non-shrink grout and cured per recommendations by manufacturer. Concrete surface shall be prepared per recommendations by manufacturer.

D. Form tie holes shall be filled with non-shrink grout. Surface of concrete to prepared per recommendations by manufacturer. Grout shall be cured per recommendations by manufacturer.

3.12 FINISHING

A. Floor slabs shall not vary from level or true plane more than ¼ inch in 10 feet when measured with a straightedge. Floor slabs shall receive a broom finish to accommodate special aggregate mechanical bonding requirements.

B. After removal of forms and repair of defects, surfaces of concrete shall be given finishes specified below.

C. Rough Form Finish: Surface left with texture imparted by forms; form facing material not specified; tie holes and defects shall be patched; all fins shall be chipped or rubbed off. The surface shall be finished in such a way that will leave the surface for the substrate rough, coarse, and porous enough to ensure that subsequent application of the cementitious surface coating can achieve a good mechanical bond to the substrate similar to a broom finish.

D. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of formed surface.

E. Final finish on formed surfaces shall continue uniformly across unformed surfaces.

3.13 WATER TIGHTNESS TEST

A. General
   1. This test applies to the pool, the surge tank, and the gutter system. A water tightness test shall be completed on each pool, surge tank and gutter system, independently of each other, prior to the application of the pool finish.
   2. The cost of the water shall be allocated as outlined in Specifications Section 13 11 14, Part 3, 3.02, F.
   3. Contractor shall include and itemize these requirements in the overall construction schedule.
   4. The Owner may elect to waive leak test requirements if schedule becomes a critical factor. Only the Owner may waive these requirements. If the Owner elects to waive these requirements the Contractor is still responsible for providing leak-free structures, and at a minimum, all specified applicable warranties shall apply.

B. Water Tightness Test Procedure
   1. Preparation

a. Visually examine the concrete structure and joints for potential leakage prior to fill. Contractor shall repair areas of potential leakage prior to fill.
b. Allow the concrete structure to cure a minimum of 28 days, or as required to gain sufficient strength to withstand the test load, prior to initiating test.
c. Securely seal all inlets/outlets and penetrations prior to fill.
d. The test shall not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.

2. Fill
   a. Fill the pool with potable water from an approved water source, and then isolate the pool, the surge tank, and the gutter system. The water tightness test and measurement documentation shall begin after the test structure has been filled for a minimum of three (3) days to allow the concrete to absorb water and minimize absorption effects during the testing period.
   b. Fill each structure to the design maximum liquid level or 4 inches below any fixed overflow level.
   c. After the initial fill, remove ground water to a level below the bottom of the structure main drain or floor slab (below lowest concrete plane) utilizing the pool observation tube, the pool de-watering system, or the construction dewatering system. This shall be completed prior to the start of the water tightness test and maintained for the duration of the test.
   d. For elevated pools with secondary containment structure, the secondary containment structure shall be monitored for the presence of water for the duration of the test. Groundwater elevation is not a factor in these pools.
3. Evaporation/Precipitation Measurement Procedure
   a. Partially fill a floating, restrained, calibrated (known volume and surface area), open container (hereafter “container” or “control container”) with water and allow this container to float within the filled structure during the testing period. This will be used to measure total evaporation and precipitation.
   b. Mark and measure the change in container’s water level. If the container water level has gone down (evaporation), this change shall be subtracted from each structure’s water loss measurement. If the container water level has risen (rain), this change shall be added to each structure’s water loss measurement.
4. Measurement
   a. Conduct all measurements with the Architect or Owner’s representative present and document all measurements on the table below.
   b. Provide an as-built drawing or sketch the pool, surge tank, and gutter identifying measurement locations and the evaporation control container’s location.
   c. The water surface elevation shall be recorded to within 1/16 of an inch, measured from a fixed point on the structure above the water surface.
   d. Average multiple sample locations for structures exposed to wind.
   e. Repeat and record the measurements for a total of three (3) consecutive days.

Measurement Times	Pool Measurements	Gutter System Measurements	Surge Tank Measurements	Control Container Measurements
12 Hrs.				
24 Hrs.				
36 Hrs.				
48 Hrs.				
60 Hrs.				
72 Hrs.				

5. Water Leakage
   a. Calculate water leakage as follows:

Leakage [Gallons] = [7.481 x Structure Surface Area (SF)] x
[Structure Loss Measurement* (FT) – Control Container Measurement (FT)].

- Structure loss measurement is a generic term referring to Pool Measurement, Gutter System Measurement or Surge Tank Measurement independently. Calculate the leakage from the pool, gutter, and surge tank independently.

b. Add the measurements for two consecutive 12-hour periods to obtain the total daily loss due to leakage.
c. Record Daily losses due to leakage for Day #1, #2, and #3 in the table below.

Total Daily Loss Due To Leakage	Pool Leakage	Gutter Leakage	Surge Tank Leakage
Day 1			
Day 2			
Day 3			

6. Submittal
   a. Provide test location as-built/sketch, measurement tables, and Water Leakage calculations to Engineer in the form of a submittal for review and records.
7. Allowable Loss from Leakage
   a. The allowable leakage rate for an unlined, open concrete structure (i.e. backfilled pool, gutter, and surge tank) shall not exceed 0.1 percent of the total water volume in a 24-hour period. (Example: 0.001 x 200,000-gallon pool = 200 gallons per 24-hour period.)
   b. Elevated pools and gutters with a secondary containment vessel shall have no measurable loss; the drop in the water surface shall not exceed 1/8” over the three-day test period when adjusted for evaporation and precipitation.
8. Repair and Retest
   a. If the leakage volume calculated exceeds the “allowable loss” in section 7, Contractor shall locate and identify leakage points, repair the structure and provide documentation on the location of repaired areas.
   b. After proper curing of all repair work, re-test the water tightness of structure following the procedure specified in this section.

END OF SECTION

SECTION 13 11 20

POOL PIPE AND PIPE FITTINGS

1. GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, connections, wall penetrations.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES/PIPE – FITTING REQUIREMENTS

A. The following latest edition reference specifications, guides, and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. ANSI/ASTM D2564 - Solvent Cements and ASTM F656 – Primers for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
   2. ASTM D2855 – Practice for Making Solvent Cemented Joints with PVC Pipe and Fittings
   3. ANSI/ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Schedules 40, 80 and 120, NSF Seal for Potable Water
   4. ASTM D1784 - Standard Specification For Rigid Poly(Vinyl Chloride) (PVC) Compounds And Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
   5. ASTM F439 - Standard Specification For Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedules 80
   6. ASTM F441 - Standard Specification For Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
   7. ASTM F493 - Standard Specification For Solvent Cements For Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe And Fittings
   8. ASTM D2466 – PVC Plastic Pipe Fittings, Schedule 40, Injection Molded, Sizes Through 12”, NSF Listed. As manufactured by Spears Manufacturing Company, “or approved equal”.
   9. ASTM D2467 – Socket Type PVC Plastic Pipe Fittings, Schedule 80, Injection Molded, Sizes through 12”, NSF Listed. As manufactured by Spears Manufacturing Company, “or approved equal”.
   10. ASTM D2855 - Standard Practice For The Two-Step (Primer And Solvent Cement) Method Of Joining Poly (Vinyl Chloride) (PVC) Or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe And Piping Components With Tapered Sockets
   11. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   12. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   13. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (Modified Proctor Maximum Dry Density)
   14. ASTM F679 – PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings, Bell Gasketed Joints, Sizes 18” Through 36”. As manufactured by J-M Manufacturing Co., Inc. “Perma-Loc”, “or approved equal”.
   15. ASTM B88 – Seamless Copper Water Tube
   16. Eslon Engineering Manual for Plastic Piping Systems

17. ASTM D2563 – Fabricated, Fiberglass Wrapped PVC Pipe Fittings 14", and above, Schedule 40 or 80 manufactured from PVC pipe conforming to ASTM D1785 and compliant to the most recent publication of the "Spears General Specification for Standard Fabricated Fittings (FAB-7-702)". Butt-fusion welded fabricated fittings are not acceptable. All fittings shall be certified for potable water service by NSF. As manufactured by Spears Manufacturing Company or "approved equal"
18. CLASS 150 – All plastic pipe flanges shall be Class 150 and of the same schedule as the associated pipe with neoprene gaskets where required.

1.04 QUALITY ASSURANCE

A. Qualifications of Pool Contractor
   1. Work of this Section shall be performed by a Contractor who has a proven record of competence and experience in the construction of similar facilities of this size and complexity for not less than 5 years. Contractors shall have an established record of reliability.

B. The following tests shall be performed during construction of the project. Refer to General Conditions and Division 01 for further requirements.
   1. Testing and Flushing of Piping
      a. Contractor shall be responsible for discovering leaks and making necessary repairs.
         1) Pressure piping and suction piping: After the piece is laid, the joints completed and the trench partially backfilled, leaving joints exposed for examination, subject new lines to a hydrostatic pressure of not less than 50 pounds per square inch. Joints shall remain watertight under this pressure for a period of two (2) hours. All air must be expelled from pipes prior to testing.
         2) Gravity lines: A water test shall be applied to all gravity drain piping systems, either in their entirety or in sections. All openings shall be tightly plugged and each system filled with water and tested with at least a 10 foot head of water (4.3 psi). The water shall be kept in the system, or in the portion under test, for at least fifteen (15) minutes before the inspection starts. System shall be watertight at all joints.
         3) Leaks shall be repaired and tested repeatedly until leakage or infiltration is approved.
      b. Provide test results to the Architect/Engineer before covering with concrete.

1.05 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Product Data: For each type of manufactured material and product indicated.

C. Provide Shop Drawings showing all pipe penetration locations through concrete pump pit walls and concrete surge tank walls. Include dimensioned location of pipe penetrations in plan and elevation view, pipe sizes, sleeve sizes, link-seal sizes, and sleeve and link-seal material/product information.

D. Provide a submittal including system drain valves and location of drain valves for Owner's use during pool shutdown and/or pool winterizing.

1.06 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

2. PRODUCTS

2.01 PIPE BEDDING & BACKFILL MATERIALS

A. Pipe Trench Foundation/Subbase: In-situ soils meeting the Project Geotechnical Report requirements for preparation. Trench base materials shall be free of large rocks, organic matter, and other deleterious substances.

B. Pipe Trench Embedment Zone (bedding, haunching, initial backfill):
   1. Existing subsoil materials shall not be used for pipe bedding.
   2. Condition 1: ASTM D 2487 Class IA Aggregate.
      a. Manufactured aggregates containing little or no fines including angular, crushed stone or rock, crushed slag, cinders, or shell.
      b. Open graded, clean: < = 10% Passing No.4 sieve, < 5% Passing No. 200 sieve
      c. Maximum pipe diameters >=6": Maximum aggregate size <= 1.5".
      d. Maximum pipe diameters <6": Maximum aggregate size 3/4".
      e. Where conditions may cause migration of fines into the trench from adjacent soil (and loss of pipe support) apply Condition 2 and use Class 1B Aggregate. Alternatively, include the addition of a filter fabric between the trench and Class 1A aggregate to prevent migration of fines into the embedment zone.
   3. Condition 2: ASTM D 2487 Class IB Aggregate.
      a. Use where conditions may cause migration of fines from adjacent soil and loss of pipe support. Process materials as required to obtain gradation which will minimize migration of adjacent materials.
      b. Manufactured processed aggregates; angular, crushed stone (or other Class IA materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils.
      c. Dense graded, clean: < = 50% Passing No.4 sieve, < 5% Passing No. 200 sieve
      d. Maximum pipe diameters >=6": Maximum aggregate size <= 1.5".
      e. Maximum pipe diameters <6": Maximum aggregate size 3/4".

C. Final Pipe Trench Backfill: Use on-site existing soils meeting the Project Geotechnical Report requirements for backfill materials. Final trench backfill may not include organic material, clay, topsoil, or other deleterious substances. The source and suitability of all proposed off-site fill shall be confirmed by the Project Geotechnical Engineer prior to bringing material on site.

2.02 PVC & CPVC PIPE & FITTINGS

A. Refer to Section 1.03 for applicable standards/requirements.

B. Refer to pipe schedule(s) on drawings for size and type.

C. PVC Pipe: All PVC Schedule 40 and schedule 80 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 consistently meeting and/or exceeding the quality assurance test requirements of these standards. The pipe shall be provided with plain ends in 20-foot cut lengths. All PVC pipe shall be certified by NSF International for potable water applications and marked accordingly.

D. PVC Sch40 Fittings: All PVC Schedule 40 white fittings shall be manufactured from PVC Type I cell classification 12454. All fittings of 12" diameter or less shall conform to ASTM D1784 for injection molded PVC Schedule 40 white fittings. All fittings greater than 12" diameter may be either injection molded or fabricated fittings produced in accordance with "Spears General Specification for Standard Fabricated Fittings (FAB-7-702)". All fittings shall be certified for potable water service by NSF International and manufactured in strict compliance to ASTM D2466.

E. PVC Sch80 Fittings: All PVC Schedule 80 fittings shall be manufactured from PVC Type I, cell classification 12454. All fittings of 12” diameter or less shall conform to ASTM Standard D1784 for injection molded PVC Schedule 80 fittings. All fittings greater than 12” diameter may be either injection molded or fabricated fittings produced in accordance with “Spears General Specification for Standard Fabricated Fittings (FAB-7-702)”. All fittings shall be Certified for potable water service by NSF International manufactured in strict compliance to ASTM D 2467.

F. CPVC Pipe: All CPVC Schedule 80 pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the quality assurance test requirements of this standard. All pipe shall be provided with plain ends in 20 foot cut lengths. CPVC Pipe shall be certified by NSF International for potable water applications and marked accordingly.

G. CPVC Fittings: All CPVC Schedule 80 fittings shall be produced from CPVC materials, cell classification 23447 conforming to ASTM Standard D1784 for injection-molded fittings through 12”, and shall be manufactured in compliance to ASTM F439 and Certified by NSF International for use with potable water service. All 14” through 24” fabricated CPVC fittings shall be produced in accordance with “Spears General Specification for Standard Fabricated Fittings (FAB-7-702)”.

H. PVC Flanges: All PVC & CPVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

I. Manufacturer:

1. As manufactured by Spears Manufacturing Company, “or approved equal”.

2.03 THREAD TAPE

A. Teflon 2

2.04 PVC SOLVENT CEMENT

A. Joining method for PVC pipe and fittings shall be solvent cement welding. All PVC solvent cement shall be suitable for all class and pipe schedules that are to be utilized.

B. PVC solvent cement shall conform to ASTM D2564, shall have DWV, SW and U.P. Code listings and be certified by NSF International for potable water use.

C. PVC solvent cement shall conform to Low VOC emission requirements in accordance with SCAQMD Rule 1168/316A. PVC cement shall be certified by Underwriters Laboratories (UL) to UL 2818 GREENGUARD GOLD for low chemical emissions.

D. All PVC solvent cement shall be provided in a clear or gray color and have a three (3) year shelf life.

2.05 CPVC SOLVENT CEMENT

A. Joining method for CPVC pipe and fittings shall be solvent cement welding. All CPVC solvent cement shall be suitable for all class and pipe schedules that are to be utilized.

B. CPVC Solvent cement shall be manufactured in accordance with ASTM F493 and certified by NSF International for potable water applications.

2.06 WALL SLEEVES

A. Pipes penetrating all watertight walls shall use "Century Line" thermoplastic wall sleeves in combination with “Link Seals” having stainless steel service designation. As manufactured by Thunderline Corporation, or the Metraflex Company, “or approved equal”.

2.07 NON-SHRINK GROUT

A. Upcon High Flow, The Upco Company, Cleveland, Ohio; Masterflow 713, The Master Builder Company, Cleveland, Ohio; Duragrout, L & M Construction Chemicals, Inc., Omaha, Nebraska.

2.08 PIPE SIGNAGE

A. Brady, B-946, custom legend, self-sticking markers, and arrows or equal.

3. EXECUTION

3.01 PIPE INSTALLATION

A. Pool Pipe Trench Excavation
   1. General:
      a. Excavation for all pool systems and related piping shall comply with the following:
         1) Division 31 Earthwork Specifications for buried utilities.
         2) Project Geotechnical Report requirements for pipe trench preparation, backfilling, and engineered fill.
         3) Current OSHA criteria and regulations.
      b. See pool pipe plans for additional piping details, notes/requirements, pipe routing, material types and sizes.
   2. Pipe Trench Requirements: Excavate pool piping trenches to proper depths for pool operations, required pipe slopes, and a minimum final cover plus backfill depth of 36-inches. Trench widths shall be minimized as indicated in the Pool Drawings “Typical Pool Pipe Trench Detail” and as required for proper compaction. Maintain a clear trench width of 6 to 12-inches beyond the nearest pipe wall. Maintain a minimum of 6-inches between each adjacent pipe. Protect the soils adjacent to the trench to maintain an undisturbed condition for optimal pipe support.
   3. Pipe Trench Foundation/Subbase: The trench bottom shall be smooth and free from large dirt clods, frozen material, and stones greater than 1.5-inches in diameter. A subbase is necessary only when native subgrade soils are unstable. For such conditions, over excavate the subgrade soils and place a layer of supportive engineered fill material as the trench subbase. Compact subbase materials to provide a firm foundation for the subsequent pipe embedment materials. Match the compaction effort specified in the Final Backfill layer of the pipe trench.

B. Pool Pipe Bedding & Backfill
   1. Embedment Zone: Controlled placement of pipe trench materials is required in the embedment zone for pipe performance and to minimize deflection. Schedule inspections prior to the backfilling as needed, however backfilling the embedment zone should follow pipe assembly as closely as possible to protect the pipe from falling debris, minimize the possibility of flooding an open trench and avoiding shifting pipe. See Part 2 PRODUCTS for material specifications and assure selected embedment zone materials are free from dirt clods, clay, frozen materials, and rocks greater than 1.5-inches in diameter. Place materials in six-inch lifts in the following three subzones:
      a. Bedding: Place six inches of supportive, compacted bedding materials beneath the pool piping to provide uniform longitudinal support under the pipe, prevent low spots,

and to set piping to the proper grade. Do not use blocking of any type to bring the pipe to grade. If the native trench soil is comprised of fine grain soils and migration of those soils into the bedding material is anticipated, a well-graded bedding material without voids or a fabric barrier should be used to avoid compromising the trench backfill materials. Consult the Geotechnical Report for specific recommendations.

b. Haunching: Haunching is required from the bottom of the pipe to the centerline of the pipe ("springline"). To provide resistance to pipe deflection compaction of the haunching zone is required prior to placement and compaction of the initial and final backfill. Place the haunching materials by hand to give effective support of the pipe Compact materials using shovel slicing and/or firmly tamping the materials under the pipe haunches, around the pipe, up to the spring-line of the pipe and out to the trench walls. If automatic tampers are used, avoid contacting and damaging the pipe. Control haunching to avoid vertical and horizontal displacement of the pipe from proper alignment.

c. Initial Backfill: The initial backfill extends from the pipe springline to a point above the top of the pipe. Place the initial backfill in 6-inch maximum loose lifts to a 12-inch minimum depth of cover above the pipe. Using small handheld or walk behind vibratory plate tampers, compact the initial backfill zone to a level no higher than ¾ of the pipe diameter, taking care not to contact the pipe/s. Do not compact the initial backfill layer directly above the pipe.

2. Final Backfill: This zone extends from the top of the initial backfill to the top of the trench and up to final grade. Adjust final grades as required to allow for landscaping, flatwork, or roadwork materials if applicable. Place materials for this zone using materials and compaction efforts in accordance with the Geotechnical Report and/or Division 31 Specification requirements. If those requirements are not provided, place materials in accordance with the following:
   a. +- 2% of the optimum moisture content
   b. 12-inch maximum lifts, as measured in loose thickness.
   c. Uniformly compact each lift to a minimum of 95 percent of the material's ASTM D-1557 Modified Proctor Maximum Dry Density, prior to placement of subsequent lifts.
   d. Place each subsequent lift and compact in a similar manner until achieving proposed finished grades.
   e. Final cover plus backfill materials shall measure a minimum of 36-inches above the top of the pipe/s unless noted otherwise on the plans or details.

C. Piping Placement and Use
1. Base Bid shall be on pipe materials shown. See the PL Drawings and associated schedules for required pipe material types.
2. All material transitions shall be above-grade, flange to flange connections and include ribbed EPDM type rubber gaskets. Below-grade materials transitions will not be allowed.
3. Piping must be laid on a grade so it will drain completely by gravity. In all instances where gravity drainage is not provided, the contractor shall install drain valves so that all lines can be drained completely. Shop drawings will be required on any such installation.
4. No installation shall be made that will provide a cross connection or inter-connection between distribution supply for drinking purposes and the swimming pool that will permit a backflow of water into the potable water supply.
5. Inspect pipe for defects before installation. Clean the interior of pipe thoroughly of foreign matter and keep clean during laying operation. Pipe shall not be laid in water or when trench conditions are unstable. Water shall be kept out of the trench until the pipe is installed. When Work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings.
6. All gutter lines shall drain by gravity to the surge tank.
7. All above grade outdoor piping shall be painted, in accordance with the manufacturer's recommendations, to protect against ultraviolet degradation.

D. PVC/CPVC PIPE AND FITTINGS INSTALLATION

1. General: All PVC pipe connections shall be flanged or solvent welded. PVC welding is not allowed without prior approval of the Architect/Engineer. Refer to ASTM D 2855, Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings for the basic techniques and requirements for making solvent cement pipe joints. Make adjustments as required to the methods and tools used according to size of piping. Consistent, quality joints in PVC and CPVC piping products requires the following:
    a. The joining surfaces of pipe and fitting must be softened and made semi-fluid.
    b. Sufficient cement must be applied to fill the gap between pipe and fitting.
    c. Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.
2. Cutting the Pipe: Cut all pipe to a square face using mechanical cutting tools designed for plastic pipe. To ensure that the pipe is cut square, use a miter box when cutting with a saw. Do not damage pipe during cutting process. If damage or cracking is evident, cut off at least 2" of the pipe beyond any visible crack.
3. Deburring & Beveling: Remove all burrs and filings from the outside and the inside of the pipe using a suitable deburring/chamfering tool. Chamfer the outside end of the pipe to ease entry of the tube into the socket and minimize the chance of cement being wiped off the fitting.
4. Threaded joints: Threaded joints may be required to some equipment or special fittings. When required, after cutting and before threading, the pipe shall be reamed and shall have burrs removed. Screw joints shall be made with graphite or inert filler and oil or with an approved graphite compound applied to male threads only. Threads shall be full-cut and not more than 3 threads on the pipe remained exposed. Use Teflon II tape on the male threads of all threaded pipe joints. Caulking of threaded joints to stop or prevent leaks will not be permitted. Unions shall be provided where required for disconnection of exposed piping. Unions will be permitted only where access is provided.
5. Solvent Cementing Assembly: Solvent welding shall be made in accordance with the manufacturer's printed instructions and the following minimum standards:

    a. All fittings shall fit easily on the pipe before applying cement. The outer surface area of pipe and inner wall of fitting shall be dry and clean. Cleaner is to be applied to the outer surface of the pipe and to the inner surface of the fitting. Cement is to be applied to the outer surface of the pipe, or on the male section of fittings only. When the outside surface area of the pipe is satisfactorily covered with cement allow ten (10) seconds open time to lapse before inserting pipe end into fittings. After full insertion of pipe into fitting, turn fitting about the pipe end approximately 1/8 to 1/4 of a turn. Wipe off excess cement at the joint in a neat cove bead. Follow manufacturer's instructions on solvents. Remove all debris, including, containers, brushes, applicators and other items from premises, dispose of properly. Burying of debris on site is not permitted.
    b. In addition to the requirements outlined above, the solvent weld process for pipe sizes of 6” diameter and larger includes additional requirements outlined below. As pipe diameter increases, so does the difficulty in installing it. Follow all of the solvent weld manufacturer’s recommendations for larger diameter pipe.
        1) The installer shall use proper size applicators to ensure enough cement is applied to fill the larger gap that exists between the pipe and fittings.
        2) Use the applicable cement for the size of pipe and fittings being installed.
        3) Provide adequate crew size to properly handle and fit pipe installations.
        4) It is important in large diameter joining that the primer and cement be applied simultaneously to the pipe and fittings. Apply a second, full layer of cement to the pipe. Pipe must be bottomed into the fitting.
        5) Large diameter pipe and fittings require longer set and cure times. Prefabricate as many joints as possible. If pipe is to be buried, fabricate as many joints as possible above ground, after joints have cured, carefully lower into trench.

c. Follow manufacturer's recommendations for specific product/application set time and cure time requirements. All joints shall remain completely undisturbed for a minimum of 10 minutes from time of jointing the pipe and fitting. If necessary, to apply pressure to a newly made joint, limit to 10% of rated pipe pressure, during the first 24 hours after the joint has been made.
d. Make provisions for expansion and contraction by way of swing joints or snaking.
e. Protect plastic pipe from exposure to aromatic hydrocarbons, halogenated hydrocarbons, and most of esters and keytones that attack the material. Protect all pipe from mechanical damage and long exposure to sunlight during storage.

E. Field Coordination
1. It is the Contractor's responsibility to provide piping by means that account for all necessary coordination, including, but not limited to: water stops, oversize sleeves, pipe supports, valves and other attachments, over-excavations required for fusion machinery or other equipment, etc.
2. Provide pipe extensions and temporary caps necessary for pressure testing requirements.
3. Contractor is required to provide coordination and adequate protection as needed to all external services (i.e., ducts, pipes, cables) that run throughout the project site. Plumbing shall be located and placed to prevent damage during and after construction from traffic loads above.

F. Overhead piping in mechanical room/pool room shall be run such that a minimum head clearance of 7'-0" is observed to all piping, pipe fittings and pipe hangers/supports. Piping runs shall not create path obstruction or a tripping hazard.

G. Pipe Identification
1. Provide identification on all piping located in mechanical equipment, chlorine, acid rooms, heater courts, etc.
2. All piping in Mechanical Room to be labeled with description of line and arrows indicating direction of flow.
3. Mark at least once on each line and at 5 ft. intervals minimum. Consult Health Department Code for minimum marking requirements.
4. Color code per Health Department requirements. If code does not identify color coding requirements consult Architect/Engineer.

3.02 SLEEVES AND WALL PENETRATIONS

A. Patch exterior side of wall penetrations with non-shrink grout. Other methods of water tightness shall be pre-approved by the Architect/Engineer.

END OF SECTION

SECTION 13 11 23

POOL PIPE SUPPORTS

1. GENERAL

1.01 SECTION INCLUDES

A. Pipe Hangers & Supports.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Product data including manufacturer's specifications, installation instructions.

C. Shop Drawings showing type and locations.

1.04 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.05 DELIVERY, STORAGE AND HANDLING

A. Refer to General Requirements and Division 01.

2. PRODUCTS

2.01 MATERIALS

A. Hangers and Supports
   1. General
      a. All hangers, pipe supports, threaded rod, hardware, etc. shall be hot-dipped galvanized steel, ASTM A123, or type 304 stainless steel or better grade.
      b. All piping connections and support hardware inside surge tanks and gutters shall be stainless steel.
   2. Strut
      a. Minimum height 1 5/8", minimum width 1 5/8", minimum thickness 12-gauge material.
      b. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
   3. Strut Clamps
      a. Pipe sizes ½" thru 12", two-piece clamps with clamping bolt and nut. Pipe sizes 14" and larger, provide "U" bolts, nuts and washers.
      b. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
   4. Strut Accessories
      a. Flat plate fittings, corner braces, post bases, etc. Finish shall be hot-dipped galvanized steel, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.

5. Wedge Anchors
    a. One-piece assembly, 3/8” minimum body diameter.
    b. Grade 2, hot-dipped galvanized steel anchors and clips, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
6. Beam Clamps
    a. Steel “C” clamp type with locknut.
    b. Finish shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
7. Support Components
    a. All threaded rod, threaded rod couplings, nuts, washers, etc. Finish shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
8. Exposed/cut Ends: All galvanized channel supports or other metallic pipe support hardware that is cut shall be field treated to cold galvanize over all exposed/compromised areas with a 95% zinc rich paint to a 1.0 to 3.0 mil thickness.

B. Locations
1. In the Pool/Waterpark/Natatorium Room: All piping supports, connections and support hardware shall be type 304 stainless steel or better grade, ASTM A240.
2. Inside Surge/Collector Tanks & Gutters: All piping supports, connections and support hardware shall be type 304 stainless steel or better grade, ASTM A240.
3. In the Pool Mechanical Room: All piping supports, connections and support hardware shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.
4. Pump Support Pads: All pump equipment pad support channels and anchor hardware shall be type 304 stainless steel or better grade, ASTM A240.
5. Pool Chemical Rooms: All piping supports, connections and support hardware shall be fiberglass or type 304 stainless steel or better grade, ASTM A240.
6. Exterior Locations: All piping supports, connections and support hardware installed outside and exposed shall be hot-dipped galvanized, ASTM A123; or type 304 stainless steel or better grade, ASTM A240.

3. EXECUTION

3.01 GENERAL

A. All mechanical room piping must be properly supported using the schedule indicated on the drawings as a guideline for maximum allowable spacing between supports.

B. It shall be the contractor’s responsibility to properly support piping at all valves, pumps, equipment, overhead areas, and changes in direction.

C. All piping must be supported laterally as well as vertically hung.

D. Ring, clevis, roller, and J hook type hangers are not acceptable.

E. Exposed/cut Ends: All galvanized channel supports or other metallic pipe support hardware that is cut shall be field treated to cold galvanize over all exposed/compromised areas with a 95% zinc rich paint to a 1.0 to 3.0 mil thickness.

F. Comply with manufacturer’s written instructions.

END OF SECTION

SECTION 13 11 24

POOL VALVES

1. GENERAL

1.01 SECTION INCLUDES

A. Butterfly Valves

B. Ball Valves

C. Check Valves

D. Drainage Valves

E. Reducers

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. ANSI – American National Standards Institute
   2. ASTM – American Society of Testing Materials

1.04 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submit Shop Drawings, clearly indicating make, model, location, type, size, pressure rating, and type of service.

C. Valve charts
   1. Submit two copies of valve charts for each piping system, consisting of isometric Drawings, or piping layouts showing and identifying each valve and describing its function to the Architect/Engineer for approval.
   2. Upon completion of the Work, one copy of each valve chart sealed to rigid backboard with clear lacquer, placed under glass and framed, shall be hung in a conspicuous location in the equipment room.

1.05 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to General Requirements and Division 01.

1.07 WARRANTIES

A. Standard Manufacturer's Warranty

2. PRODUCTS

2.01 GENERAL

A. Cast Iron valves 3" and larger shall have an epoxy coated body on all interior and exterior surfaces, ductile iron-nylon II coated disc, one piece 416 stainless steel shaft with Buna-N or EPDM seat minimum, 150 PSI rating, or cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. 150 psi rating.

B. Cast Aluminum valves 3" and larger shall have an ASTM S12A body and coated with Rilsan on all interior and exterior surfaces. Internal components include Buna-N or EPDM resilient lining and seat, Rilsan coated ductile iron disc and T304 stainless steel shaft. 150 psi rating.

C. Thermoplastic valves 3" and larger shall be constructed from PVC Type 1 Cell Classification 12454 or CPVC type 4 cell classification 23447. Thermoplastic valves shall include PVC disc with solid type 316L stainless steel shaft with Buna-N or EPDM seat pressure rated to 150 psi @ 73 degrees Fahrenheit.

2.02 BUTTERFLY VALVES

A. Butterfly valves 3" - 12" shall be wafer or lug bodies and shall be suitable for use between ANSI 125 and 150 lb. Flanges.

B. Bodies of the flangeless design shall be provided with at least two bolt guides to center the valve in the pipeline.

C. All valves shall be as manufactured by Bray Valve (713) 894-5454, Dominion or equal.

D. All bolts and, nuts and washers shall be corrosion resistant hot-dipped galvanized, ASTM A123 or type 304 stainless steel with plated washers to be used when secured to PVC flanges.

2.03 BALL VALVES

A. PVC True Union Ball Valves, Ipex, Asahi, Spears or equal.

2.04 CHECK VALVES

A. ½" thru 2 ½" shall be PVC body, true union, ball type, seal material EPDM as manufactured by Ipex, Asahi Spears or equal as indicated on Contract Drawings.

B. 3" thru 20" diameter check valves:
   1. Type: Split disc wafer style
   2. Valve Body: Ductile or cast iron with an epoxy painted exterior
   3. Lining: Fully lined with a Buna N elastomer
   4. Shaft: 316 stainless steel shaft and shaft plug
   5. Plates: 316 stainless steel (3" – 12") or Aluminum Bronze (14"+)
   6. Spring & Plate Travel Stop: 316 stainless steel
   7. Manufacturer: Center Line Series 800 as manufactured by CRANE ChemPharma & Energy, or Model CVXXK Series by Metraflex, or approved equal.

2.05 EXPANSION JOINT/FLEXIBLE CONNECTOR (WHERE REQUIRED)

A. Shall be the Metrasphere, Style R with EPDM body and threaded bolt holes, Model #MSREE Series manufactured by Metraflex, as indicated on drawings. Install with a control unit assembly (tie rods) from flange to flange per manufacturer's instructions to minimize expansion joint damage caused by excessive motion.

2.06 DRAINAGE VALVES

A. Provide min. 3/4" True Union Ball valve on all piping at such a location to allow complete drainage of system.

2.07 REDUCERS

A. Use Eccentric reducers on pump suction lines only and concentric reducers on pump discharge lines only.

B. Stainless steel body and flanges, T304 materials, ANSI 125# rated flanges.

C. Use Neptune Benson, 15-CNS/15ECS series "or equal".

D. Provide valves of same manufacturer throughout where possible and practical.

E. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

2.08 VALVE LABELS

A. Provide and install 2" round, 1/16" thick, multi-layered valve tags with contrasting lettering with non-corrosive beaded tie on all valves. All labels shall be me labeled in accordance with the valve chart per Section 13 11 14.

3. EXECUTION

3.01 VALVE CONNECTIONS

A. Provide valves suitable for connection to adjoining piping.

B. Valve size shall be the same as the pipe size.

3.02 VALVE USE

A. Pipe sizes 3" - 14" – Butterfly

B. Miscellaneous valves 1/2" – 2-1/2" - PVC True Union Ball Valves

C. All chemical lines and equipment - PVC True Union Ball Valves

3.03 VALVE OPERATORS

A. All butterfly valves shall have gear operators and chain operators as required unless drawings indicate otherwise. Chain operators shall be required on all gear operators located 7'-0" or higher above finished floor.

B. Provide extension lengths as necessary to operate submerged or below surface valves and the appropriate valve box access cover.

END OF SECTION

POOL CENTRIFUGAL PUMPS

1. GENERAL

1.01 SECTION INCLUDES

A. Pumps
   1. Flooded Suction

B. Pump Accessories
   1. Pump Strainers
   2. Gauges
   3. Flow meters

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. The following latest edition reference specifications, guides, and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. Hydraulic Institute Standards
   2. Institute of Electrical and Electronics Engineers Standards (IEEE)
   3. National Electrical Manufacturers Association Standards (NEMA)
   4. Occupational Safety and Health Administration Rules and Regulations (OSHA)
   5. National Sanitary Foundation (NSF)
   6. American Society for Testing and Materials Standards (ASTM)
   7. American Iron and Steel Institute (AISI)
   8. American National Standards Institute (ANSI)
   9. ASTM A48 – Standard Specification for Gray Iron Castings
   10. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications
   11. AISI 1045
   12. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

1.04 DESCRIPTION OF WORK

A. The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Architect/Engineer.

B. Pump capacity, horsepower, TDH (Total Dynamic Head), speed, suction and discharge diameters, type, and other requirements shall be as shown on the drawings and shall comply with the requirements as specified herein.

C. The General Conditions shall apply to this Section as fully as if repeated herein.

1.05 QUALITY ASSURANCE

A. To assure a properly integrated and compatible system, the Equipment Manufacturer shall assume full responsibility for the warranty and proper operation of the pumps and/or accessory equipment.

B. Acceptable Products and Manufacturer: As listed on the contract documents or included herein or, an Engineer approved equal product and manufacturer.

C. All pumps and strainers shall be NSF50 certified as provided, including required coatings, and shall be labeled as such on the serial number identification tag.

1.06 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submit complete motor and pump data together with shop drawings for the driven machine. All material is to be collated in a card stock binder, with pockets for large drawings, and with index. This data shall be prepared by the motor and/or pump manufacturer and shall include:
   1. Pump manufacturer and model number, name of motor manufacturer, type of pump and motor with dimensioned drawings.
   2. Characteristic curves at full load motor speed showing flow, TDH, efficiency, horsepower, and NPSH required. For all VFD applications include a family of performance curves, separate of the full load motor speed curve, for speeds of 105%, 100%, 89%, 83%, 66%, and 50% of the scheduled RPM.
   3. Nominal motor horsepower, speed at full load, frame size, enclosure construction, winding insulation class and treatment, temperature rise at nominal horsepower, service factor, voltage rating (indicate if dual voltage), number of phases, frequency rating, full-load amperes at nominal horsepower for application voltage, starting code letter, or locked rotor KVA or amperes.
   4. Complete pump description plus material list including casings, impellers, seals, shaft, bearing frame, motor mounts, guards, base plate, exterior coating type and mill thickness.
   5. Installation Instruction and Operation and Maintenance Manuals shall include recommended protection and maintenance required for storage prior to putting pumps in service and may be submitted any time before shipment of the pumps.

1.07 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Requirements and Division 01.

1.09 WARRANTIES

A. Manufacturer’s standard pump warranty. Warranty on mechanical seals covering 100% of the cost on all parts and labor extending over the same time period as the standard pump warranty.

B. Flooded Suction Pumps
   1. Pump failure of any pump component directly attributable to materials and/or workmanship within one (1) year after substantial completion shall be repaired or replaced by the pump manufacturer at no cost to the Owner.
   2. Motor failure of any motor component directly attributable to materials and/or workmanship within three (3) years after substantial completion shall be repaired or replaced by the pump manufacturer at no cost to the Owner.

2. PRODUCTS

2.01 END SUCTION, CENTRIFUGAL PUMPS

A. General
   1. Pump performance shall be optimized with provision of variable speed drives where designated in the drawings.
   2. Operational Pump Characteristics
      a. Engineer has the right to reject any pump with a pump curve having a design point operating efficiency more than 5% below the operating efficiency of the scheduled pump provided on the drawings.
   3. Furnish and install horizontal close-coupled end suction centrifugal pumps as specified on the Contract Drawings or as pre-approved by the Architect/Engineer.

B. Materials of Construction:
   1. Flooded Suction Pumps
      a. Pump internal materials shall be as follows:
         1) Casing – Ductile Iron (ASTM A536)
         2) Impeller – 316 Stainless Steel
         3) Shaft – 316 Stainless Steel
         4) Shaft Sleeve – 316 Stainless Steel
      b. Coating: All internal cast iron wetted parts shall be sandblasted and coated per the coating manufacturer's recommendations with Scotchkote 134 or equal product.
      c. Casing
         1) The casing will be of the end suction design with tangential discharge outlet. For suction piping diameters of 2" or greater, the suction and discharge shall be bolt through flanged connections. Flange connections shall be ANSI 125# rated with NPT gauge tapings.
         2) The casing shall have tapped and plugged holes for priming and draining. The casing bore shall be large enough to allow "back pullout" of the impeller without disturbing the casing or suction and discharge piping. The casing shall be supported by casing feet to avoid pipe strain.
      d. Impeller: The impeller shall be of the enclosed type, vacuum cast in one piece. It shall be finished all over, the exterior being turned and the interior being finished smooth and cleaned of all burrs, trimmings and irregularities. The impeller shall be dynamically balanced. The impeller will be keyed to the shaft, and fastened with 316 stainless steel washers, gasket and cap screw.
      e. Mechanical Seal: Shaft sealing shall be accomplished by means of a John Crane Type 21 or equal mechanical seal with solid silicone carbide face/primary ring; solid silicone carbide seat/mating ring; 316 stainless drive band, retainer and spring; and Buna-N elastomers.
      f. Shaft: The impeller shall be direct coupled to the 316SS motor shaft. The motor shaft shall be machined to provide a key way and drilled and tapped to accept the impeller fastener. Stub shafts are not acceptable.
      g. Shaft Sleeve: The pump shaft shall be fitted with a 316SS shaft sleeve to minimize shaft wear. The sleeve shall be sealed to the impeller hub by an 0-ring and shall be positively driven by a pin to the key way. The use of adhesive compounds to fasten the sleeve to the shaft shall not be accepted.
      h. Pump / motor must mount on the same plane and preserve back-pull-out design. 304SS MOTORIZER shall be supplied when pump mounting feet and motor feet do not align.
      i. Pump nameplate shall be engraved via computer on 316SS data plate.
      j. Motor
         1) The motor shall be a NEMA-JM configuration motor meeting current NEMA Premium Efficiency Standards and shall be totally enclosed fan cooled (TEFC). NEMA –JP configurations shall only be used on large pumps (Aurora 6x8x13.5 & 8x10x13.5) only.

2) The motor shall have a service factor of a least 1.15. The service factor is reserved for variations in voltage and frequency.
3) Motor must be rated for use with a Variable Frequency Drive and meet the NEMA MG1 Standard, Part 30.
4) Motors shall have 316SS shaft
5) Motors must achieve 15:1 constant torque turndown.
6) Motors shall come equipped with internal shaft grounding brush.
7) Motors Frames 326 and below shall have removable feet to achieve F1, F2, & F3 field convertible conduit box position.
8) Motor Conduit box shall have NPT threaded entry
9) The motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head capacity curve at full load speed (60 Hz) regardless of selected operating speed without overloading the nameplate horsepower rating of the motor, regardless of service factor. Vendor shall confirm that motor current does not exceed allowable full load amperage at reduced frequency. Vendor shall verify scheduled horsepower meets above requirements. In no case shall the horsepower be less than indicated on the Drawings without specific approval from the Engineer.
10) Electrical requirements including phase, frequency, and voltage are indicated on the Drawings.

2.02 PUMP ACCESSORIES

A. Pump Strainers
   1. All Horizontal Pumps
      a. Unless the pump has an integral hair and lint strainer, supply and install strainers equal to those indicated on the Contract Documents.
      b. Provide each strainer with two strainer baskets.

B. Gauges
   1. Provide compound gauges where called for on Drawings and as required by Code.
   2. Compound gauges shall be Liquid Filled, 30 Hg to 60 PSI with gauge cock and snubber as manufactured by Weksler, Marsh, Winters or equal.

C. Flowmeters
   1. Provide flow meters where called for on the Drawings and as required by Code on main lines and on branch lines of flow ranges indicated.
   2. Flowmeters shall be as specified on the contract documents or approved equal.
   3. Transmitter shall have an operating voltage of 12-24VDC and meet appropriate CE, CSA & UL standards. Reading accuracy must be within +/- 0.5% of reading at 25oC. Device shall meet NEMA 4X & IP65.

D. Pump Labels
   1. Provide corrosion-resistant, permanent pump labels with contrasting lettering.
   2. Label shall include pump ID from contract drawings and a description. (e.g. "P1A Lap Pool Filtration Pump")

3. EXECUTION

3.01 PUMP INSTALLATION

A. The pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Pool Engineer.

B. Ensure that the pumps and motors are properly supported and aligned with no pipe strain transmitted to the pump casing.

C. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

D. Permanently affix pump label to the pump.

3.02 ACCESSORY INSTALLATION

A. Install accessories as shown on the contract documents and in accordance with manufacturer’s instructions.

B. Strainers shall be supported on a concrete housekeeping pad and provided with sufficient space for maintenance.

C. Gauges shall be positioned to be read adjacent to the pump or from above, where pumps are in a pump pit.

D. Field mount the flowmeter and flow meter transmitter as located and shown on the pool plans. Mount transmitter at 4-5 feet above the floor utilizing the 3-8050 universal mounting kit.

E. Permanently affix pump label to the pump in an easily visible location.

3.03 FACTORY TRAINED REPRESENTATIVE

A. Provide a factory-trained representative for the purpose of supervising installation, start-up, final field acceptance testing, and providing instruction to the owner's operating personnel in the proper operation and maintenance of the equipment in this section.

B. Contractor and factory-trained representative shall verify pump flow aligns with the pump curve and calibrate flowmeter as required.

END OF SECTION

SECTION 13 11 26

POOL PUMP VFD

1. GENERAL

1.01 DESCRIPTION

A. Work Includes:
   1. Furnish all labor, materials, tools, and equipment, as indicated, in accord with provisions of Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation shall be furnished and installed as part of this work.

B. General:
   1. See Section 26 0001 for General Electrical Requirements.
   2. See Division 1 for General Requirements.
   3. Coordinate all requirements with Contractor providing equipment including but not limited to contacts bypass and controls.

1.02 RELATED WORK

A. Section 26 05 26 – Grounding and Bonding

B. Section 26 05 53 – Electrical Identification

C. Section 26 28 13 – Fuses

D. Section 26 28 16 – Enclosed Switches

1.03 REFERENCE STANDARDS

A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01, General Conditions of the Contract, and Section 26 0001.

B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.05 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Submit operation and maintenance data under provisions of Section 26 0001 and Division 01.

B. Instructions to include recommended maintenance procedures, maintenance schedules, recommended spare parts list, and vendor name for those parts.

1.06 EQUIPMENT STARTUP AND AGENCY TRAINING

A. Provide the services of a factory trained and certified technician to approve the installation; start-up, test, and adjust for proper operation; and instruct and train the Agency's representative in the operation and maintenance of the unit(s). Upon completion of the equipment startup, submit a complete manufacturer's field report, including startup and test log, signed by the factory trained technician. Coordinate with other Contractors as required. The startup shall be completed within ten (10) working days from the startup date.

1.07 WARRANTY

A. The warranty shall be for a period of 36 months applied from the date of project Substantial Completion, but not to exceed 42 months from shipment. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

1.08 COORDINATION

A. All line voltage power wiring to equipment, factory mounted control panels, to motor control centers, to and from disconnect switches, and to individually mounted starters, and from starter to motors, shall be provided by the Electrical Contractor.

B. Vendor/Contractor that specifies "starters by Electrical Contractor" shall furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor. In addition, furnish complete sets of wiring diagrams for Owner's bound maintenance manual.

C. All line, or low voltage, wiring which is not indicated on the drawings, or specified, but necessary to complete the installation, shall be provided by this Division.

2. PRODUCTS

2.01 MANUFACTURERS

A. ABB 580 Series

B. Alternate manufacturer's requests shall be submitted in writing to the Engineer for approval at least 20 working days prior to bid. A compliance list point by point to this specification shall be provided. Factory authorized local support for service for warranty shall be identified.

2.02 DESIGN AND CONSTRUCTION

A. The unit shall be variable torque, modular design for control of the motors and rated at the motor full load nameplate amps.

B. The unit shall be UL 61800-5-1 listed, solid state, micro processor-based with a pulse width modulated (PWM) output wave form (none others are acceptable).

C. The VFD shall employ a full wave bridge rectifier, to prevent line notching, with dual DC bus chokes, capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.

D. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.

E. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 95% non-condensing. The VFD shall be rated to Class 3S2 Pollution degree 2 according to IEC/EN 61800-5-1. The entire VFD package shall be UL listed at 100KA SCCR.

F. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same conduit.

G. The unit enclosure shall be UL Type 12 (IP55) enclosure for the application minimum. All components shall be factory assembled and tested prior to leaving the manufacturing facility.

H. Include the following operating and monitoring devices mounted on the front cover:
   1. Fused disconnect switch with door interlocked handle and lock-open padlocking provisions (VFDs with no bypass).
   2. Operating mode selector switch marked "hand-off-auto". Manual speed adjustment via keypad, mounted on the door.
   3. Manual bypass selector switch to select power through drive or bypass where indicated on drawings. A main door interlocked, thermal magnetic circuit breaker (pad lockable, door interlocked) and VFD exclusive fuses on all drives with bypass
   4. Pilot light marked "RUN".

I. Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation where indicated on drawings. When no bypass is required, a door interlocked, padlockable disconnect and fast acting fuses are to be provided.

J. Provide partitioning within drive enclosure to separate and isolate bypass section from variable frequency drive section and to house bypass wiring, contactors, relays, and manual bypass circuit so that devices within the converter/inverter compartment are able to be serviced without electrical danger to the service technician.

K. Starters shall have provisions for additional control requirements such as, but not limited to inputs and outputs for connection to external relays and equipment where required.

2.03 PERFORMANCE REQUIREMENTS

A. Units shall be suitable for input power of electrical system as scheduled on the drawings ±10% to 15%, 3 phase, 60 Hertz nominal. The VFD shall operate with line voltage +30% and -35%. All faults shall be selectable for manual or auto restart. The VFD shall detect when a motor disconnect is open and disable the VFD.

B. Provide minimum 5% line reactor in each AC phase on the input side or 5% dual DC bus reactors to reduce harmonic voltage distortion. Limit line noise, as measured at the point of common coupling, to a voltage factor of 5% or less as defined in IEEE-519, latest edition. If the distortion is greater than that allowed by IEEE-519, latest edition, the line reactor shall be changed in size to ensure compliance. The supplier of the VFD shall provide distortion calculations to be used for setup and analysis.

C. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

D. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 10:1 turndown.

E. Additional performance capabilities to include the following:
   1. Ride through a momentary power outage of 15 cycles.
   2. Short circuit and ground fault output protection (power applied only and running).
   3. Start into a rotating load without damage to drive components or motor.
   4. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage.
   5. Programmable time delay following a run command.
   6. Input power factor: Min 0.95 throughout the speed range.
   7. VFD's shall have a UL listed Short Circuit Withstand Rating of 65,000 AIC.
   8. Minimum efficiency: 95% at 100% speed, 85% at 50% speed.

2.04 CONTROL FEATURES

A. Use control circuits compatible with input signal from control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the control system in the form that it is sent. Coordinate with Vendor/Contractor supplying control system and or motor.

B. Include the following additional control features:
   1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control.
   2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from a compatible control system. Include an RS-485 port with BACnet protocol. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable. The VFD shall also include a certified PROFINET communication port.Local speed control at the VFD.
   3. Local speed control at the VFD.
   4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted.
   5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation.
   6. Three (3) sets of programmable form "C" contacts for remote indication of variable frequency drive condition. Note: default programming to be set for "Drive Run & Fault".
   7. Illuminated display keypad. VFD that use codes are not acceptable.
   8. External Fault indicator in English that is programmable (i.e. "motor disconnect open").
   9. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop.
   10. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
   11. Jumpered terminals for remote "Emergency Stop" controls.
   12. Provide Safe Torque Off circuit according to EN 61800-5-2: 2016, IEC 61508 Parts 1-2:2010, ISO 13849-1:2015, ISO 13849-2:2012, IEC 62061:2015 SIL 3/PL shall be provided in the base VFD.
   13. The VFD shall accept a N.O. dry contact that will change the control from a speed follower signal to a PID control. Actual flow and set point shall be displayed on two lines of the keypad. The flow shall be labeled GPM.

2.05 PROTECTION FEATURES

A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:

1. Activation of any safety device.
2. Instantaneous overcurrent and/or over voltage of output.
3. Power line overvoltage and undervoltage protection.
4. Phase loss.
5. Single and three phase short circuiting.
6. Ground faults.
7. Control circuit malfunction.
8. Over temperature.
9. Output current over limit.

B. Provide the following additional protective features:
   1. Input transient overvoltage protection up to 3000 volts per ANSI 37.90A; Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply to UL 1449 4th Edition;
   2. DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level;
   3. Where a control transformer is part of the assembly, provide using for the control circuit transformer;
   4. Grounded control chassis; and
   5. Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not both energized and driving motor simultaneously.
   6. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in “Watts.”

C. Provide the following additional protective features:
   1. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

2.06 DIAGNOSTICS

A. Provide an English character display (no error codes) with indicators for the following:
   1. Phase Loss
   2. Ground Fault
   3. Over Current
   4. Over Voltage
   5. Under Voltage
   6. Over Temperature
   7. Overload
   8. DC Buss Status

B. Keypad to have Bluetooth interface with a free phone app that has all the functions the keypad does. There shall be a built-in time clock in the control panel with 10-year battery backup. The calendar and timeclock can be used for programmed start/stop and other functions. Bluetooth connectivity shall allow uploading, downloading, and emailing of parameters.

2.07 QUALITY ASSURANCE TESTS

A. Use a factory heat stress test to verify proper operation of all functions and components under full load. Each VFD shall be tested on a motor load. Test results to be provided.

B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at the owner's discretion and may include any specified feature, including operation of protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by this contractor.

C. Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in the presence of the owner's representative, for the following items:
   1. Provide general inspection to verify proper installation;
   2. Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds;
   3. Demonstrate adequate protection during switching from variable frequency drive operation to bypass starter operation and back again;
   4. Measure and record voltage distortion factor and line notch depth at the point of common coupling. Provide the recorded value as part of the startup report.

2.08 BYPASS EQUIPMENT

A. Bypass Starters:
   1. See Equipment schedule in drawings and provide bypass starters where indicated.
   2. The bypass starters shall be across-the-line magnetic starter type. There shall be a VFD-Off-Bypass selector switch or keypad that shall be separate from the VFD keypad. The bypass shall have a separate power supply from the VFD. The bypass control circuit shall include its own H-O-A switch to run in bypass without an external run command. The bypass shall be able to operate with the VFD removed for service.

B. Bypass Configuration:
   1. Provide one main fused disconnect switch or circuit breaker to isolate both the drive and bypass circuit. Bypass configuration shall consist of one input drive contactor or disconnect, one output drive contactor and one output bypass contactor. The two output contactors shall be mechanically and electrically interlocked.

C. Provide motor overload protection in the bypass circuit.

D. Provide high speed fuses for the VFD (not in the bypass circuit). The VFD and bypass shall be UL listed for 100KA SCCR.

2.09 LINE REACTORS

A. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD.

B. Line reactor shall be a three-phase inductor, 5% impedance, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

3. EXECUTION

3.01 VARIABLE FREQUENCY DRIVES

A. Install where indicated on drawings and in accordance with approved submittals and manufacturer's published recommendations. Installation to be by the Division 26 contractor.

B. Input wiring shall be installed in a separate conduit system, output wiring shall be installed in a separate conduit system and control wiring shall be installed in a separate conduit system. Do not mix input power, output power, or control wiring in a common conduit.

C. Control signal for drive will be provided as indicated on drawings.

D. VFD manufacturer to perform a field test of each drive and provide Owner operational and maintenance training.

3.02 REMOTE EMERGENCY STOP

A. Factory jumper shall be removed from VFD Emergency Stop terminals. Terminals shall be wired to emergency stop pushbuttons as shown on the plans. Feature shall be programmed for Manual Reset that must occur at the VFD. VFD shall not automatically reset when emergency stop pushbuttons are reset.

END OF SECTION

SECTION 13 11 30

POOL REGENERATIVE MEDIA FILTERS - ALTERNATE

1. GENERAL

1.01 SECTION INCLUDES

A. Pool Regnerative Media Filter and all filter related components required for the proper operation of the filter system.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 QUALITY ASSURANCE

A. The equipment described herein shall be products of a manufacturer regularly engaged in the fabrication of filtration and recirculating systems for at least fifteen (15) years and shall be a professional engineering corporation.

B. The owner requires that filters bear the National Sanitation Foundation (NSF) seal for Standard #50. This NSF listing is required by the owner regardless of local health department regulations.

C. The "EQUIPMENT SUPPLIER" shall be Neptune Benson.

1.04 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Provide detailed shop drawings of the items of equipment being provided, indicating the dimensions, material of the filter tanks, valves, actuators, RMF programmer & accessory components.

C. Provide a complete set of operating instructions, embracing the operational functions and recurring maintenance processes involved in connection with the complete filtration system.

1.05 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

B. All substitutions shall be submitted using the appropriate substitution request forms as provided under the substitution section in the project manual.

C. Voluntary Alternates for Filtration System
   1. Purpose of the bid is to purchase and have installed a complete operating filtration and recirculation system for the swimming pool. It is intended to limit the bidding to a style of product and company that has a proven history and record of performance.
   2. Due to the specialized nature of certain components required for this project, these specifications, in some instances, refer to various components by trade or manufacturers name.

3. Whenever a proprietary (trade) name is used within this Specification Section, it is used for informational purposes to describe a standard of required function, dimension, appearance and quality. References to materials by trade name, make or model number shall not be construed as limiting competition. All bidders are required to bid on the named manufacturer in the BASE BID.
4. Other treatment systems will be considered only if a complete set of drawings and specifications detailing such equipment as it pertains to this project are submitted for evaluation fourteen (14) days prior to the bidding. The submission should include a list of five (5) operating installations within a reasonable distance of the jobsite. List should include the names and telephone numbers of the operating personnel. The technical contents of the submittal shall include hydraulic calculations, equipment fabrication details, filter room layout in plan and elevation views specific to the project, warranties, installation and operating instructions.
5. Alternates meeting the terms and conditions of the bidding documents will be acknowledged prior to bidding by addendum. No alternates will be considered after the bid.
6. For any and all alternates approved in accordance with the above conditions, state the amount to be DEDUCTED from the BASE BID if an alternate filtration system is being offered.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Conditions, Division 01, and Section 13 1101.

1.07 WARRANTIES

A. The “EQUIPMENT SUPPLIER” shall guarantee that the equipment to be furnished is of the correct capacity, that the various parts are designed to operate correctly and in conjunction with each other, that if the installation is made in accordance with the project drawings and operated in accordance with the suppliers instructions, the system will perform the prescribed functions correctly, the water entering the pool will be clear, bright, free from suspended matter visible to the unaided eye, and will be sanitary to the satisfaction of all authorities having jurisdiction.

B. Defender filter tanks with Flexsol 3000 shall carry a 10-year limited fully rated warranty as regularly offered by the tank manufacturer.

C. Bump tire shall carry a fully rated 1-year warranty.

D. Valve bodies shall carry a 5-year fully rated warranty.

E. Valve operators and system accessories including the RMF controller, quick exhaust valve and solenoid valve shall carry a 1-year warranty as provided by the product manufacturer.

F. Unless otherwise specified, workmanship is to be guaranteed first class and carry a 1-year warranty.

G. Internal filter tube elements shall carry a fully rated 10-year warranty.

2. PRODUCTS

2.01 FILTER SYSTEM

A. The filter system under this section shall be as detailed on the drawings.

B. It is the intent of these specifications to describe a filter system complete with all accessory items supplied and warranted by one manufacturer.

C. The primary components of the system consist of the main filter tank, flex tube filter elements, element assembly, bump mechanism, vacuum transfer system, sight glass, pressure gauge panel, inspection (viewing) window, valves, automatic filter controller, air compressor.

D. All components and related subassemblies shall be factory assembled and tested prior to shipment.

2.02 FILTER TANKS

A. The filter tank(s) shall not be less than the diameter shown on the drawings, suitable for 50 psi working pressure and hydrostatically tested to 75 psi. Tank shell shall be not less than ¼" thick. Bottom dished head shall be not less than ¼" thick. Top flat head shall be not less than 1 1/4" thick. All material to be Type A-36, carbon steel.

B. All welding shall be performed by qualified operators. Joints shall be butt or fillet welded inside and out by manual or automatic process. Welded joints shall have complete penetration and fusion with little or no reduction of the thickness of the base metal. Welds shall be free of coarse ripples, grooves, overlaps, abrupt ridges or valleys. All welded surfaces shall be chipped and brushed clean, when necessary, leaving no slag or splatter.

C. Tank legs shall be type A-36 carbon steel. Bearing plates shall be type 304L stainless steel. Each bearing plate shall have (2) 5/8" drilled holes to secure to the floor with the ½" x 4 ½" stainless steel concrete anchors provided. The legs shall be designed with bolted connections to minimize overall tank height for shipping and access into the mechanical room.

D. The tank head shall be bolted to the shell with T304 stainless steel threaded rods and nuts, around the tank perimeter.

E. Tank(s) shall be equipped with a UL listed grounding lug.

F. Tank shall incorporate connections for filter influent, effluent, drain; vacuum transfer piping, viewing window, and lift shaft gland.

G. Tank shall include brackets for mounting of automatic controller, gauge panel, filter / regulator, vacuum transfer blower and vacuum hose rack.

H. Tank shall include an integrally mounted hydraulic lifting device (davit). The davit assembly shall be designed to lift the filter head and include a pivot mechanism allowing the head to rotate 180°, for access to the tube sheet. (Model SP-18-48-176 excludes davit requirement.)

I. Tanks larger than 18" diameter shall include an integrally mounted hydraulic lifting device (davit). The davit assembly shall be designed to fit the filter head and include a pivot mechanism allowing the head to rotate 1800, for access to the tube sheet. Systems requiring additional devices for filter head removal will not be considered.

2.03 INTERIOR LINING

A. All interior surfaces shall be grit blasted to white metal condition with a 2-3 milprofile. Blasted surfaces shall be cleaned of all dust or blast residue. Lining shall be applied as soon as is practical on the same day blasting is done.

B. Flexsol 3000® shall be a urethane, 100% solid plural component lining. Hardness shall be 75 durometer on the shore D scale. Break tensile strength shall be 4000 psi with elongation of less than 10%. Adhesion shall be greater than 2500 psi.

C. Application of Flexsol 3000® lining shall be done by experienced applicators using a high pressure, high temperature plural component system. All wetted surfaces including flange faces, manway rings and manway covers shall be lined to 100 mils +/- 10 mils DFT.

D. Hardness shall be verified after curing to ASTM D 2240 standard.

E. Flexsol 3000® lining shall meet the NSF toxicity standard unconditionally and shall be approved for use with the NSF approved filter.

F. Flexsol 3000® lined vessels shall carry a ten (10) year limited non-prorated warranty.

G. The filter manufacturer shall bear the responsibility for suitability of lining and shall be the sole source for the specified warranty.

2.04 EXTERIOR COATINGS

A. All exterior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue and primed as soon as is practical on the same day blasting is done.

B. When priming has dried the coating process will begin. If prime has sat for over twenty-four hours, a refresher coat will be applied.

C. Two coats of high solids enamel shall be applied for a total developed film thickness of 5-8 mils.

D. Manufacturer is to supply min.16 oz of high solids enamel touch-up paint.

2.05 INTERNAL COMPONENTS

A. The filter shall consist of flex tube elements, filter tube sheet, stainless steel lift shaft and internal flow diversion assembly.

B. The filter elements shall be flexible tubes that provide the support structure for the media. The outer wall of each element shall be fabricated of multi-filament high strength polyester braid. Each element shall have an internal T304 (optional T316) stainless steel spring, which acts a support structure for the braided filament.

C. The filter element tube sheet shall be fabricated of T304 (optional T316) stainless steel and provide both support for the top of the element assembly as well as water tight seal to prevent media from escaping the filter tank.

D. The lift shaft shall be fabricated from T304 (optional T316) stainless steel and provide the internal connection between the filter element tube sheet and the external bump mechanism.

E. The filter influent connection shall be fitted with a T304 (optional T316) stainless steel flow diversion assembly to eliminate disturbance to the filter elements during operation.

F. All stainless steel wetted fasteners shall be Type 304 (optional T316).

2.06 BUMP MECHANISM

A. The bump mechanism shall include a pneumatically operated tire mounted externally on the filter tank head. The tire is alternately pressurized then depressurized causing the connected filter element assembly to move in an upward then downward fashion. This movement shall provide the means of dislodging the media and accumulated solids, which then recoat the filter element. NOTE: Systems that do not incorporate a pneumatic bump mechanism shall not be considered.

2.07 VACUUM TRANSFER SYSTEM

A. The vacuum transfer system shall be provided to allow the recharging of media into the filter for either bag or bulk media.

B. The vacuum shall include a 5 peak HP 115V single phase motor 60 Hz, cULus listed.

C. A GFI protected receptacle shall be provided for field installation on the vacuum mounting bracket and field wired to the RMF controller.

D. Provide three (3) 1-1/2” SCH 80 PVC ball valves: for the vacuum drain line, the blower inlet and the vacuum hose.

E. The Manufacturer shall provide all necessary pipe, fittings and hardware for field plumbing of the vacuum transfer system.

F. Provide a minimum 5 feet of vacuum hose with required fittings.

2.08 AUTOMATIC CONTROLLER

A. The automatic controller shall provide total control of the system's filtration and regeneration cycles, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.

B. The controller shall include an adjustable pressure switch, factory set to 50 psi. The switch shall stop the filtration pump and close the pneumatic valves if air pressure falls to 50 psi.

C. The controller shall control the operation of the following functions:
1. Bump cycle-manual or automatic; with or without security interlock for data logging
2. Pre-coating of the filter elements
3. Stopping and starting of the man recirculation pump
4. Opening and closing of pneumatically operated valves
5. Vacuum transfer system
6. Heather cool down delay
7. Auxiliary contacts to interlock UV Lamps, chemical control, or other equipment
8. 7-inch Hi-Res LCD Screen with Tactile Feedback Membrane
9. Step-by- Step animated graphics
10. Last Bump TM and Bump-n-Go TM Features
11. Remote Operation via browser or phone
12. Off Site Real-Time Status
13. Email on change of condition
14. Data logging of process
15. Differential Pressure Monitoring and Bump Control
16. Automatic maintenance reminders
17. Exporting of process data logs to .csv Excel TM Files
18. Modbus Communications for PLC connectivity
19. Nema 4x/IP66 approved/UL Listed

20. Electrical Requirements: 120VAC-10-60Hz, 15-amp Circuit Protection (CP)/240VAC-10-50Hz, 10-amp CP

D. The controller panel shall display the following functions:
   1. Filter status
   2. Pre-coat status
   3. Filtration pump status
   4. Vacuum transfer pump status
   5. System power
   6. Last Bump
   7. Low Pressure Alarm
   8. Recirculation Pump off Alarm
   9. Pressure Differential

E. The controller enclosure shall be NEMA 4X/IP66 Approved/4L Listed.

F. The RMF automatic controller will provide signal power to the main filtration pump motor starter. The unit is required to be a device or variable frequency drive (VFD) and is to be installed with control wiring by the electrical contractor.

G. The RMF shall be 120 V, 1 phase, 15-amp rated, and shall be UL labeled.

H. NOTE: Systems without programmable, automatic bump/regeneration/filter modes shall not be considered.

2.09 FILTER REGULATOR

A. Each filter shall include a combination filter / regulator. The regulator shall be adjustable from 0 – 120 p.s.i. 1/2” F.P.T. connections shall be provided for field installation of air lines.

2.10 WATER SEPARATOR

A. One water separator with automatic drain shall be included for each air compressor supplied. 1/2” F.P.T. connections shall be provided for field installation of air lines.

2.11 AIR COMPRESSOR

A. Provide (1) air compressor per mechanical room with the following minimum requirements: 20-gallon tank, 2 HP, 115V, 1 phase, 15 amp, 5.2 CFM @ 90 psi, air pressure gauge, pressure relief valve, belt guard, pressure switch, air filter, and tank drain.

2.12 PNEUMATIC ACTUATORS

A. Each filter shall include pneumatic actuators for (1) influent valve, (1) effluent valve and (1) pre-coat valve.

B. The actuators shall be double acting with valve mounted drilling to ISO 5211.

C. The actuators shall include (2) 1/4" FPT ports for open / close connections. Flow control valves with quick connect fittings shall be provided at each port to allow speed control adjustment for the open / close function of the actuators.

D. Materials of Construction
   1. Body: aluminum alloy, extruded acc. to ASTM 6063, anodized acc. To UNI 4522
   2. Ends: Die-cast in aluminum alloy acc. To ASTM B179, epoxy-polyester coated

3. Pistons: Die-cast in aluminum alloy acc. To ASTM B179
4. Pinion: Nickel-plated steel
5. Slideways: Acetal resin (LAT LUB 731320T)
6. Fasteners: AISI 304 Stainless steel
7. Springs: Epoxy coated steel, pre-compressed
8. Seals: NBR Nitrile rubber
9. Lubricant: MoS2

E. The actuators shall be factory lubricated to allow for 1,000,000 maneuvers.

F. The actuators shall have adjustable travel stops for both directions.

G. Working temperature limits: 4ºF to 186ºF. NOTE: Systems utilizing manually operated valves shall not be considered.

2.13 SOLENOID VALVES

A. Each filter shall include three (3) single solenoid 4-way valves mounted on a multi-station manifold for operation of the pneumatic actuators and bump mechanism.

B. The solenoids valves shall include lighted DIN connectors.

C. The solenoid valves shall be factory lubricated and shall not require any field lubrication.

D. The solenoid valves with multi-station manifold shall be located on the bottom of the automatic controller, factory wired and include quick connect fittings for attachment to the pneumatic actuators and bump mechanism.

E. The solenoid valves shall be SMC Series SY 7000, or equal.

2.14 VALVES

A. All valves 3" – 12" shall be constructed with cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing fully coated with nylon and with nylon coated ductile iron disc.

B. Valves shall be butterfly valves and shall be provided for the effluent and pre-coat lines.

2.15 CHECK VALVES

A. Shall have epoxy coated body.

2.16 SYSTEM VALVES

A. Each defender filter shall include Five (5) system valves to facilitate system fill after media recharge, pre-coat/regeneration, influent & effluent for filtering and media dump/drain valve.

B. The pre-coat/regeneration and effluent valves shall be butterfly type with pneumatic actuators per 2.12 & 2.14A.

C. The system fill valve shall be butterfly type with gear operator and shall be the same size as the pre-coat/regeneration valve.

D. The influent valve shall be wafer type check valve, ductile iron body w/double disc, SS type 304.

E. The dump/rinse valve shall be butterfly type, lever operated with stainless steel type 304 extension to facilitate operation.

F. Automated Dilution Valve shall be supplied and programmed by the RMF Controller to purge water from the system automatically to reduce pool water TDS levels.

G. Automated purge valve shall be suppled and programmed by the RMF Controller to purge water from the filter drain on a regular timed basis.

2.17 MEDIA

A. Media shall be expanded perlite with a median particle size of 37 microns. Percentage retained on a +150 Tyler Mesh shall not be less than 8% or more than 25%. Darcy permeability shall be between 1.2-1.85.

B. The media shall contain no more than 1 tenth of one percent (.001) of crystalline silicate.

C. The media shall be certified by the Manufacturer for use in the filter. The media shall be NSF listed in and Std. 50.

D. The media shall be as approved by filter manufacturer. The media shall be Aquaperl/Harborlite.

E. Provide tank loaded with the manufacturer's recommended media. **Provide six (6) additional refills** of media to the Owner.

2.18 FILTER ELEMENT CLEANING AGENT

A. The flexible filter elements should be cleaned (degreased/descaled) annually and possibly more often depending on water quality, bather load and exposure to oils and other contaminants. The filtration system shall never be operated in the recirculation mode without a proper media coating of the filter elements. The contractor shall provide the Owner a system with clean filter elements. If the Engineer or Filter Manufacturer determines that the elements require cleaning prior to project completion, the contractor shall clean the elements in accordance with the filter manufacturer's recommendations and instructions.

B. The filter manufacturer shall include in the Filter O&M Manual, and in the System Operator Training, all information required for filter element cleaning, including but not necessarily limited to the following: recommended cleaning frequency, cleaning instructions, and recommended cleaning agent.

C. The contractor shall provide to the Owner a supply of filter element degreaser/descaler cleaning agent with a copy of the material safety data sheet (MSDS). Quantity shall be 110% of the filter manufacturer's suggested quantity required to clean all filters one time. Include a copy of the MSDS sheet.

D. Filter element degreaser/descaler cleaning agent product:
   1. "Filter Cleanse" by Great Lakes Bio Chemical Co., Inc., or as recommended by the filter manufacturer.
   2. Provide one-year supply of cleaning agent necessary to clean internal tube elements.

3. EXECUTION

3.01 FILTER SYSTEM

A. **Provide installation complete with factory representative training and equipment start.**

B. Pool Contractor shall deliver four complete sets of operating and maintenance instructions for operation, maintenance and cleaning of Filter system.

C. Training and Start-Up
   1. Filter installation shall include a filter system “start-up” and “system operator training (SOT)”. Start-up shall include the first-time use of the filter in recirculation mode and all system adjustments as needed for proper operation of all filter modes. SOT shall include written and verbal instructions and demonstrations required for the system operator to properly operate and maintain the filter system in all filter operating modes.
   2. Start-Up and SOT shall be completed by a fully trained and authorized filter manufacturer representative.
   3. Prior to initiating the Start-Up procedures, the contractor shall complete all equipment installation and tests as required for proper filter operations. Contractor shall obtain the “Pre-Start-Up” requirements/checklist directly from the filter manufacturer.
   4. Contractor shall coordinate and schedule the system start-up and training directly with the filter manufacturer and Owner.
   5. SOT session shall be a minimum of one (1) day duration. Obtain written documentation with a dated signature from the system operator that training was provided to their satisfaction.

END OF SECTION

SECTION 13 11 32

POOL FIBERGLASS FILTERS

1 GENERAL

1.01 SECTION INCLUDES

A. Pool Fiberglass Filters

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. National Sanitary Foundation (NSF)
   2. ASTM D-2150 – Specification for Woven Roving Glass Fabric for Polyester

1.04 DESIGN REQUIREMENTS

A. As assurance that each item of apparatus is properly sized to perform in conjunction with each other, the Owner requires bidders to use the filter manufacturer as a single source of supply for the items of equipment as listed and described herewith.

B. The system shall be supplied complete by the manufacturer and shall include: internals, face piping and valves, gauge panel with tubing and petcocks, sight glass, air relief connection, bottom drain connection with internal strainer.

C. System shall be fabricated and fully assembled at the manufacturer's plant for pressure testing and dimensional verification. System shall be knocked down for shipping purposes in subassemblies for minimum field assembly. Internal manifold and lateral piping shall be factory installed and shipped in place. Loose fitted piping furnished for field assembly will not be accepted.

D. The filter system including tank quantity, size, filter rate, capacity and model number shall match the basis of design as indicated on the drawings.

1.05 SUBMITTALS

A. Provide detailed shop drawings of the items of equipment being provided, indicating the dimensions, material of the filter tanks, exterior face piping, internal manifolds and laterals and filter media.

B. Provide a complete set of operating instructions, embracing the operational functions and recurring maintenance processes involved in connection with the complete filtration system.

C. Provide all warranties relating to filter systems including valves, internal piping, face piping, controls, and all standard accessories.

1.06 CERTIFICATIONS

A. Shall bear the NSF Seal of Approval, Standard #50 for sand type filters.

1.07 QUALIFICATION STATEMENTS

A. The equipment described herein shall be a product of a manufacturer regularly engaged in the fabrication of fiberglass pressure vessels for at least fifteen years.

1.08 WARRANTY

A. The equipment supplier shall guarantee that the equipment to be furnished is of the correct capacity, that the various parts are designed to operate correctly and in conjunction with each other, that if the installation is made in accordance with his drawings and operated in accordance with his instructions, the system will perform the prescribed functions correctly, the water entering the pool will be clear, bright, free from suspended matter visible to the unaided eye, will not produce any toxic effect or impart undesirable taste, odors or colors, and will be sanitary to the satisfaction of all authorities having jurisdiction.

B. Equipment Warranties
   1. Filter tanks shall carry a 15 year non-prorated warranty as regularly offered by the tank manufacturer.
   2. Internal and external face piping shall carry a non-prorated 3 year warranty.
   3. Valve bodies shall carry a 5 year non-prorated warranty.
   4. Valve operators and system accessories including sight glass, pressure gauges and air relief valve shall carry one year warranty as provided by the product manufacturer.
   5. Unless otherwise specified, workmanship is to carry a one (1) year warranty

1.09 SYSTEM STARTUP

A. An authorized representative of the equipment supplier shall provide the supervisory services of an Installation Engineer for at least one day to fully instruct designated personnel in the operation, care and maintenance of the filter system.

1.10 MANUFACTURER

A. The equipment manufacturer shall be per the basis of design as listed in the drawings equipment schedule.

B. Alternative manufacturers meeting the specifications within may also be accepted. Product submittal and review with approval by the Aquatics Engineer/Architect shall be required.

C. Equipment not meeting these specifications must be pre-approved prior to bid. Other treatment systems may be considered with Owner's approval and only if a complete set of drawings and specifications detailing such equipment as it pertains to this project are submitted for evaluation ten (10) days prior to the bid date. The submission should include a list of five (5) operating installations with names and telephone numbers of the operating personnel. The technical contents of the submittal shall include hydraulic calculations, equipment fabrication details, filter room layout in plan and elevation views, warranties, installation and operating instructions.

2 PRODUCTS

2.01 FILTERS

A. Fiberglass Filter Tank
   1. The filter tank shall be suitable for 50 psi working pressure, hydrostatically tested to 75 psi and designed with a 4:1 safety factor.
   2. Two saddle style bases shall be provided for tank support. Systems that incorporate stacked tanks shall include similar bases and mounting saddles for the upper vessel. Access to the tank shall be provided by a 14" x 18" manhole with a two-bolt, 4-point yoke. Manhole seal shall be complete with one piece ¼" neoprene gasket and positioned so that internal pressure from the filter will augment the seal. Externally mounted bolt-on covers will not be accepted.
   3. Drain out system shall consist of one (1) 3/4" fiberglass coupling mounted to the tank bottom. Each coupling to be fitted with a slotted PVC sand retainer. Air relief connection shall be one (1) 3/4" coupling provided on top of the tank. Bulkhead fittings will not be accepted.
   4. Each filter tank shall be equipped with the necessary flanges and connections for the internal and external piping. Connections shall be comprised of 1" minimum thickness fiberglass flanges with ANSI standard 150 lb. bolt pattern. Connections requiring bolt-thru hardware will not be accepted.
   5. The resin used shall be a commercial grade, premium corrosion resistant vinyl ester that has been evaluated in a laminate by test in accordance with ASTM C-581 in service comparable to the intended service and recommended for this service by the manufacturer. Other generic types of resin such as isophthalics or general purpose polyester resins shall not be acceptable.
   6. Ultraviolet absorbers shall be added to the exterior surface for improved exterior resistance.
   7. Chopped strand mat shall be constructed from commercial grade E-type glass strands bonded together using a binder. The strands shall be treated with a sizing that is chemically compatible with the resin system used. Continuous roving shall be a commercial grade of E-type glass fiber with a sizing that is chemically compatible with the resin system used.
   8. The inner surface exposed to the corrosive environment shall be followed with a layer composed of vinylester resin, reinforced only with non-continuous glass fiber strands applied to a minimum thickness of 0.100 inches. The combined thickness of the inner surface and interior layer shall be 0.110 to 0.130 inches and in no case less than 0.100 inches.
   9. The exterior laminate shall consist of filament winding and unilateral construction so as to create a modulus of elasticity to maintain no more than 0.1% strain in any direction.
   10. Resin used in these layers shall be Hetron 922 incorporating a Cobalt/MEKP cure system as recommended by the manufacturer.

B. Filter Piping - Internal
   1. The upper and lower internal distribution system shall be a horizontal header/lateral arrangement. The headers shall be Schedule 80 PVC construction, capped on one end and flanged on the other end. Lateral connections shall be spaced no more than 6" on the centers and shall be 1½" FPT connections.
   2. Underdrain laterals shall consist of 1.5" Schedule 80 PVC pipe with machined double slotted openings on 1/8" centers. Machined openings shall be designed to retain all media particles as small as 0.012 inch (0.30 mm) particle size. Molded or drilled openings or retainer screens will not be acceptable. Each lateral shall be fabricated complete with a socket cap on one end and male adapter on the other. Both fittings to be solvent welded to the slotted pipe. Laterals shall be fitted with a rubber 0-ring to allow for proper positioning of the machined openings.
   3. Upper laterals shall consist of 1½" Schedule 80 PVC pipe with 1/2" wide machine slotted openings on 1 1/4" centers. Upper laterals shall be designed and sized at the factory so as to provide uniform distribution and unrestricted flow during filter and backwash cycles. Laterals shall be fitted with a rubber 0-ring to allow for proper positioning of the machined openings.

4. All hardware shall be T304L stainless steel or non- metallic.

C. Face Piping
   1. External face piping shall be Schedule 80 PVC pipe and fittings. All fittings, including 10" and 12" sizes shall be molded type. Fabricated or fiberglass wrapped fittings will not be acceptable. Flanges shall be located so as to allow for easy dismantling of face piping. All fittings shall be solvent cemented.
   2. Piping shall be drilled and tapped where necessary to accommodate gauge tubing connectors.
   3. All valves shall be constructed in accordance with the Specification 13 11 24 unless otherwise specified. All valves 3" – 12" shall be constructed with cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing epoxy coated and with nylon coated ductile iron disc.
   4. Unless otherwise specified, all nuts and bolts shall be stainless steel with stainless steel washers to be used when secured to PVC flanges.
   5. Standard accessory items shall include sight glass rated for 50 psi with polycarbonate glass, remote mounted gauge panel with two 4½" diameter pressure gauges, ¼" petcocks, ¼" poly vent tubing with PVC compression adapters.
   6. Face piping shall be fully factory assembled, knocked down and crated for shipment. The warranty of the face piping shall be provided by the filter manufacturer. Field gluing of the face piping by anyone other than the filter manufacturer will not be accepted.
   7. Face piping arrangement shall be as indicated on the drawings. All backwash control valves shall be located no greater than 60" off the floor.

D. Automatic Air Relief Valve
   1. A minimum 1" valve shall be provided to automatically and continuously release air in the filter. The valve shall be fabricated of plastic with Buna-N seals.

E. Air Relief & Drain Plumbing
   1. An air relief plumbing kit shall be provided for each filter with two (2) True Union PVC ball valves to allow manual air relief and isolation of the automatic valve. A filter drain plumbing kit shall be provided for each filter with a single True Union PVC ball valve to allow manual draining of each filter. Air relief and drain plumbing shall be properly supported and extended to as close as possible to the nearest floor area drain without crossing any maintenance aisle/s. Valves fabricated of cast iron, bronze or stainless steel shall not be acceptable.

F. Valve Control Assembly
   1. A mechanical linkage constructed of T304 stainless steel shall connect two valves in order to create simultaneous movement.
   2. Assembly shall be designed so that filter and backwash cycles can be accomplished by repositioning two pairs of valves.
   3. Each pair of valves shall be operated as specified with gear or electric actuation.
   4. All linkage components shall be grit blasted to a 1-2 mil profile. All linkage components shall be finish coated with minimum 3-4 mils Type 316 stainless steel paint.

G. Gear Operators
   1. Valves shall be provided with infinite position gear operators. Gear case (body) shall be constructed of cast iron painted internally and externally for maximum protection. Enclosure shall be sealed to IP65 and maintenance free.
   2. Self-locking gearing shall be capable of holding the disc in any position with no movement up the full pressure rating of the valve. Gear operator shall provide 90° of travel with ± 5° adjustment in closed position. Gear operator shall include a non-

corrosive sealed indicator for remote visibility. Gear operator shall include manual adjustment capabilities.

H. Electric Operators
1. Electric service shall be 110 VAC unless otherwise indicated in drawings. Operator housing shall be corrosion resistant NEMA 4X (IP65). Electrical connectors shall be four-pole industrial style and meet DIN 43650 standards. Plug connection shall be gasketed and mechanically secured with a stainless steel screw. Harness assemblies from operator to control panel shall be factory fabricated. No field wiring shall be required.
2. Drive assembly shall include hardened steel and polyamide reduction gears with permanent lubrication. Operator shall be equipped with a manual override. Operator shall have a visual position indicator.
3. Electric drive motor minimum duty cycle rating to be 35%. Overloading protection shall be self-resetting. Limit switches shall be provided to allow adjustment of cycle. Two additional limit switch contacts shall be provided for indication or auxiliary.

I. Automatic Controller - MFP4
1. The automatic controller shall provide total control of the system's filtration and backwash, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.
2. The controller shall contain at least two microprocessors that will monitor all functions of the system.
3. The controller shall control the operation of the following functions by time or pressure differential:
   a. Backwash: Manual or automatic; with or without security interlock for data logging
   b. Heater cool down delay
   c. Auxiliary contacts to interlock UV lamps, chemical control, or other equipment
   d. 7 inch Hi-Res LCD Screen with Tactile Feedback Membrane
   e. Step-by-step animated graphics
   f. Last backwash display
   g. Remote Operation via browser or phone
   h. Off Site Real-Time Status
   i. Data logging of process
   j. Differential Pressure Monitoring and Bump Control
   k. Exporting of process data logs to .csv Excel™ files
   l. Modbus Communications for PLC connectivity
   m. Nema 4X / IP66 approved / UL Listed
   n. Electrical Requirements: 120VAC-1Ø-60Hz, 15 amp Circuit Protection (CP)/230VAC-1Ø-50Hz, 10 amp CP

2.02 FILTER MEDIA

A. Each filter tank shall be provided with media as required per manufacturer's recommendations.

B. Gravel support media of a hard coarse aggregate with a subangular grain shape with a particle size of 1/8" x ¼" shall be used on the inside of the bottom head to the elevation where the filter media commences. The specific gravity shall not be less than 2.5. Place support media by hand to avoid damage to the underdrain system and level before the addition of the upper layer of filter media. Support gravel shall be delivered and stored in bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Concrete underfill shall not be used. Media shall be free from minerals that may precipitate onto pool surfaces.

C. Sand shall be a carefully selected grade of hard, uniformly graded silica material. Media shall be naturally rounded particles of silica or milled angularly shaped particles of silica quartz.

Sand shall have a particle size between .45 mm and .55 mm (#20). No more than 1.5% shall be allowed to pass through a #40 sieve (.0164”). Uniformity coefficient shall not exceed 1.53. Specific gravity to be not less than 2.5. Bed depth shall be placed as required by the filter manufacturer. Sand shall be delivered and stored in bags (approximately one cubic foot) for ease of handling and elimination of possible contamination. Media shall be free from minerals that may precipitate onto pool surfaces.

3 EXECUTION

3.01 FILTER SYSTEM

A. All filter piping and valves shall be factory assembled and knocked down into sub-assemblies for shipment. The components shall be carefully packaged in a totally enclosed wooden crate to prevent damage during transport.

B. Filters shall be installed level and anchored to the floor.

C. Provide installation complete with factory representative training and equipment start.

D. Pool Contractor shall deliver operating and maintenance instructions for operation, maintenance and cleaning of Filter system.

E. Training and Start-Up
   1. Filter installation shall include a filter system “start-up” and “system operator training (SOT)”. Start-up shall include the first-time use of the filter in recirculation mode and all system adjustments as needed for proper operation of all filter modes. SOT shall include written and verbal instructions and demonstrations required for the system operator to properly operate and maintain the filter system in all filter operating modes.
   2. Start-Up and SOT shall be completed by a fully trained and authorized filter manufacturer representative.
   3. Prior to initiating the Start-Up procedures, the contractor shall complete all equipment installation and tests as required for proper filter operations. Contractor shall obtain the “Pre-Start-Up” requirements/checklist directly from the filter manufacturer.
   4. Contractor shall coordinate and schedule the system start-up and training directly with the filter manufacturer and Owner.
   5. SOT session shall be a minimum of one (1) day duration. Obtain written documentation with a dated signature from the system operator that training was provided to their satisfaction

END OF SECTION

SECTION 13 11 37

POOL CHEMICAL SYSTEMS AND CONTROLS

1. GENERAL

1.01 SECTION INCLUDES

A. Chemical Controller with the following sensors:
   1. pH Sensor
   2. ORP Sensor
   3. Temperature Sensor
   4. Flow Sensor

B. Free Chlorine Sensor

C. Total Chlorine Sensor

D. Conductivity Sensor

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 QUALITY ASSURANCE

A. The controller shall carry the following product certifications:
   1. NSF Standard 50
   2. UL 61010-1

1.04 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submittals required: For each type of manufactured material and product indicated. Provide Submittals indicating equipment provided, dimensions, material specifications, wiring diagrams and all accessory components including sensors.

1.05 SUBSTITUTIONS

A. Refer to General Conditions, Division 01.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Conditions, Division 01.

1.07 WARRANTIES

A. Controller shall be covered by manufacturer’s 5-year warranty.

B. ORP and pH sensors shall be covered by manufacturer’s 2-year warranty.

C. Other sensors and flow cell components shall be covered by manufacturer’s 1-year warranty.

D. Chemical feed pumps shall be covered by manufacturer's 2-year warranty.

E. A factory trained/authorized representative shall provide training to the owner. The control system shall be provided with on-site start-up, on-site operator training, and 1-year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.

2. PRODUCTS

2.01 All products listed as basis of design are acceptable, as are approved equivalents by project manager.

2.02 CHEMICAL CONTROLLER

A. The water chemistry control system shall provide continuous monitoring and control of the water chemistry and related disinfection equipment.
   1. The controller shall continuously monitor and control pH. Chemical feed shall be configurable for manual, automatic, proportional, and on/off modes.
   2. The controller shall continuously monitor and control sanitizer based upon the ORP reading, the free chlorine sensor, or both. Chemical feed shall be configurable for either on/off or time-based proportional feed.
   3. The controller shall have a programmable superchlorination function, based upon ORP or ppm superchlorination setpoint, which is triggered manually.
   4. The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.
   5. The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon sensor data and/or manual entered by the operator.
   6. The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A Low Flow Alarm shall be operator settable, which can be programmed to disable chemical feeds.
   7. The controller shall also have a Minimum Flow Rate setting to turn off heater whenever system flow is less than this programmed minimum level. The controller shall also manage the heater on/off status based on real-time water temperature reading.
   8. The controller shall continuously monitor, display, and data log pool tank level. The controller shall automatically control a water makeup relay to add makeup water to maintain pool level set point based on pool tank level.

B. The standard display shall be a backlit transflective LCD that will continuously display information related to the following:
   1. All installed sensor readings
   2. Set points, with current control status
   3. All active alarms, including time activated

C. The flow sensor shall be used to prove flow to the chemical controller to prevent dosing of chemicals during a system low flow/no flow condition.

D. The controller shall automatically abort a Manual or Scheduled Turndown upon declining water chemistry and return to the standard programmed circulation rate to maintain optimal water quality. Declining water chemistry is signaled by any of the alarm conditions.

E. The controller shall signal all alarm conditions with the following indicators:
   1. A bright flashing LED on the front of the controller.
   2. Each active alarm listed on the LCD display along with time activated.
   3. Email and text alarm notifications.

F. The controller inputs are as follows:
   1. The controller shall have inputs available for pH, ORP, Temperature, free chlorine, and flow sensors.
   2. The controller shall come with a minimum of (3) fully assignable digital inputs available for items other than those listed above.

G. The controller outputs are as follows:
   1. The controller shall have integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions available for Acid or Co2 feed and sanitizer feed pumps.
   2. The controller shall come with a minimum of (2) fully assignable integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions available for items other than those listed above.
   3. All relays must account for the effects of the temperature gradient inside the IP66 or NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity. All solid-state relays shall have a provision for an electrical interlock with the circulation pump motor starter.
   4. The controller shall come with a minimum of (8) separately isolated 4-20mA output signals.
   5. The controller shall be capable of expanded capabilities with optional expansion package.

H. Required controller safety features:
   1. The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in “Manual On” mode).
   2. The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed. The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.
   3. The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations.
   4. The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall require entry of a security access code.

I. Required controller remote communication and access features:
   1. The controller shall have the ability to allow field upgrades and updates and programming as needed. Controller must be capable of being accessed via remote communication.
   2. The controller shall have a means to preserve data logs during power outages, for input level recording and events. All input levels shall be recorded and maintained for 365 days on the controller, with a sample taken every minute. The controller shall record and maintain the events over the last 365 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.
   3. The controller shall also support the following types of connection to 3rd party applications such as EMS, BMS, BAC and SCADA systems:
      a. 1) MODBUS TCP/IP
      b. MS/TP (RS485)
      c. TCP/IP (Ethernet) BACnet connection
         The connection shall support access to Inputs (current readings), System Information, Set Points, Alarm Points, Control Status and Alarms. Set Points and Alarm Points shall be modifiable from the 3rd party application via the selected interface.
   4. The controller shall come with an integral Wi-Fi module.

5. The controller shall be Windows 10 compatible or include the necessary software and apps to allow for the real-time monitor/ of the following via personal computer, smartphone, or tablet device:
    a. Auto-Polling – to allow automatic download of data logs.
    b. Graphical Operator's Console – to display current readings, setpoints, alarm points and control status mode.
    c. Data Logging
    d. Email and text alarms notifications.
6. The controller shall require security access codes.

J. The controller shall be housed in an IP66 or NEMA 4X polycarbonate enclosure. All high-voltage wiring shall be performed in a separate IP66 OR NEMA 4X enclosure that precludes access to the controller electronics.

2.03 PH SENSOR

A. The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:
    1. 2 – 12 sensing range
    2. operating temperature range of 32-140 °F (0-60°C)
    3. operating pressure range of 0 - 60 psi (0 TO 4.1 bar)

    The controller shall continuously monitor, display and data log pH with minimum 0.1 resolution.

2.04 ORP SENSOR

A. The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:
    1. 0 to 999 mV sensing range;
    2. operating temperature range of 32- 140° F (0-60°C)
    3. operating pressure range of 0- 60 psi (0 TO 4.1bar)

    The controller shall continuously monitor, display and data log ORP with minimum 6mV resolution.

2.05 TEMPERATURE SENSOR

A. The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:
    1. 32 – 212°F (0 – 100°C) sensing range
    2. Operating temperature range of 32 – 212°F (0 – 100°C)
    3. Operating pressure range of 0-145 psi (0-10 bar)

    The controller shall continuously monitor, display and data log temperature with 5/9 °C (1°F) resolution.

2.06 CIRCULATION FLOW SENSOR

A. The controller shall provide a measurement of pool circulation flow rate and volume by utilizing a flow sensor with the following characteristics:
    1. paddle wheel flow sensor
    2. O-ring seal

    The controller shall continuously monitor, display and data log flow rate with 0.45 lpm (0.1 gpm) resolution.

2.07 FREE CHLORINE SENSOR

A. The controller shall provide a measurement of free chlorine by utilizing an amperometric sensor with the following characteristics:
   1. to 10.0 mg/l (ppm) measuring range
   2. 41° - 113°F (5 to 45° C) operating temperature range,
   3. Operating pressure range 0-14.5 psi (0-1 bar)
   4. replaceable membrane and electrolyte

   The controller shall continuously monitor, display and data log free chlorine with 0.1 mg/l resolution.

2.08 TOTAL CHLORINE SENSOR (WITH COMBINED CHLORINE READING)

A. The controller shall provide measurement of total chlorine utilizing a sensor with the following characteristics:
   1. to 10.0 mg/l (ppm) measuring range
   2. (41° - 113°F) 5°-45°C operating temperature range
   3. Operating pressure range 0-44 psi (0-3 bar)
   4. replaceable membrane and electrolyte

   The controller shall continuously monitor, display and data log total chlorine with 0.1 mg/l resolution. The controller shall also continuously monitor, display and data log combined chlorine (from the total chlorine and free chlorine sensors) with 0.1 mg/l resolution.

2.09 CONDUCTIVITY/TDS SENSOR

A. The controller shall provide a measurement of conductivity/TDS by utilizing a sensor with the following characteristics:
   1. 0 to 20,000 micromhos (0 to 10,000 ppm TDS) measuring range
   2. 32 – 212°F (0 – 100°C) operating temperature range
   3. Operating pressure range 0-100 psi (0 TO 6.9 bar)
   4. O-ring seals

   The controller shall continuously monitor, display and data log conductivity/TDS with 1 micromho/ppm resolution.

2.10 AUTO-FILL WATER LEVEL SENSOR

A. The controller shall provide a measurement of the water level by utilizing a continuous level sensor with the following characteristics:
   1. Field configurable sensor length,
   2. Installation options for wall mount and stand pipe glass configurations.
   3. 4 to 20 mA output

   The controller shall continuously monitor, display and data log the water level with 10 mm (0.4”) resolution or better. The controller shall use the sensor to control a water makeup valve to maintain water level (Autofill) and/or control a main drain modulating valve.

3. EXECUTION

3.01 CHEMICAL CONTROLLER INSTALLATION

A. Installation of the system shall be per the manufacturer’s specification and no exceptions shall be allowed. A factory trained/authorized representative shall provide training to the owner. The control system shall be provided with on-site start-up, on-site operator training, and 1-year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.

B. Provide coordination and instructional training of the chemical controller’s remote use functions and alarms with Owner’s designated staff and information technology personnel.

C. Calibration of chemical controller shall be executed only after the monitored pool temperature has been established to within 4 degrees of the design temp, or as required by the manufacturer's installation instructions, if more stringent.

3.02 CHEMICAL STORAGE INSTALLATION

A. Tank shall be hydrostatically tested at time of installation.

3.03 MANUALS

A. Manufacturer shall supply an Installation, Operation and Maintenance Manual describing features, operating instructions, maintenance procedures and replacement parts.

END OF SECTION

SECTION 13 11 40

POOL HEATING SYSTEMS

1. GENERAL

1.01 SECTION INCLUDES

A. Gas-fired Pool Heaters

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 DESCRIPTION OF WORK

A. Heating system for swimming pool. Coordinate all venting, interlocking and control wiring for pool heaters with HVAC Contractor.

1.04 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submittals required:
   1. Heaters
   2. Thermometers
   3. Printed and bound operating, installation, and service manuals

1.05 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to General Requirements and Division 01.

1.07 WARRANTIES

A. Standard Manufacturer’s Warranty

2. PRODUCTS

2.01 POOL HEATERS

A. Provide gas fired heaters for pools, as scheduled on Contract Drawings, complete with controls.

B. Heaters must be A.S.M.E. Coded and labeled by manufacturer if they exceed the HLW-101 service limits; a heat input of 200,000 Btu/hr (60 kW) or a nominal water-containing capacity of 120 gal (450 L).

C. Heaters will not require A.S.M.E labeling if they do not exceed the HLW-101 service limits; a heat input of 200,000 Btu/hr (60 kW) nor a nominal water-containing capacity of 120 gal (450

L). However, the heater must meet HLW-700 and HLW-800 design requirements per current A.S.M.E. standards.

D. Provide and install per State and Local Codes, including State Boiler Code required control and safety device packages.

2.02 THERMOMETERS

A. Thermometers shall have an adjustable angle and separable 304 stainless steel socket thermowell. The insertion length shall accommodate pipe size as required by the manufacturer.

B. Thermometers shall be liquid filled with a 9" scale, glass window, and dual face to display both Fahrenheit and Celcius temperatures, manufactured by Weksler, Marsh, Winters or approved equal; or thermometers shall be solar powered with digital display, glass passivated thermistor and aluminum stem as manufactured by Wika or approved equal.

3. EXECUTION

3.01 POOL HEATERS

A. Install per manufacturer’s installation instructions and recommendations, and in accordance with all applicable State and Local Codes.

B. Furnish and install thermometers in inlet and outlet piping to heater and downstream in the blended water stream.

C. Furnish and install a pressure relief valve for each heater and pipe to within 6" of floor.

D. Furnish and install a flow switch per heater manufacturer's requirements.

E. Factory authorized start-up required. Start-up form shall be included in the Operating and Maintenance Manuals and submitted separately to the Architect/Engineer.

END OF SECTION

SECTION 13 11 45

POOL RAIL GOODS

1. GENERAL

1.01 SECTION INCLUDES

A. Rail Goods
   1. Hand rails
   2. Ladders
   3. Stanchions

B. Accessories
   1. Wedge Anchors
   2. Escutcheons

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

1.04 DESCRIPTION OF WORK

A. Fabrication and installation of hand rails, grab rails ladders, stanchions and accessories required for installations.

1.05 QUALITY ASSURANCE

A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.06 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submittals required:
   1. Hand Rails
   2. Ladders
   3. Anchors
   4. Escutcheon Plates

C. Provide care and maintenance instructions, embracing the operation functions and maintenance processes involved in connection with the complete system, including routine maintenance and cleaning. Provide information regarding maintenance practices and products which may be detrimental to the products.

D. Printed and bound operating, installation, and service manuals.

1.07 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Requirements and Division 01.

1.09 WARRANTIES

A. Pool Equipment
   1. Manufacturer's Standard Warranty

2. PRODUCTS

2.01 GENERAL

A. Provide the equipment scheduled, and any necessary fittings, anchors, and connectors as required and not provided by the manufacturer. The equipment shall be the manufacturer and model number listed or a pre-approved equal. Although unit quantities are shown, it is the installing contractor's responsibility to verify and provide actual quantities required.

B. The following manufacturers have been pre-approved as capable of providing products meeting this specification. Note that custom material/size/finish may be required from some of the manufacturer's listed to meet these specifications.
   1. Spectrum Aquatic, 800-791-8056
   2. SR Smith LLC, 800-824-4387
   3. Paragon Aquatics, 888-KDI-SWIM

2.02 MATERIALS OF CONSTRUCTION

A. Rails
   1. All rail products specified in this section shall be 316L stainless steel.
   2. All rail goods with a grip surface (handrails, grab rails, therapy bars, ladders) shall be 1.50" OD.
   3. Provide rail material with 0.120 wall thickness.
   4. The surface of the rails shall be polished to a minimum 500 grit mirror finish and passivated according to ASTM A967.
   5. Final coating of steel shall be per manufacturer's standard treatment procedure. All welds shall be finished, polished, and passivated to blend and match the rail finish.

B. Wedge Anchors
   1. Rail Anchors shall be corrosion resistant, sized to accept the rail dimensions specified and a minimum of 4" deep. For anchors greater than 4" deep, contractor shall verify adequate concrete thickness at the anchor points.

C. Escutcheon Plates
   1. Provide escutcheon plates for each anchor location, sized to match rail diameter.
   2. Shall be rail manufacturer's round, stamped 316L Stainless Steel escutcheon.

3. EXECUTION

3.01 INSTALLATION

A. Manufacturer's Installation Instructions
   1. All equipment of this section shall be installed in accordance with industry standards and comply with manufacturer's installation instructions/recommendation. The contractor shall notify the engineer in writing of any discrepancies between the contract documents

and the manufacturer's instruction. This notification shall include a request for clarification prior to installation.

B. Install equipment true and level.

C. Equipment shall be installed secure, with no "play" or movement when shaken.

D. Rails shall be clean, free of dirt and contamination, and polished prior to turnover to owner.

E. Protect Equipment from damage during installation and up to substantial completion. Repair or replace damaged parts.

END OF SECTION

SECTION 13 11 46

POOL EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Pool Equipment
   1. Pool fittings, deck, maintenance, and safety equipment.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. Specialty Equipment
   1. Equipment submitted shall be designed by manufacturer to meet all federal, state, and local requirements.
   2. Equipment manufacturer shall meet applicable requirements of Consumer Product Safety Commission, ASTM, UL, and other applicable standards.
   3. Comply with ASTM F2461-09, standard practice for manufacture, construction, operation, and maintenance of aquatic play equipment.

1.04 DESCRIPTION OF WORK

A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.05 QUALITY ASSURANCE

A. Refer to General Requirements and Division 01 of the Specifications for additional requirements.

1.06 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submittals required:
   1. Pool Fittings and Equipment
   2. Deck Equipment
   3. Safety Equipment
   4. Maintenance Equipment

1.07 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to General Requirements and Division 01.

1.09 WARRANTIES

A. Pool Equipment
   1. Manufacturer's Standard Warranty

A. Pool Specialty Equipment
   1. Manufacturer's Standard Warranty – 2-year minimum

2. PRODUCTS

2.01 GENERAL

A. Provide the equipment scheduled on the drawings, and any necessary fittings, anchors, and connectors as required and not provided by the manufacturer. The equipment shall be the manufacturer and model number listed or a pre-approved equal. Although unit quantities are shown for value engineering purpose, it is the installing contractor's responsibility to verify actual quantities required.

3. EXECUTION

3.01 INSTALLATION

A. Manufacturer's Installation Instructions
   1. All equipment of this section shall be installed in accordance with industry standards and comply with manufacturer's installation instructions/recommendation. The contractor shall notify the engineer in writing of any discrepancies between the contract documents and the manufacturer's instruction. This notification shall include a request for clarification prior to installation.

B. Install equipment true and level.

C. Protect Equipment from damage during installation and up to substantial completion. Repair or replace damaged parts.

END OF SECTION

SECTION 13 11 60

POOL QUARTZ AGGREGATE FINISH

1. GENERAL

1.01 SECTION INCLUDES

A. Includes but is not limited to the complete installation of a quartz aggregate finish as designated in the plans and specifications within strict accordance to manufacturer instructions and listed references.

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. The following latest edition reference specifications, guides and standards shall become part of this Specification as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. National Plasterer's Council "Pool Plaster Technology", Phone # 866-483-4672, www.mpconline.org
   2. National Spa and Pool Institute "Start Up Do's and Don'ts for Newly Plastered Swimming Pools; Why You Should Use Plaster in Your Swimming Pool; Care Tips for New Swimming Pool Plaster and Technical Manual", Phone # 703-838-0083.

1.04 QUALITY ASSURANCE

A. The installer shall provide documentation providing a minimum of five (5) successful installations of similar scope and complexity with current contact information and phone number.

B. The installer shall be a member of the National Plasterer's Council in good standing.

C. The installer shall provide documentation/certification that the laborer's performing the work on site have been factory trained by the pool finish manufacturer.

D. The installer shall provide a letter of reference from the pool finish manufacturer.

1.05 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submit product literature and sample colors for Quartz Aggregate Finish and manufacturer approved bond coat forty (40) days prior to use. Quartz Aggregate material shall be listed in the material submitted.

C. Submit all documents required above for experience and qualification.

D. Provide three (3) 3'x3' onsite mock-ups of varying grades of coarseness for Owner's approval. The pool contractor is responsible to coordinate approval of mock ups prior to the quartz aggregate pool finish installation.

1.06 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.07 DELIVERY, STORAGE, AND HANDLING

A. If material is stored, it must be in a cool, dry area, protected from the elements.

1.08 WARRANTIES

A. It shall be noted that the pools may be subject to be drained for prolonged periods of time for normal maintenance and cleaning.

B. Provide Manufacturer's Product Warranty on the Quartz Aggregate Pool Finish Product. The pool finish manufacturer shall acknowledge that the pool(s) are subject to be drained completely for winterization and periods during normal maintenance and shall guarantee the pool finish for five (5) years covering any defects caused by product failure.

C. Provide Special Project Application Warranty on the Quartz Aggregate Finish Application. The pool finish installer shall acknowledge that the pool(s) are subject to be drained completely for winterization and periods during normal maintenance and shall guarantee the pool finish application for two (2) years covering any defects caused by the application of the product not limited to: abnormal cracks (other than closed shrinkage cracks that may appear), discoloration, hollow spots and de-lamination.

D. Special Project Warranty on Concrete Structure and Special Aggregate Finish: The Pool Contractor shall guarantee for two (2) years repair of the special aggregate finish covering any defects, cracks and/or leaking in the pool shell.

2. PRODUCTS

2.01 ACCEPTABLE PRODUCTS AND MANUFACTURERS

A. Sun Stone by:
CLI Industries, Inc.
P.O. Box 593704
Orlando, FL 32859,
(407) 851-2660.
www.clindustries.com

B. Approved Equal

2.02 INSPECTION/MEETINGS AND PREPARATION

A. Schedule a pool finish pre-installation conference before applying the pool finish.
   1. Attendees: Manufacturer's representative, Pool Finish Installer, Contractor and its superintendent and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the work.
   2. Agenda: Review the manufacturer's application instructions and discuss items of significance that could affect progress and installation, including but not limited to the following:
      a. Construction schedule
      b. Critical work sequencing
      c. Accessibility

d. Designation of responsible personnel qualified to do the work
e. Concrete surface preparation requirements
f. Bond coat curing and application
g. Pool Finish application and surface preparation
h. Finishing methods as recommended by the manufacturer to include exposing the aggregate
i. Verify and discuss proposed work force is adequate to complete the installation as recommended by the manufacturer
j. Verify pool mechanical and chemical system is prepared for immediate start up after filling the pool

3. Record significant discussions and agreements and disagreements of the conference, and the approved schedule. Promptly publish and distribute any issues or discrepancies to the Architect/Engineer prior to installing the pool finish.

3. EXECUTION

3.01 PREPARATION

A. All pool finish work must strictly follow manufacturer installation guidelines, references and recommendations.

B. Environmental conditions must comply with manufacturer's requirements, and finish may not be applied to frozen or frost laden surfaces or when the temperature is 40 degrees F or due to fall to 40 degrees within 24 hours.

C. The filtration and chemical system must be ready for startup and operating immediately after the pool is filled for pool finish curing per manufacture instruction.

D. The pool finish applicator shall coordinate with the pool shell concrete contractor, specific concrete finish requirements for the pool finish application.

E. It is the applicator's responsibility to ensure that the concrete substrate is adequate for proper bonding of pool finish in accordance with manufacturer recommendations.

F. Prepare all pool surfaces to receive the quartz aggregate finish per manufacturer recommendation.

G. A brush or roll on bonding coat produced and approved by the pool finish manufacturer is required to be applied to the entire pool structure where the pool finish is to be applied. The manufacturer's approved bond coat must be installed and cured in accordance with manufacturer instructions prior to applying the quartz aggregate finish. No exceptions.

H. Adding any supplements to the manufacturer's pre-bag mix is strictly prohibited unless manufacturer's approved written documentation is submitted and is pre-approved by the pool Architect/Engineer.

3.02 APPLICATION

A. All pool finish work must strictly follow manufacturer installation guidelines, references and recommendations.

B. Apply the quartz aggregate finish so that it is flush with the pool gutter, tiles and other embedded items as detailed in the plans and specifications.

C. The pool finish must be installed to a thickness and tolerance between 3/8” to 1/2” or as recommended by the manufacturer.

D. Finish quartz aggregate in a workmanlike fashion. Trowel surface smooth. Proceed with application to natural breaks.

E. No hollow areas, discolored or delaminated areas will be acceptable, any and all hollow areas must be chipped out and repaired, patching shall be done in a quality workmen’s like fashion. If hollow spots are detected where individual patching required will reduce the overall aesthetic value, it will be the Architect/Engineers discretion to have an entire area between breaks removed and replaced.

F. All pool floors and horizontal surfaces shall have a slip resistant finish. Slip resistance shall meet Dynamic Coefficient of Friction (DCOF) value of WET:> 0.42. Abrasive resistance shall meet a DCOF value of WET:>0.60.

G. The contractor is responsible for all brushing/cleaning, chemical monitoring and other requirements set forth by the manufacturer installation and curing instructions. This shall not be the responsibility of the owner.

H. The installing contractor shall guaranty the finish to be free of sharp edges and splatter that may cause cuts on swimmers’ feet.

END OF SECTION

SECTION 13 11 61

POOL CERAMIC TILE

1. GENERAL

1.01 SECTION INCLUDES

A. Porcelain Ceramic Pool Tile

1.02 RELATED DOCUMENTS

A. Drawings and Contracting Requirements, including General and Supplementary Conditions and Division 01 - General Requirements, apply to this Section.

1.03 REFERENCES

A. The following latest edition reference specifications, guides and standards shall become part of this Section as if herein written. If provisions conflict, the more stringent provisions shall apply.
   1. ANSI A108 – Specifications for Installation of Ceramic Tile
   2. ANSI A137.1 – Tile Grade Requirements
   3. ASTM C-150, Type 1 – Portland Cement
   4. ASTM C-206, 7 Type S – Hydrated Lime
   5. ASTM C-144 - Sand
   6. ANSI A118.1 – Dry Set Mortar
   7. TCA 759 – Dry Set Mortar
   8. ANSI A118.3 – Epoxy Adhesive
   9. TCNA – Tile Council of North America, Handbook for Ceramic, Glass, and Stone Tile Installation, latest edition
   10. ISO 13007 – International Standards Organization; Classification for Grouts and Adhesives.

1.04 SUBMITTALS

A. Refer to General Requirements and Division 01.

B. Submit product data and samples for each tile product indicated.

C. Submit shop drawings for approval before ordering tile. Include the following:
   1. Plan, elevations, and sections of pool tank and deck.
   2. Indicate tile layout, patterns, color, expansion joints, junctions with dissimilar materials and setting details.

D. Plans of all tile marking showing exact locations and positions of individual tiles.

E. Maintenance data: Include routine maintenance and stain removal methods.

F. Provide five copies of submittals.

1.05 SUBSTITUTIONS

A. Refer to General Requirements and Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to General Requirements and Division 01.

B. Deliver all products to job in manufacturer's unopened containers with grade seals unbroken and labels intact.

C. Keep tile cartons dry.

1.07 QUALITY ASSURANCE

A. Single source responsibility:
   1. Obtain each type and color tile material from single source.
   2. Obtain setting and grouting materials from one manufacture to ensure compatibility.
   3. Obtain membrane from same manufacturer as setting material or from manufacturer approved by setting material manufacturer to ensure compatibility.
   4. Furnish fifteen (15) year guarantee from installation material manufacturer. This guarantee is inclusive of installation materials, finish product, and labor.

B. Manufacturer Qualifications:
   1. Tile: Minimum five (5) years' experience in manufacture of tile products.
   2. Setting Materials: Minimum ten (10) years' experience in manufacture of setting and grout materials specified.

C. Installer Qualifications: Specializing in tile work having a minimum of 5 years successful documented experience with finish work comparable to that required for this project.

D. Certifications:
   1. Submit "Master Grade Certificate" for each shipment, type, and composition of tile, signed by tile manufacturer and installer with requirements of ANSI A137.1.
   2. Submit manufacturers certifications that tile, setting materials, adhesives, and grouts are suitable for intended use in submerged, swimming pool environment.

E. Field Samples:
   1. Sample Installation:
      a. For final review of each type of installation, construct sample panel of approximately 100 square feet.
      b. Install in location as directed by Architect and approved by Owner's Representative.
      c. Show workmanship of finished work and construction techniques including installation and incorporation of waterproofing membrane. Where a particularly difficult detail or technique is required, or where special sizes or shapes of product are needed, they shall be included in sample panel.
      d. Approved field samples will serve as project standard and may remain as part of the work.

F. Pre-Installation Conference:
   1. Require attendance of General Contractor, Pool Contractor, Tile Installer and Installers of related work. Review installation procedures and coordination required with related and adjacent work. Hold meeting at least one week prior to commencing work of this section. Publish meeting minutes within 5 days of meeting, distribute minutes to participants, copy Architect.
   2. Meeting agenda shall include, but is not limited to:
      a. Surface preparation
      b. Tile and installation material compatibility
      c. Edge protection, transition and pre-fabricated movement joint profiles

d. Waterproofing techniques
e. Crack Isolation techniques
f. Environmental requirements
g. Finish protection

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's unopened containers, fully identified with brand, name, type and grade. Comply with requirements in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Protect materials from contamination, dampness, freezing or overheating in accordance with manufacturer's instructions.

C. Broken, chipped, warped, stained or damaged tile will be rejected.

D. Store liquid latexes in unopened containers and protect from freezing.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

B. Do not begin installation until construction in spaces is complete and ambient temperature and humidity conditions are consistent with standards and manufacturers written instructions.

C. Ventilate spaces receiving tile in accordance with manufacturer's instructions.

1.10 WARRANTIES

A. Contractor shall provide written materials and installation warranty, executed by the contractor, Installer and Manufacturer, agreeing to repair or replace tile that fails in material or workmanship within the specified warranty period to Architect/Engineer prior to filling pool with water.
1. Warranty Period: Two (2) years after Substantial Completion, or manufacturer's system warranty, if longer.
2. Warranty Period: Fifteen (15) years after Substantial Completion, or manufacturer's system warranty, if longer

2. MATERIALS

2.01 GENERAL

A. ANSI Standard for Ceramic Tile: Provide tile that complies with ANSI 137.1 for types, compositions, and grades of tile indicated.

B. ANISI Standard for Tile Installation Materials: Provide materials that comply with ANSI standards referenced in "American Standard Specifications for the Installation of Ceramic Tile" with products and materials indicated for setting and grouting.

C. Furnish ceramic tile required as follows. Colors shall be as selected by Owner and Architect.

D. Furnish all tiles required for special markings and lettering in conformance with the drawings and applicable Codes, including depth markings and no diving markers.

E. Racing lane tile edges shall be installed flush with finish pool floor.

F. Target tile shall be installed flush with finish pool wall.

G. Use surface bullnose on pool edge where required for proper trim and as directed on the drawings.

2.02 POOL CERAMIC TILE

A. Indoor Pool Ceramic Tile
   1. Agrob Bucthtal, Dal-Tile - Keystone or equal as scheduled.
      a. Provide impervious tile with water absorption rate of less than .5% per ASTM C373. Sizes, types, and slip resistance as scheduled, see Drawings.
      b. Color as selected by Owner/Architect (see Architect's tile selection schedule).
      c. Increase the slip resistance of all endwall target tile with the addition of 7.5% by weight abrasive grains.
      d. Provide special shapes, bullnose and other tile as required.

2.03 MORTAR, GROUT AND ADHESIVE MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers or an approved equal:
   1. Custom Building Products, Huntington Beach, CA.
   2. Laticrete International, Inc., Bethany, CT.
   3. MAPEI Corporation, Deerfield Beach, FL.

2.04 MORTAR MATERIALS: THICK SET

A. Latex – Portland Cement Mortar: Thick Set (ANSI A118.4)

B. Description: Two component system; latex additive water emulsion added to Portland cement mortar in place of water or replacing part of the water. The dry-set mortar must be pre-blended and must be specified by the latex manufacturer for use with the particular latex additive. Use amount of liquid latex recommended by latex additive manufacturer.

C. Acceptable Products:
   1. Thick Bed Mortar mixed with Patching & Leveling Latex Additive, by Custom Building Products
   2. Laticrete 226 thick bed mortar mixed with Laticrete 3701 Mortar Admix, by Laticrete International.
   3. MAPEI, 4 to 1 Mud Bed Mix mixed with MAPEI, Planicrete AC, by MAPEI Corporation.

2.05 MORTAR MATERIALS: THIN SET AND SLURRY BOND COAT

A. Improved Modified Dry-Set Cement Mortar: Thin Set (ANSI A118.15)

B. Description: Two component system; latex additive water emulsion added to Portland cement mortar in place of water or replacing part of the water. The dry-set mortar must be pre-blended and must be specified by the latex manufacturer for use with the particular latex additive. Use amount of liquid latex recommended by latex additive manufacturer.

C. Acceptable Products:
   1. Laticrete 254 Platinum thin set mortar by Laticrete International.
   2. Keralastic System consisting of Keralastic polymer additive and Kerabond dry-set mortar by MAPEI Corporation.

2.06 EPOXY GROUT

A. Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material. (ANSI A118.3)

B. Acceptable Products:
   1. CEG-Lite by Custom Building Products
   2. Laticrete SpectraLock Pro Grout by Laticrete International.
   3. Kerapoxy CQ by MAPEI Corporation.

2.07 ELASTOMERIC JOINT SEALANT

A. Provide as required by TCNA guidelines, and as indicated on drawings, conforming to ASTM 920 and ASTM C 794

B. Acceptable products:
   1. Commercial 100% Silicone Sealant by Custom Building Products
   2. Latasil by Laticrete International
   3. Mapesil by MAPEI Corporation

2.08 ANTI-FRACTURE/ WATERPROOFING MEMBRANE

A. Multi-component, factory prepared, anti-fracture/ waterproofing membrane system comprised of a self-curing liquid rubber polymer

B. Acceptable Products:
   1. RedGard by Custom Building Products
   2. Laticrete Hydroban by Laticrete International.
   3. Mapelastic AquaDefense by MAPEI Corporation.

2.09 WALL PATCH & RENDER MORTAR

A. Quick-Setting, Fiber-Reinforced, Cementitious Patch and Render Mortar.

B. Acceptable Products:
   1. Custom Float Bedding Mortar by Custom Building Products
   2. Laticrete 3701 Fortified Mortar Bed by Laticrete International
   3. Planitop 330 Fast by MAPEI Corporation.

2.10 MISCELLANEOUS MATERIALS

A. Temporary protective coating: Provide product that is formulated to protect exposed surfaces of tile against adherence of mortar and grout, is compatible with tile and mortar/grout products, and is easily removable after grouting is completed without damaging grout or tile.
   1. Grout release in form of manufacturers standard propriety liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.

B. Acceptable Products:
   1. Aqua Mix Grout Release by Custom Building Products
   2. Stonetech Grout Release by Laticrete International.
   3. UltraCare Grout Release by MAPEI Corporation.

C. Epoxy Grout Haze Remover.
   1. Aqua Mix Non-cement Grout Haze Remover
   2. Stontech Epoxy Grout Haze & Coating Stripper by Laticrete International

3. UltraCare Epoxy Grout Haze Remover by MAPEI Corporation

2.11 MIXING MORTAR AND GROUT

A. Mix mortars and grouts in accordance with manufacturer’s instructions.

2.12 EXTRA MATERIALS

A. Supply extra 5% of each color of flat and trim in clean marked cartons for Owner's use.

3. EXECUTION

3.01 ACCEPTABILITY OF SURFACES

A. Before tiling, check area to be tiled for acceptability as follows:
   1. Surface medium-rough texture.
   2. All surfaces to be tiled shall be free of dust, rust, paint, from oil or other release coatings.
   3. Provision for ladders and other embedments at proper locations.
   4. Concrete true to line, level, plumb and curvature.
   5. Width, depth and length will permit finished accuracy of markings and dimensions.
   6. Verify surfaces for compatibility with tile setting material manufacturer’s requirements prior to installation.

3.02 ENVIRONMENTAL CONDITIONS

A. Protect all newly tiled areas.

B. Maintain temperature at 50 degrees F minimum during tile work and for seven days after completion or furnish protection as approved by the Architect/Engineer.

3.03 PREPARATION

A. Clean substrates.

B. Wet down or wash dry, dusty surfaces and remove excess water immediately prior to tile applications.

C. Install waterproofing membrane at pools A & B.

D. Install slurry bond coat.

E. Do not seal substrate unless required by manufacturer.

F. Prime substrate if required by manufacturer.

3.04 INSTALLATION

A. Tile installation, General
   1. Install tile materials in accordance with ANSI A137.1, other reference ANSI or TCNA specifications, and TCNA “Handbook For Ceramic, Glass, and Stone Tile Installation”, except for more stringent requirements of manufacturer or these specifications.
   2. Cut and fit tight to protrusions and vertical interruptions.
   3. Work tile joints uniform in width, subject to variance in tolerance in tile size. Make joints watertight, without voids, cracks, excess mortar or grout.

4. Prepare surface, fit, set, bond, grout and clean in accordance with applicable requirements of ANSI standards and Tile Council of North America.
5. Floors and walls: dry set: TCNA F113, F115, and W202E.
6. Comply with tile setting material manufacturer's installation requirements.

B. Thin set method
1. Apply mortar or adhesive with notched trowel using scraping motion to work material into good contact with surface to be covered. Back bed tiles with mortar. Maintain 95 percent coverage on back of tile and fully bed all corners.
2. Apply only as much mortar or adhesive as can be covered within allowable windows as recommended by mortar or adhesive manufacturer or while surface is still tacky.
3. Set tile in place and rub or beat with small beating block.
4. Beat or rap tile to ensure proper bond and also to level surface of tile.
5. Align tile to show uniform joints and allow to set until firm.
6. Clean excess mortar or adhesive from surface of tile with wet cheesecloth while mortar is fresh.
7. Sound tile after setting. Replace hollow sounding tiles.

C. Thick Set Method
1. Apply slurry bond coat.
2. While the slurry bond coat is wet, spread the mortar and compact well.
3. While slurry bond coat is wet and sticky, set tile in place and beat in well.
4. Beat or rap tile to ensure proper bond and also to level surface of tile.
5. Align tile to show uniform joints and allow to set until firm.
6. Clean excess mortar or adhesive from surface of tile with wet cheesecloth while mortar is fresh.
7. Sound tile after setting. Replace hollow sounding tiles.
8. Maintain ambient temperature above 50 F and below 100F for 72 hours after installation.

D. Grouting
1. Allow tile to set a minimum of 72 hours before grouting.
2. If bonding materials are rapid setting, follow manufacturer's recommendations.
3. Install in accordance with grout manufacturer's recommendations and ANSI A108.10.
4. Pack joints full and free before mortar takes initial set.
5. Clean excess grout from surfaces per manufacturer recommendations, as work progresses.

3.05 LAYOUT

A. Align all joints to give straight uniform grout lines.

B. Observe exact minimum length per dimensions shown on Contract Drawings.

C. Observe exact minimum width per dimensions shown in Contract Drawings.

D. Observe +/- 1/16" maximum finish elevation tolerance on all gutter edges.

E. Provide expansion joints per TCNA EJ171.

3.06 WORKMANSHIP

A. Supply first-class workmanship in all tile work.

B. Use all products in strict accordance with recommendations and directions of manufacturer.

C. Proportion all mixes in accordance with latest ANSI Standard Specifications.

D. Smooth all exposed cut edges.

E. Gutter edges shall not vary from level or true plane more than 1/8" of pool static water level.

3.07 CLEANING

A. Clean excess mortar from surface with water as work progresses.

B. Clean tile surface as thoroughly as possible on completion of grouting, preform cleaning while mortar is fresh and before it hardens on surfaces.

C. Before acid cleaning, saturate with clean water all grout joints in areas to be cleaned.

D. Use manufacturers suggested products for cleaning off grout film.

E. Remove temporary protective coating by method recommended by coating manufacturer. Trap and removing coating to prevent it from clogging drains.

3.08 PROTECTION

A. Prohibit traffic from tile finish for 72 hours after installation.

B. Protect work so that it will be without any evidence of damage or use at time of acceptance.

C. Allow tile finish to set for 14 days prior to submerging tile.

3.09 TILE SCHEDULE

A. See Tile schedule, on Drawings, for tile information.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

1. GENERAL

1.01 SECTION INCLUDES

A. Applications.

B. Ball valves.

C. Check valves.

1.02 RELATED REQUIREMENTS

A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

B. Section 22 07 16 - Plumbing Equipment Insulation.

C. Section 22 07 19 - Plumbing Piping Insulation.

D. Section 22 10 05 - Plumbing Piping.

1.03 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.

D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2022.

E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.

G. ASME B31.9 - Building Services Piping 2020.

H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

I. AWWA C606 - Grooved and Shouldered Joints 2015.

J. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.

K. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

L. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

2. PRODUCTS

2.01 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Swing Check (Pump Outlet):
      a. 2 NPS and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

C. Domestic, Hot and Cold Water Valves:
   1. 2 NPS and Smaller:
      a. Bronze: Provide with solder-joint ends.
      b. Ball: One piece, full port, bronze with bronze trim.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.
   4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
   4. Solder Joint Connections: ASME B16.18.
   5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
   1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
   2. Solder-joint Connections: ASME B16.18.
   3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
   1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
   2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Bronze Trim:
   1. Comply with MSS SP-110.
   2. SWP Rating: 400 psig.
   3. CWP Rating: 600 psig.
   4. Body: Bronze.
   5. Ends: Press.
   6. Seats: PTFE.

2.04 BRONZE, SWING CHECK VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 CWP Rating; 200 psig (1,380 kPa) WOG:
   1. Comply with MSS SP-80, Type 3.
   2. Design: Y-pattern, horizontal or vertical flow.
   3. Body: Bronze, ASTM B62.
   4. Ends: Threaded.
   5. Disc: Bronze.
   6. Manufacturers:
      a. Apollo Valves.
      b. Jomar Valves, a division of Jomar Group.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

3. EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2022.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

F. MFMA-4 - Metal Framing Standards Publication 2004.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

2. PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
   1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   2. Comply with MFMA-4.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
      c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

E. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
   3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
   4. Hollow Masonry: Use toggle bolts.
   5. Hollow Stud Walls: Use toggle bolts.
   6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
   7. Sheet Metal: Use sheet metal screws.
   8. Wood: Use wood screws.
   9. Plastic and lead anchors are not permitted.
   10. Powder-actuated fasteners are not permitted.
   11. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
      a. Comply with MFMA-4.
      b. Channel Material: Use galvanized steel.
      c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

3. EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

2. PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:
   1. Brady.
   2. Brimar Industries.
   3. Craftmark Identification Systems.
   4. Panduit.
   5. Seton Identification Products.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.
   4. Plastic: Comply with ASTM D709.

2.02 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.03 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.

B. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.04 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

E. Color code as follows:
   1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. Plumbing Valves: Green.

3. EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 91 23 for stencil painting.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 09 91 23.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 22 05 53

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass fiber insulation.

B. Hydrous calcium silicate insulation.

C. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 09 91 23 - Interior Painting: Painting insulation jacket.

C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2019).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017.

H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.

I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

J. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation 2021.

K. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester 2020.

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a.

N. MICA Manual - North American Commercial & Industrial Insulation Standards Manual 9th Edition.

O. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth 2016b.

P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

A. Manufacturers:
   1. Armstrong International.
   2. CertainTeed Corporation.
   3. Johns Manville Corporation.

4. Knauf Insulation.
5. Owens Corning Corporation.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.

G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

H. Insulating Cement: ASTM C449.

2.03 HYDROUS CALCIUM SILICATE INSULATION

A. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1,200 degrees F.
3. Density: 15 pcf.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement: ASTM C449.

D. High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.

2.04 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 20 mil, 0.020 inch.
e. Connections: Brush on welding adhesive.

2. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic Jacket:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 180 degrees F.
c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 30 mil, 0.03 inch.
e. Connections: Brush on welding adhesive.

C. Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.

D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

E. Reinforced Tape:
1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723 or ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
4. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with current edition of MICA Manual and manufacturer's installation instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

G. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces without Ceilings (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

J. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

END OF SECTION 22 07 19

SECTION 22 10 05

PLUMBING PIPING

1. GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Pipe hangers and supports.
   4. Ball valves.

1.02 RELATED REQUIREMENTS

A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

B. Section 22 07 19 - Plumbing Piping Insulation.

C. Section 31 23 16 - Excavation.

D. Section 31 23 23 - Fill.

E. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV 2021.

D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2017.

E. ASME B31.1 - Power Piping 2022.

F. ASME B31.9 - Building Services Piping 2020.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2022.

J. ASTM B32 - Standard Specification for Solder Metal 2020.

K. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes 2020.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

N. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.

O. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2016.

P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2016.

Q. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings 2020a.

R. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.

S. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings 2020.

T. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.

U. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.

V. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2018.

W. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.

X. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.

Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

Z. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

AA. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

BB. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

2. PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.

2. Joints: ASTM B32, alloy Sn50 solder.

C. PVC Pipe: ASTM D2665.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), TypeLL (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.

2.06 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
2. Joints: ASME B31.1, welded.

2.07 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
1. Fittings: ASTM A234/A234M, wrought steel welding type.
2. Joints: ASME B31.1, welded.
3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.08 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

B. Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

C. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

2.09 BALL VALVES

A. Manufacturers:
   1. Anvil International
   2. Apollo Valves.
   3. Nibco, Inc.
   4. Uponor, Inc
   5. Viega LLC
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

3. EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

E. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

F. Excavate in accordance with Section 31 23 16.

G. Backfill in accordance with Section 31 23 23.

H. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.

I. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

J. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

K. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 33 01 10.58.

B. Prior to starting work, verify system is complete, flushed, and clean.

3.05 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved water meter with by-pass valves, pressure reducing valve, and sand strainer.

END OF SECTION 22 10 05

SECTION 22 10 06

PLUMBING PIPING SPECIALTIES

1. GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Sumps.

1.02 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 30 00 - Plumbing Equipment.

C. Section 22 40 00 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains 2019.

B. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

C. NSF 372 - Drinking Water System Components - Lead Content 2022.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Loose Keys for Outside Hose Bibbs: One.
   3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

2. PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company.
   2. Josam Company.
   3. Zurn Industries, LLC.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Floor Drains:
   1. Manufacturers:
      a. Jay R. Smith Manufacturing Company.
      b. Zurn Industries, LLC..
      c. Substitutions: See Section 01 60 00 - Product Requirements.

C. Floor Drain (FD-1):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company.
   2. Josam Company.
   3. Zurn Industries, LLC.

2.04 SUMPS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company.
   2. Zurn Industries, LLC.
   3. Zoeller Pump Company..
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Precast concrete with required openings and drainage fittings.

C. Cover: 3/8 inch thick checkered steel plate with gasket seal frames and anchor bolts.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

END OF SECTION 22 10 06

SECTION 22 30 00

PLUMBING EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Sump pumps.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

B. Product Data:
   1. Indicate pump type, capacity, power requirements.
   2. Provide electrical characteristics and connection requirements.

C. Project Record Documents: Record actual locations of components.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

A. Provide five year manufacturer warranty for domestic water heaters.

2. PRODUCTS

2.01 SUMP PUMPS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstronfluidtechnology.com/#sle.
   2. Goulds Water Technology, a xylem brand: www.goulds.com/#sle.
   3. Zoeller Company: www.zoeller.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Type: Vertical centrifugal, direct connected, simplex arrangement.

C. Impeller: Cast iron; open non-clog, keyed to corrosion resistant alloy steel shaft.

D. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

E. Bearings: Oil lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.

F. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

G. Controls (Simplex): Float switch with float rod, stops, and corrosion resistant float, and separate pressure switch high level alarm with transformer, alarm bell and stand-pipe.

3. EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Pumps:
1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION 22 30 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.

C. NEMA MG 1 - Motors and Generators 2021.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Operation Data: Include instructions for safe operating procedures.

E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

B. Comply with NFPA 70.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

2. PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:
   1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
   2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.

B. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   4. Motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller: High energy efficient type.

C. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.

C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

E. Motors located in exterior locations, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, explosion proof environments, and dust collection systems: Totally enclosed type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 23 05 13

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

1. GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

1.03 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Valve Stem Packings: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

2. PRODUCTS

2.01 PIPE SLEEVES

A. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

E. Pipe Passing Through Mechanical Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

F. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

G. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
   2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.

3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

3. EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
   a. Pack solid using mineral fiber in compliance with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

F. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 23 05 17

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2022.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

H. MFMA-4 - Metal Framing Standards Publication 2004.

I. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

2. PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.
   2. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
   4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
      c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
      d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
   1. General Construction and Requirements:
      a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
      b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
      c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
      d. Insulation inserts to consist of rigid polyisocyanurate (urethane) or Calcium silicate insulation surrounded by a galvanized steel protection shield with a minimum 180-degree coverage on bottom supported piping and full 360-degree coverage on clamped piping..

E. Pipe Supports:
   1. Liquid Temperatures Up To 122 degrees F:
      a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
      b. Support From Below: MSS SP-58 Types 35 through 38.
   2. Operating Temperatures from 122 to 446 degrees F:
      a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
      b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
      c. Sliding Support: MSS SP-58 Types 35 through 38.

F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Riser Clamps: MSS SP-58 Type 8, carbon steel riser clamp.
   1. Provide copper plated clamps for copper tubing support.
   2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

H. Strut Clamps: Two-piece pipe clamp.

I. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

J. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
   1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
   2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

K. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
   1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
   2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
   3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
   4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
   5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
   6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

L. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

M. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
   1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
   4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

N. Pipe Insulation Protection Shields:
   1. MSS SP-58 Type 40.
   2. Shield Material: Galvanized carbon steel of not less than 18-gauge.
   3. For use on insulated pipe with outer diamter 2-1/2-inch and larger.
   4. Minimum Shield Length: 12-inches.

O. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
   3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
   4. Hollow Masonry: Use toggle bolts.
   5. Hollow Stud Walls: Use toggle bolts.
   6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
   7. Sheet Metal: Use sheet metal screws.
   8. Wood: Use wood screws.

9. Plastic and lead anchors are not permitted.
10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

3. EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 23 05 29

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

1. GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

C. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

2. PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 1-inch operating clearance beneath base unless otherwise indicated.

D. Piping Isolation:
   1. Provide vibration isolators for piping supports:
      a. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   2. Minimum Static Deflection:
      a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
      b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
   3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
   4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
   5. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Type S - Vibration-Isolated Structural Steel Bases:
   1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

B. Type IB - Vibration-Isolated Concrete Inertia Bases:
   1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Minimum Base Depth: 6 inches.
   3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
   4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
   5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 30 00.
   6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

2.03 VIBRATION ISOLATORS

A. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

2. Spring Elements for Spring Isolators:
    a. Color code or otherwise identify springs to indicate load capacity.
    b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    f. Selected to function without undue stress or overloading.

B. Vibration Isolators for Nonseismic Applications:
1. Type 3 - Open (Unhoused) Spring Isolators:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
    b. Bottom Load Plate: Nonskid, molded, elastomeric (e.g. neoprene, rubber) isolator material or steel with nonskid elastomeric isolator friction pad with provisions for bolting to supporting structure as required.
    c. Furnished with integral leveling device for positioning and securing supported equipment.
2. Housed Spring Isolators:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
    b. Furnished with integral elastomeric (e.g. neoprene, rubber) snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
    c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
    d. Furnished with integral leveling device for positioning and securing supported equipment.
3. Type 4 - Restrained Spring Isolators, Nonseismic:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
    b. Bottom Load Plate: Steel with nonskid elastomeric (e.g. neoprene, rubber) isolator pad with provisions for bolting to supporting structure as required.
    c. Furnished with integral leveling device for positioning and securing supported equipment.
    d. Provides constant free and operating height.
4. Type 5 - Spring Isolator Hangers, Nonseismic:
    a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric (e.g. neoprene, rubber) element for the lower hanger rod connection.
    b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

3. EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   3. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
      b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
   4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   6. Adjust isolators to be free of isolation short circuits during normal operation.
   7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 23 05 48

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Product Data: Provide manufacturers catalog literature for each product required.

D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

E. Project Record Documents: Record actual locations of tagged valves.

2. PRODUCTS

2.01 NAMEPLATES

A. Letter Color: White.

B. Letter Height: 1/2 inch.

C. Background Color: Black.

D. Plastic: 1/16-inch thick plastic laminate, beveled edges, screw mounting. Comply with ASTM D709.

2.02 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving.
   2. Brady Corporation.
   3. Brimar Industries, Inc.
   4. Craftmark Pipe Markers.
   5. Kolbi Pipe Marker Co.
   6. Seton Identification Products.
   7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.03 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
   4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
   5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
   6. Ductwork and Equipment: 2-1/2 inch high letters.

B. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.04 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

3. EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 91 23 for stencil painting.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 09 91 23.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

1. GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Employment of testing agency and payment for services.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   2. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   3. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      d. Final test report forms to be used.
      e. Expected problems and solutions, etc.
      f. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
      g. Details of how TOTAL flow will be determined; for example:

1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.

h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
i. Confirmation of understanding of the outside air ventilation criteria under all conditions.
j. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
k. Method of checking building static and exhaust fan and/or relief damper capacity.
l. Proposed selection points for sound measurements and sound measurement methods.
m. Methods for making coil or other system plant capacity measurements, if specified.
n. Time schedule for TAB work to be done in phases (by floor, etc.).
o. Description of TAB work for areas to be built out later, if any.
p. Time schedule for deferred or seasonal TAB work, if specified.
q. False loading of systems to complete TAB work, if specified.
r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
s. Interstitial cavity differential pressure measurements and calculations, if specified.
t. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
u. Procedures for formal progress reports, including scope and frequency.
v. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Field Logs: Submit at least twice a week to the Construction Manager.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Progress Reports.

F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit under provisions of Section 01 40 00.
2. Revise TAB plan to reflect actual procedures and submit as part of final report.
3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.
7. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.

e. Project location.
f. Project Architect.
g. Project Engineer.
h. Project Contractor.
i. Project altitude.
j. Report date.

G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.

3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

C. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

D. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

END OF SECTION 23 05 93

SECTION 23 07 13

DUCT INSULATION

1. GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Insulation jackets.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.

E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).

F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

G. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019 (Reapproved 2022).

H. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers 2015.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a.

K. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

C. Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

2. PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723, with following exceptions:
   1. Insulation installed outdoors may have a Flame spread index/Smoke developed index of 75/150.

B. Insulation materials shall be asbestos free.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. K value: 0.25 at 75 degrees F (1.5 pcf density), when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Puncture Resistance: 25 units minimum.
4. Secure with outward clinching staples and seal with pressure sensitive tape or two coats vapor barrier mastic and glass fabric.

D. Vapor Barrier Tape:
1. Manufacturers:
a. VentureTape.
b. Listed insulation manufacturer.
c. Substitutions: See Section 01 60 00 - Product Requirements
2. Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film matching insulation jacket type and color, with pressure sensitive acrylic or rubber based adhesive.

E. Indoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or synthetic latex mastic, compatible with insulation, white color.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K Value: 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 3.0 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
a. Aluminum Faced: Aluminum foil-scrim-kraft (FSK) facing.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with mechanical fasteners and seal with pressure sensitive tape or two coats vapor barrier mastic and glass fiber.

D. Vapor Barrier Tape:
1. Manufacturers:
a. VentureTape.

b. Listed insulation manufacturer.
c. Substitutions: See Section 01 60 00 - Product Requirements

2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, matching insulation jacket type and color, with pressure sensitive acrylic or rubber based adhesive.

E. Indoor Vapor Barrier Finish:
1. Manufacturers:
a. Design Polymerics [____]: www.designpoly.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements
2. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
3. Vinyl emulsion type acrylic or synthetic latex mastic, compatible with insulation, white color.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC: www.armacell.us/#sle.
3. K-Flex USA LLC: www.kflexusa.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
4. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
1. Manufacturers:
a. Design Polymerics; DP 5050 Water Based, Zero VOC, High Strength, Weather Barrier Coating: www.designpoly.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements

2.05 JACKETS

A. Fabric Reinforced Mastic Jacket (FMJ): UL listed 6 oz/sq yd plain weave cotton or glass fiber reinforced fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
a. Manufacturers:
1) Design Polymerics; DP 3050 Water Based, Zero VOC, Premium Quality, Lagging Adhesive, and Vapor Retarder: www.designpoly.com/#sle.
2) Substitutions: See Section 01 60 00 - Product Requirements
b. Compatible with insulation.

B. Protective Metal Jacket (PMJ): ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch aluminum sheet.
2. Finish: Smooth.

3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

C. Self-Adhering Jacket (SAJ): Flexible Weather-Proofing Outdoor Self-healing, field-applied cladding.
1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
2. Thickness: 34 mils.
3. Finish: Embossed.
4. Color: Silver.
5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
7. Emissivity: 0.030 when tested in accordance with ASTM C1371.
8. Manufacturers:
a. Polyguard Products; Alumaguard All-Weather: www.polyguardproducts.com.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements

3. EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated Ducts Conveying Air Below Ambient Temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated Ducts Conveying Air Above Ambient Temperature:
1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Insulated Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with vaport barrier jacket or canvas jacket sized for finish painting.

F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

G. Slope exterior ductwork to shed water.

H. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

END OF SECTION 23 07 13

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

1. GENERAL

1.01 SECTION INCLUDES

A. Dampers.

B. Damper Operators:
   1. Electric operators.

C. Thermostats:
   1. Electric room thermostats.
   2. Room thermostat accessories.

D. Time clocks.

1.02 RELATED REQUIREMENTS

A. Section 23 09 23 - Direct-Digital Control System for HVAC.

B. Section 23 09 93 - Sequence of Operations for HVAC Controls.

C. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.

D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

E. Section 26 27 26 - Wiring Devices: Elevation of exposed components.

1.03 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.

B. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating

size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

D. Manufacturer's Instructions: Provide for all manufactured components.

E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.

G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section documented experience approved by manufacturer.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

2. PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 DAMPERS

A. Manufacturers:
   1. Nailor.
   2. Greenheck.
   3. Ruskin.
   4. Johnson Controls.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Performance: Test in accordance with AMCA 500-D.

C. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gauge, 0.1046 inch.

D. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gauge, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.

E. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.

F. Jamb Seals: Spring stainless steel.

G. Shaft Bearings: Oil impregnated sintered bronze.

H. Linkage Bearings: Oil impregnated sintered bronze.

I. Leakage: Less than one percent based on approach velocity of 2000 ft per min and 4 inches wg.

J. Maximum Pressure Differential: 6 inches wg.

K. Temperature Limits: Minus 40 to 200 degrees F.

2.03 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

B. Electric Operators:
   1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

2.04 THERMOSTATS

A. Electric Room Thermostats:
   1. Manufacturers:
      a. Honeywell.
      b. Johnson Controls.
      c. Viconics.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
   3. Service: Heating only.
   4. Covers: Locking with set point adjustment, with thermometer.

B. Room Thermostat Accessories:
   1. Thermostat Covers: Brushed aluminum.
   2. Adjusting Key: As required for device.

2.05 TIME CLOCKS

A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION 23 09 13

SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

1. GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Central fan systems.
   2. Unit heaters.

1.02 RELATED REQUIREMENTS

A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.

C. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.04 QUALITY ASSURANCE

A. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 CENTRAL FAN SYSTEMS

A. Time Schedule: Start and stop supply and return fans. Determine fan status through auxiliary contactors in motor starter. If fan fails to start as commanded, signal alarm.

B. Safety Devices:
   1. Freeze Protection: Stop fans and close outside air dampers if temperature before supply fan is below 37 degrees F; signal alarm.

3.02 UNIT HEATERS

A. Single temperature electric room thermostat maintains constant space temperature of 55 degrees F by cycling unit fan motor.

END OF SECTION 23 09 93

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

1. GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

B. Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators 2019.

B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators 2019.

C. ANSI Z223.1 - National Fuel Gas Code 2021.

D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2021.

E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

F. ASME B31.1 - Power Piping 2022.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2022.

I. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2018.

J. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends 2011.

K. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

D. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

2. PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ANSI Z223.1, welded.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.02 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 1 Inch:

2.04 BALL VALVES

A. Manufacturers:
   1. Apollo Valves.
   2. Grinnell Products.
   3. Milwaukee Valve Company.
   4. Nibco, Inc.
   5. Viega LLC.

6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder or threaded ends.

2.05 PLUG VALVES

A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged ends. Provide lever operator with set screw.

2.06 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Manufacturers:
1. Actaris Metering Systems (A brand of ITT Controls).
2. Dungs Combustion Controls.
3. Maxitrol Company.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Compliance Requirements:
1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

C. Materials in Contact With Gas:
1. Housing: Aluminum, steel (free of non-ferrous metals).
2. Seals and Diaphragms: NBR-based rubber.

D. Maximum Inlet Operating Pressure: 5 psi.

E. Output Pressure Range: 1 inch wc to 80 inch wc.

3. EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
   1. Painting of exterior piping systems and components is specified in Section 09 91 13.

J. Install valves with stems upright or horizontal, not inverted.

K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Provide plug valves in natural gas systems for shut-off service.

END OF SECTION 23 11 23

SECTION 23 31 00

HVAC DUCTS AND CASINGS

1. GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

H. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2015.

I. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.

J. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.

K. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2016.

L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

2. PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. General Exhaust: 1/2 inch wg pressure class, galvanized steel.

D. Outside Air Intake: 1/2 inch wg pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.

C. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

D. Stainless Steel for Ducts: ASTM A666, Type 304.

E. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.
   3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

F. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.

G. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

H. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

E. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

3. EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION 23 31 00

SECTION 23 33 00

AIR DUCT ACCESSORIES

1. GENERAL

1.01 SECTION INCLUDES

A. Backdraft dampers - metal.

B. Flexible duct connectors.

C. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 25 35 23 - Integrated Automation Control Dampers: Product furnishing.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.04 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

2. PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

A. Manufacturers:
   1. Ruskin Company.
   2. Vent Products.
   3. Air Balance.
   4. Pottorff.
   5. Greenheck.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.02 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Maximum Installed Length: 14 inch.

2.03 VOLUME CONTROL DAMPERS

A. Products furnished per Section 23 09 13.

3. EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

END OF SECTION 23 33 00

SECTION 23 34 23

HVAC POWER VENTILATORS

1. GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.

B. Inline centrifugal fans and blowers.

1.02 RELATED REQUIREMENTS

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

B. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.

B. AMCA 99 - Standards Handbook 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2014.

G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.

H. UL 705 - Power Ventilators Current Edition, Including All Revisions.

I. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Fan Belts: One set for each individual fan.

1.05 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

2. PRODUCTS

2.01 MANUFACTURERS

A. Greenheck Fan Corporation: www.greenheck.com/#sle.

B. Loren Cook Company: www.lorencook.com/#sle.

C. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.

D. Twin City Fan & Blower: www.tcf.com/#sle.

E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.03 ROOF EXHAUSTERS

A. Roof Curb: 16 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, and factory installed nailer strip.

B. Motors:
   1. Open drip-proof (ODP) or Electronically commutated motor (ECM), as scheduled.

C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

D. Performance Ratings: As indicated on drawings.

2.04 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor.

B. Forward Curved Blower:
   1. Adjustable belt or direct-driven, resiliently-mounted Open drip-proof (ODP) or Electronically commutated motor (ECM) motor, heavy duty ball bearings, galvanized steel housing for indoor or outdoor service lined with acoustic insulation, and removable service panels.
   2. Accessories: Provide backdraft damper and external vibration isolator spring.

C. For direct drive fans, provide solid state, variable speed controller for use in final air balancing of fan.

D. Disconnect Switch: Factory wired, non-fusible for thermal overload protected motor.

E. Sheaves: For V-belt drives, provideCast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

F. Performance Ratings: As indicated on drawings.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Provide sheaves required for final air balance.

D. Install backdraft dampers on inlet to roof and wall exhausters.

E. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION 23 34 23

SECTION 23 37 00

AIR OUTLETS AND INLETS

1. GENERAL

1.01 SECTION INCLUDES

A. Louvers.

1.02 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012 (Reapproved 2015).

B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets 2006 (Reaffirmed 2021).

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.04 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

2. PRODUCTS

2.01 LOUVERS

A. Manufacturers:
   1. Airolite K6776.
   2. Industrial Louvers 65.
   3. Amterican Waterming and Ventilating LE-31.
   4. Carnes FPCB.
   5. Vent Products Co., Inc. 2850.
   6. Ruskin ELF6375 DX.
   7. Greenheck ESK-635.
   8. Pottorff EFD-637.
   9. Substitutions: See Section 01 60 00 - Product Requirements.

B. Type: 6 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.

C. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.

D. Color: To be selected by Architect from manufacturer's standard range.

E. Mounting: Furnish with interior flat flange for installation.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

END OF SECTION 23 37 00

SECTION 23 51 00

BREECHINGS, CHIMNEYS, AND STACKS

1. GENERAL

1.01 SECTION INCLUDES

A. Field fabricated breechings.

B. Manufactured breechings.

C. Type B double wall gas vents.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances 2015 (Reaffirmed 2020).

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

D. NFPA 31 - Standard for the Installation of Oil-Burning Equipment 2020.

E. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances 2019.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

G. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances Current Edition, Including All Revisions.

H. UL 441 - Standard for Gas Vents Current Edition, Including All Revisions.

1.04 DEFINITIONS

A. Breeching: Vent connector.

B. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

C. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and be UL listed and labeled.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.07 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

D. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.

E. Manufacturer's Certificate: Certify that refractory lined metal stacks meet or exceed specified requirements.

1.08 QUALITY ASSURANCE

A. Designer Qualifications: Design stacks under direct supervision of a Professional Structural Engineer experienced in design of the type of work specified and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

2. PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

A. Regulatory Requirements:
   1. Comply with applicable codes for installation of natural gas burning appliances and equipment.
   2. Comply with NFPA 31 for installation of oil burning appliances and equipment.
   3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 FIELD FABRICATED BREECHINGS

A. Breechings 24 inches or More in Diameter: Fabricate from ASTM A1011/A1011M Type B carbon steel; weld longitudinal seams and make end joints by welding, lapping and bolting, or with companion flanges.

B. Breechings Less Than 24 inches in Diameter: Fabricate from hot-dipped galvanized steel sheet, ASTM A653/A653M FS, with G90/Z275 coating; make longitudinal seams using pipe

lock or flat lock groove seam and make end joints beaded and crimped.

C. Minimum Metal Thicknesses based on SMACNA (DCS):
   1. Sizes up to 12 inches: 18 gauge, 0.0478 inch.
   2. Sizes 13 to 24 inches: 16 gauge, 0.0598 inch.
   3. Sizes 25 to 36 inches: 14 gauge, 0.0747 inch.

D. Provide adjustable self-actuating barometric draft dampers, where indicated on drawings, full size of breeching.

E. Provide cleanout doors of same gauge as breeching where indicated on drawings.

F. Reinforcing: Provide angle frames for rectangular breeching and flanged girth joints or angle frames for round breeching in accordance with SMACNA (DCS), at following intervals:
   1. Sizes up to 30 inches: No reinforcing required.

2.03 MANUFACTURED BREECHINGS

A. Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.

B. Assembly to be UL listed for use with building equipment in compliance with NFPA 211.

C. Fabricate with 1 inch minimum air space between walls and construct inner liner of 304 stainless steel and outer jacket of 304 stainless steel.
   1. Protect aluminized steel surfaces exposed to the elements with a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperatures of the application.

D. Design, fabricate, and install gas-tight preventing products of combustion leaking into the building.
   1. Securely connect inner joints and seal with factory supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
   2. System design to compensate for all flue gas induced thermal expansion.

2.04 TYPE B DOUBLE WALL GAS VENTS

A. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

B. Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.66.

3. EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to

SMACNA (DCS) for equivalent duct support configuration and size.

D. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

E. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.

END OF SECTION 23 51 00

SECTION 23 82 00

CONVECTION HEATING AND COOLING UNITS

1. GENERAL

1.01 SECTION INCLUDES

A. Electric unit heaters.

1.02 RELATED REQUIREMENTS

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:
   1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

E. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

2. PRODUCTS

2.01 ELECTRIC UNIT HEATERS

A. Manufacturers:
   1. INDEECO (Industrial Engineering and Equipment Company).
   2. Modine Manufacturing Company.
   3. Trane, a brand of Ingersoll Rand.
   4. McQuay International.
   5. Airtherm, LLC.
   6. Rittling.
   7. Sterling HVAC Products.
   8. Substitutions: See Section 01 60 00 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Assembly: Suitable for mounting from ceiling or structure above with built-in controls, thermal safety cut-out, and electric terminal box.

D. Acceptable Heating Element Assemblies:
   1. Horizontal Projection Units:
      a. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
      b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
      c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
   2. Vertical Projection Units:
      a. Finned tubular.
      b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
      c. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.

E. Housing:
   1. Horizontal Projection Units:
      a. Construction materials to consist of heavy gauge steel with high gloss baked enamel finish.
      b. Provide with threaded holes for threaded rod suspension.
      c. Provisions for access to internal components for maintenance, adjustments, and repair.
   2. Vertical Projection Units:
      a. Construction materials to consist of heavy gauge steel with high gloss baked enamel.
      b. Provide with mounting support brackets or provisions for mounting from ceiling or structure above.
      c. Provisions for access to internal components for maintenance, adjustments, and repair.

F. Air Inlets and Outlets:
   1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
   2. Outlets: Provide diffuser cones or directional louvers.

G. Fan: Factory balanced, direct drive, axial type with fan guard.

H. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.

I. Controls:
   1. Built-in thermostat.

2.02 ELECTRIC CABINET UNIT HEATERS

A. Manufacturers:
   1. INDEECO (Industrial Engineering and Equipment Company).
   2. Marley Engineered Products: www.marleymep.com/#sle.
   3. Trane, a brand of Ingersoll Rand.
   4. AAF International - American Air Filter.
   5. Airtherm, LLC.
   6. Mestek Technology, Inc.
   7. McQuay International.
   8. Rittling.
   9. Sterling HVAC Products.
   10. Substitutions: See Section 01 60 00 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Heating Elements: Provide open-wire, finned tubular, or resistance wire enclosed in steel sheath.

D. Cabinet: Minimum 18 gauge, 0.0478 inch thick steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet, and inlet grilles.

E. Finish:
   1. Factory applied, painted finish.
   2. Color: As selected from color chart.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Controls:
   1. Thermostat.

3. EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Unit Heaters:
   1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
   2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Cabinet Unit Heaters:
   1. Install as indicated.
   2. Coordinate to ensure correct recess size for recessed units.

3.03 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Install new filters.

3.04 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

END OF SECTION 23 82 00

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 RELATED REQUIREMENTS

A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

B. Section 02 84 00 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Owner before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize

outage duration.

1. Obtain permission from Owner at least 72 hours before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.

1. Notify Owner before partially or completely disabling system.
2. Notify local fire service.
3. Make notifications at least 72 hours in advance.
4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

1. Notify Owner at least 24 hours before partially or completely disabling system.
2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
3. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 26 05 05

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Service entrance cable.

C. Power and control tray cable.

D. Variable-frequency drive cable.

E. Photovoltaic wire.

F. Wiring connectors.

G. Electrical tape.

H. Heat shrink tubing.

I. Oxide inhibiting compound.

J. Wire pulling lubricant.

K. Cable ties.

L. Firestop sleeves.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 05 36 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

F. Section 31 23 16 - Excavation.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2013.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2009.

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 79 - Electrical Standard for Industrial Machinery 2018.

L. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

M. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

P. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.

Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

R. UL 854 - Service-Entrance Cables Current Edition, Including All Revisions.

S. UL 2277 - Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.

D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.

E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

F. Field Quality Control Test Reports.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use power and control tray cable or metal-clad cable for installation in cable tray.
      b. Use variable-frequency drive cable for connection between variable-frequency motor controllers and associated motors.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For overhead service drop, installed in raceway to service head.
      b. For underground service entrance, installed in raceway.

F. Armored cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air

plenums.

K. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

L. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

M. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

N. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      c. Equipment Ground, All Systems: Green.
      d. Isolated Ground, All Systems: Green with yellow stripe.
      e. Travelers for 3-Way and 4-Way Switching: Pink.
      f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
      g. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:

a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. General Cable Technologies Corporation: www.generalcable.com/#sle.
d. Service Wire Co: www.servicewire.com/#sle.
e. Southwire Company: www.southwire.com/#sle.
f. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
a. Size 4 AWG and Larger: Type XHHW-2.
b. Installed Underground: Type XHHW-2.
c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 SERVICE ENTRANCE CABLE

A. Manufacturers:
1. Copper Service Entrance Cable:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. Service Wire Co: www.servicewire.com/#sle.
d. Southwire Company: www.southwire.com/#sle.
e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Service Entrance Cable for Above-Ground Use: NFPA 70, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.

C. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

2.05 VARIABLE-FREQUENCY DRIVE CABLE

A. Manufacturers:
1. Service Wire Co; ServiceDrive: www.servicewire.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 1000 V.

E. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.

F. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.

G. Provide metallic shielding.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.06 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use mechanical connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Mechanical Connectors: Provide bolted type or set-screw type.

1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ilsco: www.ilsco.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ilsco: www.ilsco.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ilsco: www.ilsco.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
    a. 3M: www.3m.com/#sle.
    b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
    c. Substitutions: See Section 01 60 00 - Product Requirements.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
    a. 3M: www.3m.com/#sle.
    b. Burndy LLC: www.burndy.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
    a. Burndy LLC: www.burndy.com/#sle.
    b. Ideal Industries, Inc: www.idealindustries.com/#sle.

c. Ilsco: www.ilsco.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. American Polywater Corporation: www.polywater.com/#sle.
c. Ideal Industries, Inc: www.idealindustries.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
1. Products:
a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.
   7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
   8. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
      b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Installation in Cable Tray: Also comply with Section 26 05 36.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

H. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

I. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

J. Install conductors with a minimum of 12 inches of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
   2. Damp Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R. Identify conductors and cables in accordance with Section 26 05 53.

S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
   1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Ground enhancement material.

1.02 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.

2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are

verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode where indicated.
      e. Provide ground access well for each electrode.
   5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
    b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
    c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
7. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
    c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.

I. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
      a. Exceptions:
         1) Use mechanical connectors for connections to electrodes at ground access wells.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
      a. Exceptions:
         1) Use exothermic welded connections for connections to metal building frame.
   4. Manufacturers - Mechanical and Compression Connectors:
      a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
      b. Burndy LLC: www.burndy.com/#sle.
      c. Harger Lightning & Grounding www.harger.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   5. Manufacturers - Exothermic Welded Connections:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
      c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Bars:
   1. Description: Copper rectangular ground bars with mounting brackets and insulators.
   2. Size: As indicated.
   3. Holes for Connections: As indicated or as required for connections to be made.
   4. Manufacturers:
      a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. Harger Lightning & Grounding: www.harger.com/#sle.
      d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

E. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
   4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
   5. Manufacturers:
      a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
      d. Harger Lightning & Grounding: www.harger.com/#sle.
      e. Substitutions: See Section 01 60 00 - Product Requirements.

F. Oxide Inhibiting Compound: Comply with Section 26 05 19.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

F. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

G. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.

D. MFMA-4 - Metal Framing Standards Publication 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.

5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.

C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.
3. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. HoldRite, a brand of Reliance Worldwide Corporation; [_____]: www.holdrite.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
1. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation: www.erico.com/#sle.
    c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
    a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.

b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2 inch diameter.
b. Busway Supports: 1/2 inch diameter.
c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
f. Outlet Boxes: 1/4 inch diameter.
g. Luminaires: 1/4 inch diameter.

G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
4. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Erico International Corporation: www.erico.com/#sle.
c. PHP Systems/Design: www.phpsd.com/#sle.
d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
e. Substitutions: See Section 01 60 00 - Product Requirements.

H. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

a. Comply with MFMA-4.
b. Channel Material: Use galvanized steel.
c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
    e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required vibration isolation and/or seismic controls in accordance with Section 26 05 48.

I. Field-Welding (where approved by Architect): Comply with Section 05 50 00.

J. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

K. Conduit Support and Attachment: Also comply with Section 26 05 33.13.

L. Box Support and Attachment: Also comply with Section 26 05 33.16.

M. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.

N. Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00.

O. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

P. Secure fasteners according to manufacturer's recommended torque settings.

Q. Remove temporary supports.

R. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Intermediate metal conduit (IMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Electrical metallic tubing (EMT).

F. Rigid polyvinyl chloride (PVC) conduit.

G. Electrical nonmetallic tubing (ENT).

H. Liquidtight flexible nonmetallic conduit (LFNC).

I. Conduit fittings.

J. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 84 00 - Firestopping.

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

D. Section 26 05 29 - Hangers and Supports for Electrical Systems.

E. Section 26 05 33.16 - Boxes for Electrical Systems.

F. Section 26 05 33.23 - Surface Raceways for Electrical Systems.

G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

H. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

I. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC) 2018.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.

F. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit 2004.

G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.

H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2016.

K. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT) 2014 (Reaffirmed 2019).

L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.

N. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.

O. UL 360 - Liquid-Tight Flexible Steel Conduit Current Edition, Including All Revisions.

P. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.

Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.

R. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.

S. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

T. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

U. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
1. Under Slab on Grade: Use galvanized steel rigid metal conduit or rigid PVC conduit.
2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit or rigid PVC conduit.
3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use reinforced thermosetting resin conduit (RTRC).
7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of

where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit or rigid PVC conduit.
   2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit.
   3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit or reinforced thermosetting resin conduit (RTRC).
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
   5. Where electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
      b. Where exposed below 20 feet in warehouse areas.

K. Exposed, Exterior: Use galvanized steel rigid metal conduit.

L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
   1. Corrosive locations include, but are not limited to:
      a. Cooling towers.

N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

O. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.

4. Vibrating equipment includes, but is not limited to:
    a. Transformers.
    b. Motors.

P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 26 21 00.

C. Communications Systems Conduits: Also comply with Section 27 10 00.

D. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.

E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

G. Minimum Conduit Size, Unless Otherwise Indicated:
    1. Branch Circuits: 3/4 inch (21 mm) trade size.
    2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
    3. Control Circuits: 1/2 inch (16 mm) trade size.
    4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
    5. Underground, Interior: 3/4 inch (21 mm) trade size.
    6. Underground, Exterior: 1 inch (27 mm) trade size.

H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
    1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
    2. Nucor Tubular Products: www.nucortubular.com/#sle.
    3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
    4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
    5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
    a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel.
    a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
    a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
    b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    c. Thomas & Betts Corporation: www.tnb.com/#sle.
    d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel.
    a. Do not use die cast zinc fittings.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
    1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
    2. Electri-Flex Company: www.electriflex.com/#sle.
    3. International Metal Hose: www.metalhose.com/#sle.
    4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: See Section 01 60 00 - Product Requirements.
    2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
    3. Material: Use steel.
        a. Do not use die cast zinc fittings.

2.07 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
    1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
    2. Nucor Tubular Products: www.nucortubular/#sle.
    3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
    4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
    5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
        d. Substitutions: See Section 01 60 00 - Product Requirements.
    2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
    3. Material: Use steel.
        a. Do not use die cast zinc fittings.
    4. Connectors and Couplings: Use compression (gland) or set-screw type.
        a. Do not use indenter type connectors and couplings.
    5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle: www.jmeagle.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.
   3. International Metal Hose: www.metalhose.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.10 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

G. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
   1. Products:
      a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
      b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.

H. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.

I. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
   1. Products:
      a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

E. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

F. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

G. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.

4. Conduits in the following areas may be exposed, unless otherwise indicated:
    a. Electrical rooms.
    b. Mechanical equipment rooms.
    c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route conduits exposed:
    a. Across floors.
    b. Across roofs.
    c. Across top of parapet walls.
    d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in the same area together on a common rack.

H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

I. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
   5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
   6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
   7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
   8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations:
   1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
   2. Make penetrations perpendicular to surfaces unless otherwise indicated.
   3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
   4. Conceal bends for conduit risers emerging above ground.
   5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
   6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
   7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
   8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
   9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
   10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

K. Underground Installation:
   1. Provide trenching and backfilling in accordance with Section 31 23 16.13.
   2. Minimum Cover, Unless Otherwise Indicated or Required:
      a. Underground, Exterior: 24 inches.
      b. Under Slab on Grade: 12 inches to bottom of slab.
   3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
   1. Include proposed conduit arrangement with submittals.
   2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.

3. Install conduits within middle one third of slab thickness.
4. Secure conduits to prevent floating or movement during pouring of concrete.

M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings or approved flexible connections to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

O. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

P. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

Q. Provide grounding and bonding in accordance with Section 26 05 26.

R. Identify conduits in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Underground boxes/enclosures.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 33.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 27 26 - Wiring Devices:
   1. Wall plates.
   2. Additional requirements for locating boxes for wiring devices.

G. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SCTE 77 - Specification for Underground Enclosure Integrity 2017.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures and underground boxes/enclosures.
   1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

C. Samples:

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection,

examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, and underground boxes/enclosures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   6. Use suitable concrete type boxes where flush-mounted in concrete.
   7. Use suitable masonry type boxes where flush-mounted in masonry walls.
   8. Use raised covers suitable for the type of wall construction and device configuration where required.
   9. Use shallow boxes where required by the type of wall construction.

10. Do not use "through-wall" boxes designed for access from both sides of wall.
11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
16. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
17. Wall Plates: Comply with Section 26 27 26.
18. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co; [_____]: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.
    f. Substitutions: See Section 01 60 00 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
    c. Hubbell Incorporated; Wiegmann Products; [_____]: www.hubbell-wiegmann.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
a. Manufacturers:
1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
2) MacLean Highline: www.macleanhighline.com/#sle.
3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
4) Substitutions: See Section 01 60 00 - Product Requirements.
b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
c. Product(s):
1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.

2.02 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
1. Manufacturers:
a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
      b. Communications Systems Outlets: Comply with Section 27 10 00.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
   11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required seismic controls in accordance with Section 26 05 48.
3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.

M. Install boxes as required to preserve insulation integrity.

N. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

Q. Close unused box openings.

R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

S. Provide grounding and bonding in accordance with Section 26 05 26.

T. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

C. Section 26 05 73 - Power System Studies: Arc flash hazard warning labels.

D. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

E. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.

E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Samples:
   1. Identification Nameplates: One of each type and color specified.
   2. Warning Signs and Labels: One of each type and legend specified.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
         5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
         6) For power panelboards without a door, use typewritten circuit directory to identify load(s) served for each branch device. Identify spares and spaces.
      b. Transformers:

1) Identify kVA rating.
2) Identify voltage and phase for primary and secondary.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

c. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
4. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification nameplate on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification nameplate on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
9. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 91 23 and 09 91 13.
10. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
a. Service equipment.
11. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
12. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
13. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.

3. Use identification nameplate to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    a. At each source and load connection.
    b. Within boxes when more than one circuit is present.
    c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
    d. In cable tray, at maximum intervals of 20 feet.
5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
    a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
    b. For exposed boxes in public areas, do not color code.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    a. For exposed boxes in public areas, use only identification labels.
4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

E. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 10 00.
2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
3. Factory Pre-Marked Wallplates: Comply with Section 26 27 26.
4. Use identification label to identify fire alarm system devices.
    a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
    a. Brimar Industries, Inc: www.brimar.com/#sle.

b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
c. Seton Identification Products: www.seton.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Materials:
   a. Indoor Clean, Dry Locations: Use plastic nameplates.
   b. Outdoor Locations: Use stainless steel or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
   a. Brady Corporation: www.bradyid.com/#sle.
   b. Brother International Corporation: www.brother-usa.com/#sle.
   c. Panduit Corp: www.panduit.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. Equipment designation or other approved description.
   b. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
   c. Other Information: 1/4 inch.
   d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
   a. Normal Power System: White text on black background.
   b. Emergency Power System: White text on red background.
   c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
    a. Exceptions:
        1) Provide white text on red background for general information or operational instructions for emergency systems.
        2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
    a. Include voltage and phase for other than 120 V, single phase circuits.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton; [_____]: www.hellermanntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
   1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

B. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

C. Legend:
   1. Markers for Voltage Identification: Highest voltage present.

D. Color: Black text on orange background unless otherwise indicated.

2.05 FLOOR MARKING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Insite Solutions, LLC: www.stop-painting.com/#sle.
   4. Seton Identification Products: www.seton.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.06 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Insite Solutions, LLC; [_____]: www.stop-painting.com/#sle.
   4. Seton Identification Products: www.seton.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
a. Do not use labels designed to be completed using handwritten text.
b. Provide polyester overlaminate to protect handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

SECTION 26 05 83

WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 05 33.13 - Conduit for Electrical Systems.

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 27 26 - Wiring Devices.

E. Section 26 28 16.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Comply with NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 27 26.

D. Flexible Conduit: As specified in Section 26 05 33.13.

E. Wire and Cable: As specified in Section 26 05 19.

F. Boxes: As specified in Section 26 05 33.16.

2.02 EQUIPMENT CONNECTIONS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 05 83

SECTION 26 06 50.16

LIGHTING FIXTURE SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specific requirements for individual luminaire types.

1.02 RELATED REQUIREMENTS

A. Section 26 51 00 - Interior Lighting: General requirements applicable to products specified in this section.

B. Section 26 56 00 - Exterior Lighting: General requirements applicable to products specified in this section.

PART 3 EXECUTION

2.01 SEE OTHER LIGHTING SECTIONS FOR GENERAL REQUIREMENTS APPLICABLE TO THIS SECTION.

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Outdoor motion sensors.

C. Time switches.

D. Outdoor photo controls.

E. Lighting contactors.

F. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 05 73 - Power System Studies.

F. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
   1. Includes finish requirements for wall controls specified in this section.
   2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

G. Section 26 28 13 - Fuses.

H. Section 26 51 00 - Interior Lighting.

I. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Disharge Ballasts 2020.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
   2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Lutron Electronics Company, Inc; [_____]: www.lutron.com/#sle.
   3. Sensor Switch Inc: www.sensorswitch.com/#sle.
   4. WattStopper: www.wattstopper.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.
6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
   a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
11. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
13. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
   a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
   b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
   c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
   d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
   e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

f. Provide selectable audible alert to notify occupant of impending load turn-off.
g. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
c. Provide field selectable setting for disabling LED motion detector visual indicator.
d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
e. Finish: White unless otherwise indicated.
2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 15 feet, with a field of view of 360 degrees.

E. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

A. Manufacturers:
1. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
2. Lithonia Lighting: www.lithonia.com/#sle.
3. WattStopper: www.wattstopper.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.
5. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

C. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

D. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

E. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

F. Integral Photocell: For dusk to dawn operation.

G. Manual Override: Activated by switching power off to unit and then back on.

H. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

I. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

J. Finish: Color to be selected.

2.04 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
   1. Intermatic, Inc: www.intermatic.com/#sle.
   2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Stem-Mounted Outdoor Photo Controls:
   1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
   2. Housing: Weatherproof, impact resistant polycarbonate.
   3. Photo Sensor: Cadmium sulfide.
   4. Provide external sliding shield for field adjustment of light level activation.
   5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
   6. Voltage: As required to control the load indicated on the drawings.
   7. Failure Mode: Fails to the on position.
   8. Load Rating: As required to control the load indicated on the drawings.
   9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

2.05 LIGHTING CONTACTORS

A. Manufacturers:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Rockwell Automation Inc; Allen-Bradley Products; : ab.rockwellautomation.com/#sle.
   4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   5. Siemens Industry, Inc; : www.usa.siemens.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

C. Short Circuit Current Rating:

1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.

D. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Finish: Manufacturer's standard unless otherwise indicated.

2.06 ACCESSORIES

A. Auxiliary Contacts:
   1. Comply with NEMA ICS 5.
   2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Install lighting control relays furnished under Section 25 36 26

C. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

D. Install lighting control devices in accordance with manufacturer's instructions.

E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Install lighting control devices plumb and level, and held securely in place.

G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.

H. Provide required supports in accordance with Section 26 05 29.

I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

J. Identify lighting control devices in accordance with Section 26 05 53.

K. Occupancy Sensor Locations:
   1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

L. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

M. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

N. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

O. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

P. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

R. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33.16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
   4. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 21 00

LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 33.13 - Conduit for Electrical Systems.

E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 24 16 - Panelboards: Service entrance equipment.

1.03 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.04 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)) 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Utility Company letter of availability for providing electrical service to project.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

D. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
1. Obtain Utility company approval of shop drawings prior to submittal.

E. Drawings prepared by Utility Company.

F. Project Record Documents: Record actual locations of equipment and installed service routing.

1.07 QUALITY ASSURANCE

A. Comply with the following:
1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Division of Responsibility: Per Utility Company requirements.

D. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.

E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 03 30 00.

F. Provide required protective bollards in accordance with Utility Company requirements.

G. Provide required support and attachment components in accordance with Section 26 05 29.

H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.

I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

3.04 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION 26 21 00

SECTION 26 24 16.11

PANELBOARDS - SCHNEIDER ELECTRIC SQUARE D NQ / NF

PART 1 GENERAL

1.01 DEFINITIONS

A. Panelboards may also be identified as LP.

1.02 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).

B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e, with Amendment (2017).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NEMA PB 1 - Panelboards 2011.

E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

J. UL 67 - Panelboards Current Edition, Including All Revisions.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Requirements of local authorities having jurisdiction.
   3. Applicable local codes.

B. Manufacturer Qualifications:
   1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 50 years.
   2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.

3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
4. Certified in accordance with ISO 14001.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.

D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.05 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of commissioning or 18 months from date of shipment, whichever comes first. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D NQ and NF; www.se.com/#sle.

B. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 LIGHTING AND APPLIANCE PANELBOARDS

A. Basis of Design: Schneider Electric; Square D NQ and NF; www.se.com/#sle.

B. Comply with NEMA PB 1; listed and labeled as complying with UL 67.

C. Short Circuit Current Rating: Where not specified, provide panelboards with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.

D. Provide panelboards marked for use as service equipment where required for application.

E. Panelboard Interiors:

1. 240 VAC and 48 VDC Maximum Panelboards:
    a. Continuous main current ratings up to 600 A.
    b. Available Circuit Capacity: Up to 84 circuits.
    c. Minimum Short Circuit Current Rating:
        1) 240 VAC:
        2) 48 VDC: 5 kA.
    d. Provide branch circuit connectors suitable for both plug-on and bolt-on branch circuit breakers.
    e. Circuit Breaker Orientation:
        1) Main Circuit Breakers up to 150 A: Horizontally mounted.
        2) Main Circuit Breakers Above 150 A: Vertically mounted.
        3) Sub-Feed Circuit Breakers: Vertically mounted.
    f. Products:
        1) Schneider Electric Square D NQ.
2. Bussing:
    a. Provide sequentially phased branch circuit connectors for each bus bar.
    b. Provide fully rated bussing with one continuous bus bar per phase, unless otherwise indicated.
        1) Split-Bus and Separated-Distribution Panelboards:
            a) Provide one continuous bus bar per phase for each branch distribution section.
            b) Split-Bus Panelboard Sections: Connected from upstream lugs or branch circuit breaker to one back-fed main circuit breaker in downstream section.
            c) Separated-Distribution Panelboard Sections: Connected via removable, stranded copper cables, secured via mechanical lugs on each section.
    c. Determine bus current ratings in accordance with UL 67 heat-rise tests.
    d. Maximum current ratings apply for main-lug-only or main-circuit-breaker panelboards.
    e. Rated 100 A to 400 A: Plated aluminum.
    f. Rated 600 A and Above: Plated copper.
    g. Run bus bar plating entire length of bus bar.
    h. Predrill interior phase bus to accommodate field-installed options (e.g., sub-feed lugs, sub-feed breakers, thru-feed lugs).
3. Neutral:
    a. Panelboards 20 inches Nominal and Wider: Plated, solid, and split.
    b. Panelboards 14 inches Wide and Column Width: Plated and solid.
4. Ground:
    a. Provide solidly bonded aluminum equipment ground bar.
5. Interiors in Type 1 and 2 Enclosures:
    a. Field convertible for top or bottom incoming feed.
    b. Provide interior leveling provisions for flush mounting applications.
6. Interior Trim: Dead-front construction to shield energized parts, with filler plates to cove unused mounting spaces.
7. Main-Lug Interiors up to 600 A: Field-convertible to main circuit breaker.

F. Enclosures:
1. Comply with UL 50 and UL 50E.
2. Key all lock assemblies alike.
3. Mount clear plastic directory cardholder or welded metal frame directory cardholder on inside of door.

4. Type 1 Enclosures:
    a. Provide surface-mounted or flush-mounted enclosures as indicated on drawings.
    b. Boxes:
        1) Hot zinc dipped galvanized steel; unpainted galvannealed steel is not acceptable.
        2) Provide removable end walls with knockouts at one end.
        3) Provide standard 5.75-inch deep enclosures with permanently affixed interior mounting studs; provide interior mounting brackets as required.
        4) Box Width:
            a) Standard Box Width: 20 inches; provide box widths of 26 inches or 27 inches where required by application.
    c. Fronts:
        1) Finish: ANSI 49 gray enamel paint baked onto cleaned, phosphatized steel.
        2) Provide one-piece fronts with door.
        3) Provide doors with rounded corners and edges, free of burrs.
        4) Provide cylindrical tumbler-type lock with catch and spring-loaded steel door pull, quarter-turn fasteners, or three-point latch.

G. Markings and Labeling:
    1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
    2. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
    3. Provide nameplates containing system information and catalog number or factory order number.
    4. Display interior wiring diagram, neutral wiring diagram, and short circuit current rating on interior or in booklet format.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break circuit breakers with over-center, trip-free toggle mechanism; ratings, configurations, and features/accessories as indicated on drawings.

B. Comply with FS W-C-375; listed labeled as complying with UL 489.

C. Interrupting Capacity: As required to provide short circuit current rating indicated.

D. Multi-Pole Circuit Breakers: Provide common tripping for all poles.

E. Thermal Magnetic Circuit Breakers:
    1. Provide permanent trip unit with thermal and magnetic trip elements in each pole.
    2. Thermal Elements: True RMS-sensing, factory calibrated to operate in 104 degrees F ambient temperature; ambient compensating above 104 degrees F.

F. Vertically Mounted Main Circuit Breakers and Sub-Feed Circuit Breakers:
    1. Trip Units:
        a. Up to 400 A: Thermal magnetic.
        b. Above 400 A: Electronic trip.
    2. Electronic Trip Units:
        a. Basic Electronic Trip Units: Provide adjustable trip current.

b. Where indicated on drawings, provide electronic trip units with field-adjustable long-time and instantaneous protection settings.
c. Provide current transformers combining iron-core sensors for self-powered electronics and air-core, Rogowski coil sensors for measurement accuracy.

3. Provide push-to-trip button for maintenance and testing purposes.
4. Indicate rated ampacity on circuit breaker handle and faceplate.
5. Listed for reverse connection without restrictive line or load markings.
6. Frame Sizes Above 125 A: Provide single magnetic trip adjustment on front of circuit breaker to simultaneously select desired trip level of all poles.
7. Provide escutcheon with international I/O markings in addition to standard ON/OFF markings.
8. Lugs:
   a. Listed to accept solid or stranded copper and aluminum conductors.
   b. Listed to accept 75 degree C rated wire.
   c. Bolt lug body in place; snap-in designs are not acceptable.
9. Listed for use with the following accessories:
   a. Shunt trip.
   b. Undervoltage trip.
   c. Ground fault shunt trip.
   d. Auxiliary switch.
   e. Alarm switch.
   f. Mechanical lug kits.
   g. Compression lug kits.
   h. Handle Locking Provisions: For locking handle in ON or OFF position.
10. Products:
    a. Schneider Electric; Square D PowerPacT series.

G. Horizontally Mounted and Back-Fed Main Circuit Breakers:
1. Trip Units: Thermal magnetic.
2. Operating Range: Between 14 degrees F and 140 degrees F.
3. Provide two forms of visible trip indication:
   a. Circuit breaker handle resides in position between ON and OFF.
   b. Red Visi-Trip indicator appears in clear window of circuit breaker housing.
4. Lugs:
   a. Listed to accept solid or stranded copper and aluminum conductors.
   b. Listed to accept 75 degree C rated wire.
5. Listed for use with the following factory-installed accessories:
   a. Shunt trip.
   b. Auxiliary switch.
   c. Alarm switch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions.

B. Install panelboards in accordance with NECA 1 and NEMA PB 1.1.

C. Maintain proper phasing for multi-wire branch circuits.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
   1. Include necessary material, equipment, labor, and technical supervision.
   2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.

C. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

D. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads within 20 percent of each other.

E. Inspect tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's written specifications.

3.03 PROTECTION

A. Protect installed panelboards from subsequent construction operations.

END OF SECTION 26 24 16.11

SECTION 26 28 13

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 28 16.16 - Enclosed Switches: Fusible switches.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
   1. Spare Fuse Cabinet: Include dimensions.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.02 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
   1. Class RK1, Time-Delay Fuses:
   2. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
   3. Class RK5, Time-Delay Fuses:
   4. Class RK5, Fast-Acting, Non-Time-Delay Fuses:

H. Class J Fuses: Comply with UL 248-8.
   1. Class J, Fast-Acting, Non-Time-Delay Fuses:

I. Class L Fuses: Comply with UL 248-10.

1. Class L, Fast-Acting, Non-Time-Delay Fuses:

J. Class T Fuses: Comply with UL 248-15.

K. Class CC Fuses: Comply with UL 248-4.
1. Class CC, Fast-Acting, Non-Time-Delay Fuses:

L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

END OF SECTION 26 28 13

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 28 13 - Fuses.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

G. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection,

examination, preparation, installation, and starting of product.

G. Project Record Documents: Record actual locations of enclosed switches.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.06 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

E. Substitutions: See Section 01 60 00 - Product Requirements.

F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

G. Provide with switch blade contact position that is visible when the cover is open.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

L. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

END OF SECTION 26 28 16.16

SECTION 26 29 23

POOL PUMP VARIABLE FREQUENCY DRIVES (VFD'S)

1. GENERAL

1.01 DESCRIPTION

A. Furnish all labor, materials, tools, and equipment, as indicated, in accord with provisions of Contract Documents.

B. Completely coordinate with work of all other trades.

C. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation shall be furnished and installed as part of this work.

D. See Section 26 00 00 for General Electrical Requirements.

E. See Division 1 for General Requirements.

F. Coordinate all requirements with Contractor providing equipment including but not limited to contacts, bypass, and controls.

1.02 RELATED WORK

A. Section 26 05 26 – Grounding and Bonding for Electrical Systems

B. Section 26 05 53 – Identification for Electrical Systems

C. Section 26 28 13 – Fuses

D. Section 26 28 16.16 - Enclosed Switches

1.03 REFERENCE STANDARDS

A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

B. UL 61800-5-1 Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 01, General Conditions of the Contract, and Section 26 00 00.

B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.05 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Submit operation and maintenance data under provisions of Section 26 00 00 and Division 01.

B. Instructions to include recommended maintenance procedures, maintenance schedules, recommended spare parts list, and vendor name for those parts.

1.06 EQUIPMENT START UP AND AGENCY TRAINING

A. Provide the services of a factory trained and certified technician to approve the installation; start-up, test, and adjust for proper operation; and instruct and train the Agency's representative in the operation and maintenance of the unit(s). Upon completion of the equipment startup, submit a complete manufacturer’s field report, including startup and test log, signed by the factory trained technician. Coordinate with other Contractors as required. The startup shall be completed within ten (10) working days from the startup date.

1.07 WARRANTY

A. The warranty shall be for a period of 36 months applied from the date of project Substantial Completion, but not to exceed 42 months from shipment. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

1.08 COORDINATION

A. All line voltage power wiring to equipment, factory mounted control panels, to motor control centers, to and from disconnect switches, and to individually mounted starters, and from starter to motors, shall be provided by the Pool Electrical Contractor.

B. Vendor/Contractor that specifies "starters by Electrical Contractor" shall furnish project specific wiring diagrams to Pool Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor. In addition, furnish complete sets of wiring diagrams for Owner's bound maintenance manual.

C. All line, or low voltage, wiring which is not indicated on the drawings, or specified, but necessary to complete the installation, shall be provided by this Division.

2. PRODUCTS

2.01 MANUFACTURERS

A. ABB 580 Series.

B. Cutler Hammer-Eaton.

C. Alternate manufacturer’s requests shall be submitted in writing to the engineer for approval at least 20 working days prior to bid. A compliance list, point by point to this specification, shall be provided. Factory authorized local support for service for warranty shall be identified.

2.02 DESIGN AND CONSTRUCTION

A. The unit shall be variable torque, modular design for control of the motors as specified by others, to be furnished by Pool Electrical Contractor and rated at the motor full load nameplate amps.

B. The unit shall be U.L. listed (UL 61800-5-1), solid state, microprocessor-based with a pulse width modulated (PWM) output wave form (no others are acceptable).

C. The VFD shall employ a full wave bridge rectifier, to prevent line notching, with dual DC bus choke, capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.
   1. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on all printed circuit boards.

D. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 95% non-condensing. The VFD's shall be rated to Class 3S2 Pollution degree 2 according to IEC/EN 61800-5-1. The entire VFD package shall be UL listed at a minimum of 65,000 amps SCCR. Pool Electrical Contractor shall submit short circuit calculations for review if they plan to submit shop drawings for VFD's with an SCCR rating of less than 65,000 amps.
   1. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same conduit.

E. The unit enclosure shall be UL Type 12 (IP55) enclosure minimum. All components shall be fully factory assembled and tested prior to leaving the manufacturing facility.

F. Include the following operating and monitoring devices mounted on the front cover:
   1. Fused disconnect switch with a door interlocked handle and lock-open padlocking provisions.
   2. Operating mode selector switch marked "hand-off-auto". Manual speed adjustment via keypad, mounted on the door.
   3. Provide a manual bypass circuit and bypass starter to transfer from Variable frequency drive operation to bypass operation.
   4. Pilot light marked "RUN".

G. Starters shall have provisions for additional control requirements such as, but not limited to inputs and outputs for connection to external relays and equipment where required.

2.03 PERFORMANCE REQUIREMENTS

A. Units shall be suitable for input power of electrical system as scheduled on the drawings ±10 to 15%, 3 phase. The VFD shall operate with line voltage +30% and -35%. All faults shall be selectable for manual or auto restart. The VFD shall detect when a motor disconnect is open and shall disable the VFD.
   1. Provide minimum 5% line reactor in each AC phase on the input side or 5% dual DC bus reactors to reduce harmonic voltage distortion. Limit line noise, as measured at the point of common coupling, to a 5% VTHD or less as defined in IEEE-519, latest edition. If the distortion is greater than that allowed by IEEE-519, latest edition, additional filters shall be changed in size to ensure compliance. The supplier of the VFD shall provide distortion calculations in the submittal.

B. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

C. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 10:1 turndown.

D. Additional performance capabilities to include the following:
   1. Ride through a momentary power outage of not less than 15 cycles.
   2. Short circuit and ground fault output protection (power applied only and running).
   3. Start into a rotating load without damage to drive components or motor.
   4. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage.
   5. Programmable time delay following a run command.
   6. Input power factor: Min 0.95 throughout the speed range.
   7. VFD's shall have a UL listed Short Circuit Withstand Rating of 65,000 AIC.
   8. Minimum efficiency: 95% at 100% speed, 85% at 50% speed.

2.04 CONTROL FEATURES

A. Use control circuits compatible with input signal from control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the control system in the form that it is sent. Coordinate with Vendor/Contractor supplying control system and or motor.

B. Include the following additional control features:
   1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control.
   2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from a compatible control system. Include an RS-485 port with BACnet protocol. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable.
   3. Local speed control at the VFD.
   4. Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted.
   5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation.
   6. Three (3) sets of programmable form "C" contacts for remote indication of variable frequency drive condition. Note: default programming to be set for "Drive Ready, Drive Run & Fault".
   7. Illuminated display keypad. VFD that use codes are not acceptable.
   8. External Fault indicator in plain English that is programmable (i.e. "motor disconnect open").
   9. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop.
   10. One (1) input for a N.C. dry contact type input for external faults: (freeze-stats, fire alarm, E-stop, etc). This input shall be factory wired to prevent both the VFD and bypass starter (if provided) operation when external fault is present.
   11. Jumpered terminals for remote "Emergency Stop" controls.
   12. Provide Safe Torque Off circuit according to EN 61800-5-2: 2016, IEC 61508 Parts 1-2:2010, ISO 13849-1:2015, ISO 13849-2:2012, IEC 62061:2015 SIL 3/PL shall be provided in the base VFD.

2.05 PROTECTION FEATURES

A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:
   1. Activation of any safety device.

2. Instantaneous overcurrent and/or over voltage of output.
3. Power line overvoltage and undervoltage protection.
4. Phase loss.
5. Single and three phase short circuiting.
6. Ground faults.
7. Control circuit malfunction.
8. Over temperature.
9. Output current over limit.

B. Provide the following additional protective features:
1. Input transient overvoltage protection up to 3,000 volts per ANSI 37.90A. Coordinated AC transient surge protection system consisting of 4 MOV's (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOV's shall comply to UL 1449 4th Edition.
2. DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level.
3. Where a control transformer is part of the assembly, provide using for the control circuit transformer.
4. Ground control chassis.
5. Motor heating functions prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts".

C. Provide the following additional protective features:
1. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

2.06 DIAGNOSTICS

A. Provide an English character display (no error codes) with indicators for the following:
1. Phase Loss
2. Ground Fault
3. Over Current
4. Over Voltage
5. Under Voltage
6. Over Temperature
7. Overload
8. DC Buss Status

B. Keypad to have Bluetooth interface with a free phone app that has all the functions the keypad does. There shall be a built-in time clock in the control panel with 10-year battery back-up. The calendar and time clock can be used for programmed start/stop and other functions. Bluetooth connectivity shall allow uploading, downloading, and emailing of parameters.

2.07 QUALITY ASSURANCE TESTS

A. Use a factory heat stress test to verify proper operation of all functions and components under full load. Each VFD shall be tested on a motor load. Test results to be provided.

B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at the owner's discretion and may include any specified feature, including operation of protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by this contractor.

C. Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in the presence of the owner's representative, for the following items:
   1. Provide general inspection to verify proper installation.
   2. Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds.
   3. Measure and record voltage distortion factor and line notch depth at the point of common coupling. Provide the recorded value as part of the startup report.

2.08 BYPASS EQUIPMENT

A. See Equipment Schedule on drawings and provide bypass starts where indicated. There shall be a VFD-Off-Bypass selector switch or keypad that shall be separate from the VFD keypad. The bypass shall have a separate power supply from the VFD.

B. The bypass control circuit shall include its own H-O-A switch to run in bypass without an external run command. The bypass shall be able to operate with the VFD removed for service.

C. Bypass configuration. Provide one main circuit breaker to isolate both the drive and bypass circuit. Bypass configuration shall consist of one input drive contactor, one output drive contactor and one output bypass contactor, the two output contactors shall be mechanically and electrically interlocked.

D. Provide motor overload protection in the bypass circuit.

E. Provide high speed fuses for the VFD (not in the bypass circuit). The VFD and bypass shall be UL listed for 65,000 amps SCCR minimum.

2.09 LINE REACTORS

A. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD.

B. Line reactor shall be a three phase inductor, 5% impedance, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

3. EXECUTION

3.01 VARIABLE FREQUENCY DRIVES

A. Install where indicated on drawings and in accordance with approved submittals and manufacturer's published recommendations. Installation to be by the Division 26 contractor.

B. Input wiring shall be installed in a separate conduit system, output wiring shall be installed in a separate conduit system and control wiring shall be installed in a separate conduit system. Do not mix input power, output power, or control wiring in a common conduit.

C. Control signal for drive will be provided as indicated on drawings.

1. VFD manufacturer to perform a field test of each drive and provide Owner operational and maintenance training.

3.02 REMOTE EMERGENCY STOP

A. Factory jumper shall be removed from VFD Emergency Stop terminals. Terminals shall be wired to emergency stop pushbuttons as shown on the plans. Feature shall be programmed for Manual Reset that must occur at the VFD. VFD shall not automatically reset when emergency stop pushbuttons are reset.

END OF SECTION 26 29 23

SECTION 31 23 16

EXCAVATION

PART 2 PRODUCTS

1.01 MATERIALS

A. Bedding and Fill to Correct Over-Excavation:
   1. See Section 31 23 23 for bedding and corrective fill materials at general excavations.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.
   1. Resurvey benchmarks during installation of excavation support and protection systems and notify Owner if any changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

2.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Notify utility company to remove and relocate utilities.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect plants, lawns, and other features to remain.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

2.03 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.

2.04 EXCAVATING

A. Excavate to accommodate new structures and construction operations.

B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which

are excessively moist due to lack of dewatering or surface water control.

2.05 SUBGRADE PREPARATION

A. See Section 31 23 23 for subgrade preparation at general excavations.

2.06 FILLING AND BACKFILLING

A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.

B. See Section 31 23 23 for fill, backfill, and compaction requirements at general excavations.

2.07 REPAIR

A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.

2.08 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

2.09 CLEANING

A. Remove excess excavated material from site.

2.10 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION 31 23 16

SECTION 31 23 23

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade.

B. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.

1.03 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses 2017.

B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2021, with Errata (2022).

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.

D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) 2012 (Reapproved 2021).

F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data for Manufactured Fill.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

D. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill - Fill Type Class 6: Complying with State of Colorado Highway Department standard.

B. Granular Fill - Fill Type Class 6: Coarse aggregate, complying with State of Colorado Highway Department standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

F. Correct areas that are over-excavated.
   1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

G. Compaction Density Unless Otherwise Specified or Indicated:

H. Reshape and re-compact fills subjected to vehicular traffic.

I. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Under Interior Slabs-On-Grade:
   1. Use granular fill.

2. Compact to 95 percent of maximum dry density.

C. At Foundation Walls and Footings:
   1. Use granular fill.
   2. Do not backfill against unsupported foundation walls.

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

END OF SECTION 31 23 23

SECTION 32 13 14

CONCRETE WALKS AND DECKS

PART 1 - GENERAL

1.01 Section Includes

A. Scope of Work – The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely install concrete decks, walks and sub base as indicated in the Contract Documents.

1.02 Related Sections

A. Division 1
B. Division 3 – Section Miscellaneous Concrete
C. Division 31 – Section “Earth Moving” for subgrade preparation, grading, and subbase course.

1.03 References

The Publications listed below form a part this specification to the extent referenced. The Publications are referred to within the text by the basic designation only and are modified as hereafter provided. If provisions conflict, the more stringent shall apply.

A. American Concrete Institute (ACI) – www.aci.org
   1. ACI 301 – Specification for Structural Concrete
   2. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. ASTM, International (ASTM) – www.astm.org
   1. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   2. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   3. ASTM C33 – Specification for Concrete Aggregates
   4. ASTM C91 – Standard Specification for Masonry Cement
   5. ASTM C94 – Specification for Ready Mixed Concrete
   6. ASTM C144 – Standard specification for Aggregate for Masonry Mortar
   7. ASTM C150 – Specification for Portland Cement
   8. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete
   9. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes
   10. ASTM C260 – Specification for Air-Entraining Admixtures for Concrete
   11. ASTM C309 – Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete
   12. ASTM C404 – Standard Specification for Aggregates for Masonry Grout
   13. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Filler for Concrete Paving and Structural Construction.
   14. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   15. ASTM D4254 – Standard Text Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

C. American Association of State Highway Testing Organization (AASHTO) http://www.transportation.org/
   1. AASHTO M182 – Burlap Cloth made from Jute or Kenaf

2. AASHTO T99 – The Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12") Drop.

1.04 Submittals

A. Quality Assurance/Control Submittals
1. Design Data, Test Reports
a. Laboratory Test Reports: Submit two (2) copies of laboratory test reports of concrete materials and mix design tests 30 days prior to any concrete work.
b. Test Panel: Contractor shall prepare test panel on site of a minimum 8' x 8' for approval of the surface texture. If this panel is accepted by the owner, it may be used as part of the deck construction. If the test panel is unacceptable, it shall be removed and replaced with a panel which is acceptable to the owner at no additional cost.
2. Certificates
a. Concrete Testing Service: The Contractor shall engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixtures.

1.05 Quality Assurance

A. Qualifications
1. Manufactures Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C94 / C94M requirements for production facilities and equipment.

B. Regulatory Requirements
1. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
2. ACI Publications: Comply with ACI 304. Recommended Practice for Measuring, Mixing, and Placing concrete.
3. Comply with requirements of all authorities having jurisdiction.

C. Certifications
3. Materials and installed work may require testing and retesting at any time during the progress of the work. Retesting of rejected materials and installed work shall be done at the Contractor's expense.

D. Mock-ups: Cast mock-ups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
1. Build mock-ups in the location and of the size indicated.
2. Obtain Owner / Aquatic Designer's approval of mock-ups before starting construction.
3. Maintain approved mock-ups during construction in an undisturbed condition as a standard for judging the completed pavement.
4. Approved mock-ups may become part of the completed work if undisturbed at time of Substanti8al Completion.

1.06 Project/Site Conditions
A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities. Allow free access to material stockpiles and facilities at all times.

PART 2 - PRODUCTS

2.01 Materials

A. Aggregate Base Course

1. Crushed Stone: Crushed stone shall be the angular arrangement resulting from crushing by mechanical means the following types of rock quarried from undisturbed, consolidate deposits: granite and similar phanero-crystalline igneous rocks; limestone; dolomite sandstone; or massive metamorphic quartzite, or similar rocks. Dolomite shall be a carbonate rock containing 11.0 percent or more magnesium oxide (MgO). Limestone shall be a carbonate rock containing less then 11.0 percent magnesium oxide (Mg).
2. Gradation:

Sieve Size	% Passing
1 ½"	100
1	95±5
½"	75±15
No. 4	43±13
No. 16	25±15
No. 200	8±4

B. Forms

1. Strengths of forms to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use Forms that are straight and free of distortion and defects.
   a. Use flexible or curved forms or laminated boards to form radius bends as required.
2. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

C. Steel Reinforcement

1. Plain-Steel Welded Wire Reinforcement: ASTM A185, fabricated from as-drawn steel wire into flat sheets.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60.
3. Joint Dowel Bars: Plain steel bars, ASTM A615/A615M, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Concrete Materials

1. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
   a. Portland Cement: ASTM C150, Type 1.
   b. Fly Ash: ASTM C618, Class C or F.
2. Normal-Weight Aggregates: ASTM C33, coarse aggregate, uniformly graded. Provide aggregates from a single source.
   a. Maximum Coarse – Aggregate Size: 1 inch nominal.
   b. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. Water: ASTM C94/C94M.
4. Air-Entraining Admixture: ASTM C260.
5. Calcium Chloride: Do not use calcium chloride in concrete.

E. Curing Materials

1. Absorptive Cover: AASHTO M182, Class 3, burlap cloth made from jute or kenaf, weighting approximately 9 oz./sq.yd. dry.
2. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet. Type 1 or Type 2.
3. Polyethylene sheeting: AASHP M171.
4. Polyethylene-Coated burlap.

5. Water: Potable.

F. Expansion Joint Filler
1. Expansion Joint Filler Strips: ASTM D1752, cork or self-expanding cork.
a. Except where joints are shown sealed, ASTM D1752.

G. Joint Sealant
1. Single Component, gun-grade polyurethane joint sealant conforming to ASTM C 920-86, TT-S-00230C. Vulkem 116 approved equal.

H. Mortar and Grout Materials
1. Portland Cement – Lime Mix: Package blend of Portland cement complying with ASTM C150, Type 1 or Type 3 may be used for cold weather construction.
a. Provide natural color or white cement.
2. Hydrated Lime: Comply with ASTM C207.
3. Masonry Cement: ASTM C91
4. Aggregate for Mortar: ASTM C144; except for joints less than ¼" thick, use aggregate graded with 100% passing the No. 16 sieve.
5. Aggregate for Grout: ASTM C404.
6. Water: Potable.

2.02 Components

A. Deck Drains and/or Grates
1. Deck drains or grates as indicated.
2. Area Drain inlets shall be "NDS" No. 642, 6"x6" structural foam Polyethylene Adapter and Grate with stainless steel screws or approved equals. (NDS is National Diversified Sales, Inc., 805.389.6700)

B. Manufactured Trench Drain
1. Shall be NDS Pro Series channel drain, part number 814 as needed.
2. Pro Series drain color to be selected by owner.
3. Shall be Lawson Aquatics "Drain-the-Deck" system. Grating has three color choices to be selected by owner.
4. Shall be Daldorado Capshure 4" Deck Drain system. Grating has three color choices to be selected by owner.

2.03 Mixes

A. Concrete Mixtures
1. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
a. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
2. Proportion mixtures to provide normal-weight concrete with the following properties:
a. Compressive Strength (28 days): 4000 psi.
b. Slump Limit: 2" – 4".
3. Add Air-entraining admixture at manufacture's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
a. Air Entrainment: 5% to 8% for 1-1/2" nominal maximum aggregate size.
4. Maximum Cement Content: 6 Sacks (564 lbs) per cubic yard of concrete.

B. Concrete Mixing

1. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
    a. When air temperature is between 85 deg. F, and 90 deg. F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 Examination

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Roll prepared subbase surface to a smooth and uniform texture free from lumps, rocks, pockets, soft spots, and spongy areas.
1. Subbase with soft spots and areas of pumping or rutting require correction according to requirements in Division 31 Section “Earth Moving.”

C. The base course shall consist of furnishing and placing one or more courses of aggregate on a prepared subgrade or subbase.
1. Place the base course in layers not more than four (4) inches (compacted) in thickness, except that if tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of eight (8) inches.
2. Compaction
    a. The granular material shall be compacted to not less than 98% of the standard laboratory density.
    b. The standard laboratory density shall be the maximum density determined in accordance with AASHTO T99 (Method A or C).
    c. If test indicate that a base course does not comply with the density requirements, additional wetting, if necessary, and rolling will be required until the density is obtained.
    d. Moisture shall be added to the material during compaction only when it is necessary to increase the percentage of moisture to obtain the required density.
    e. Facilities such as slab on grade, sidewalks, roadways, and drives shall be stripped of all vegetation and topsoil. These areas then should be proof rolled using a minimum of twenty ton. All yielding and unstable areas should be excavated and backfilled using select fill material consisting of crushed stone CA-6. All backfill should be placed in maximum loose lifts of eight (8) inches and compacted to a minimum of 75” relative density as per ASTM D4253 and ASTM D4254.

D. Proceed with concrete pavement operations only after unsatisfactory conditions have been corrected and subgrade is ready to receive pavement.

3.02 Preparation

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 Edge Forms and Screed Construction

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous

progress of work and so forms can remain in place at least 24 hours after concrete placement.

1. Design form work to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
2. Check completed formwork for grade and alignment to the following tolerance:
   a. Top of Form Units: Not more than 1/8" in 10'-0".
   b. Vertical Face: Longitudinal axis, not more than ¼" in 10'-0".
3. Clean Forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 Installation Steel Reinforcement

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bars supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full square, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 Joints

A. General: Form joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
   1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Construction joints shall coincide with expansion joints.

3.06 Expansion Joints

A. Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, wall and other fixed objects.

B. Locate expansion joints at 20' O.C., unless otherwise shown.

C. Extend joint fillers full width and depth of joint. Furnish joint filler in one piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler section together. Form top edge of filler to conform to top profile of concrete except where sealing is indicated.

D. Except where sealing is indicated, protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after both sides of joint are in place.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated on drawings. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   a. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with at recommended cutting tool and finishing with a jointer.

b. Sawed Joints: Form contraction joints with power saw equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8” wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3.07 Application Concrete Placement

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site, unless indicated in the approved design mix.

F. Do not add water to concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanically vibrating equipment supplemented by hand spading, rodding, or tamping.
1. Consolidate concrete along face of forms and adjacent to transverse joints with and internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Screed pavement surfaces with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before beginning finishing operations or spreading surface treatments.

K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-daycompressive strength.

L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing action, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg. F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F. and not more that 80 deg. F. at any point of placement.
2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemicals accelerators unless otherwise specified and approved in mix design.

M. Hot Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg. F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Aquatic Designers option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture without standing water, soft spots, or dry areas.

3.08 Construction Float Finishing

A. General: Do not add water to concrete surfaces during finishing operations.
1. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.09 Concrete Protection and Curing

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.
1. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
2. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
a. Moist Curing: Keep surfaces continuously most for not less than three days with the following materials:
b. Water.
c. Continuous water-fog spray
d. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edge with 12” lap over adjacent absorptive covers.
3. Moisture-Retaining-Cover Churning: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12”, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.10 Removal of Forms

A. Formwork may be removed 24 hours after placing concrete, provided concrete is sufficiently cured to not be damaged by form removal operations, and provided curing and protection operation and maintained.

3.11 Repair/Restoration

A. Panels which are not finished to the satisfaction of the Aquatic Designer shall be removed and replaced at no cost to the Owner.
   1. Protect concrete from damage. Exclude traffic from pavement until concrete has obtained at least 75% design strength. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains, and spillage of materials as they occur.

3.12 Trench Drain Appurtenances

A. Trench drains shall be installed per manufacturer's instruction with surrounding concrete deck, to provide proper drainage into channel, and not create a tripping hazard.

B. The Low-Profile Housing Adapter shall be caulked in directly above each drop-out in the trench drain system. Screw the Grate into the Housing Adapter.

C. Remove all sharp and jagged edges prior to turnover to owner.

3.13 Quality Control

A. Site Procedures/Tests, Inspection
   1. Manufacturers' Field Services
   2. Laboratory Procedures/Tests, Inspection

3.14 Cleaning

A. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign materials prior to final inspection.

END OF SECTION

SECTION 32 31 15

CHAIN LINK FENCING

PART 1 - GENERAL

1.01 Section Includes

A. Scope of Work – The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely install PVC Coated Chain Link Fencing as indicated in the Contract Documents.

1.02 Related Sections

A. Division 1

B. Section 32 31 30 – Post / Net / Rope Barriers

1.03 References

The Publications listed below form a part this specification to the extent referenced. The Publications are referred to within the text by the basic designation only and are modified as hereafter provided. If provisions conflict, the more stringent shall apply.

A. ASTM, International (ASTM) www.astm.org

1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
4. ASTM C94 – Specification for Ready Mixed Concrete
5. ASTM F567 – Standard Practice for Installation of Chain-Link Fence
6. ASTM F900 – Standard Specification for Industrial and Commercial Swing Gates
7. ASTM F1043 – Standard Specification for Strength and Protective Coating on Steel Industrial Chain Link Fence Framework.
8. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

B. Chain Link Fence Manufacturer's Institute (CLFMI) www.chainlinkinfo.org

1. Standard guide for metallic-coated steel chain link fence fabric.
2. Industrial steel guide for fence rails, posts, gates, and accessories.
3. Standard guide for polyvinyl chloride (PVC) coated steel chain link fence fabric.

C. Federal Specification http://apps.fss.gsa.gov/pub/fedspecs/

1. RR-F-191 – Fencing, Wire, and Post , Metal (Chain Link Fence Posts, Top Rails and Braces)

1.04 Submittals

A. Product Data

1. Metal fencing, fabric, gates, and accessories.

1.05 Quality Assurance

A. Qualifications

1. Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of the work described for this section, and who shall be present at all times during progress of the work of this section and shall direct all work performed under this section.

1.06 Delivery, Storage, and Handling

A. Storage and Protection

1. Use all means necessary to protect the fence and gate materials before, during, and after installation and to protect the installed work and materials of all other trades.

PART 2 - PRODUCTS

2.01 Materials

A. Chain Link Fabric

1. Use chain link fabric as required to obtain six (6) foot height requirement. Chain link fabric shall be of a 9-guage (0.148"± 0.005", core wire size) galvanized steel, two (2) inch mesh shall have a minimum of not less than .021 thickness colored PVC coating over a 0.40 ounce zinc substrate, minimum 1290 pounds breaking strength, with a minimum of 6 ga. Finish wire diameter. Comply with ASTM F668, Class 2, except provide fabric with diameter (gauge) of core wire equivalent to fabric diameter specified when measured prior to application of non-metallic coating. Fabric shall be knuckled at both selvages. Furnish one piece fabric width for fencing up to 12' high.

B. Framework

1. All line post, terminal post, top rails, intermediate rails, and fittings shall be galvanized zinc steel, ASTM F1083, with not less than 1.8 oz. zinc per square foot of surface area and 12 mils PVC thickness.
2. Fittings and accessories: Galvanized, ASTM A153, with zinc weight per Table 1.

C. Line Posts

1. Shall be one of the following:
   a. 2-1/2" O.D. Schedule 40, ASTM A53, 3.65 pounds/LF.
   b. S-40-ASTM A1011, 3.12 pounds/LF.
   c. Standard C Section ASTM F1043, 2.28 pounds/LF.
   d. H Section ASTM F1043, 3.26 pounds/LF.

D. Gate Posts

1. Shall be one of the following:
   a. 3" O.D. Schedule 40, 5.79 pounds/LF.

b. SS-40, 4.64 pounds/LF.
c. Roll Formed Post, 4.85 pounds/LF.

E. End, Corner, and Pull Posts

1. Shall be one of the following:
   a. 3” O.D. Schedule 40, 5.79 pounds/LF.
   b. SS-40, 4.64 pounds/LF.
   c. Roll Formed Post, 4.85 pounds/LF.

F. Top and Intermediate Rails, and Bottom Tension Wire

1. Rails shall be: longest lengths available, with expansion type couplings, approximately 6” long, for each joint. Provide with means for attaching securely to each post other than line posts. Provide and install posts as required. Shall be one of the following:
   a. 1-5/8” O.D. Schedule 40, 2.27 pounds/LF.
   b. S-40, 1.84 pounds/LF.
   c. Roll Formed Rail, 1.37 pound/lf with Galvanizing.
2. Manufacturer’s standard bottom tension wire system.

2.02 Equipment

A. Fabric Ties

1. Fabric ties used to secure fabric to framework shall be aluminum extruded type .9-gauge outside diameter.

B. Hog Rings, Bolts, and Nuts

1. The above components shall be coated with .007 mils film thickness of Phenolic baked phosphate enamel capable of 250 hours salt spray test.

C. Post Brace Assembly

1. Adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.0375” diameter rod and adjustable tightener.

D. Caps, Bands, and Connectors

1. All caps, bands, and connectors used in construction of chain link fence shall be galvanized pressed steel, malleable or cast steel, or aluminum alloy. Provide a weather tight closure cap designed to receive top rail.

E. Stretcher Bars

1. One-piece lengths equal to full height of fabric, with minimum cross section of 3/16” x 3/4”. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.

F. Stretcher Bar Bands

1. Space not over 15” o.c.

2.03 Fabrication

A. Gate Fabrication

1. Fabricate perimeter frames of gates from metal and finish to match fence framework. Assemble gate frames by wielding or with special fittings and rivets for ridge connections, providing security against removal or breakage connections.
2. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members' maximum of 8' apart.
3. Provide same fabric as for fence. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretcher bars to gate frame at not more than 15" o.c.
4. Install diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist.

B. Swing Gates:

1. Fabricate perimeter frames of minimum 2" O.D., SS 40 galvanized pipe frame, braced with 1-5/8" O.D., SS 20 PVC coated galvanized pipe, trussed with 3/8" galvanized rod, welded construction, filled with fabric to match fence.

C. Swing Gate Hardware

1. Provide hardware and accessories for each gate, galvanized per ASTM F900, and in accordance with the following:
   a. Hinges: size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6' nominal height.
   b. Latch: forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
   c. Keeper: Provide keeper which automatically engages gate leaf and holds it in open position until manually released.
   d. Double Gates: provide gate stops for double gates, consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.

PART 3 - EXECUTION

3.01 Installers

A. Installation to conform to ASTM F567 and as described in these specifications. Installation shall be made in a workmanlike manner by skilled mechanics, experienced in erection of this type fence. The fence shall be erected on lines and to grades as provided by the General Contractor. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

3.02 Erection

A. Posts

1. All posts shall be set in concrete foundations in the ground or in pipe sleeves as detailed on the contract documents. Concrete shall conform to the standard ASTM C94, 3000 p.s.i. @28 days.
2. The diameter of the foundation to be a minimum of nine (9) inches except for terminal posts on which the minimum diameter shall be three times the outside diameter of the post. All foundations shall slope away from the post to assure proper drainage or as detailed on the contract documents.
3. All posts shall be of sufficient length to provide thirty-six (36) inch setting in concrete footings.
4. Excavation: drill or hand excavate (using post hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
    a. Excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than 4 times largest cross-section of post.
    b. Excavate hole depths approximately 3” lower than post bottom, with bottom of posts set not less than 36” below finish grade surface.
5. Setting Posts: Center and align posts in holes 3” above bottom of excavation.
    a. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
    b. Extend concrete footings 2” above grade and trowel to a crown to shed water.
    c. Allow concrete to attain at least 75% of its minimum 28 day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire, or fabric is installed. Do not stretch and tension fabric and wires, and do not hang gates until the concrete has attained its full design strength.

B. Top / Intermediate Rails / Bottom Wire

1. Intermediate rails shall be installed at all braced sections at terminal posts, either side or a corner or at intervals indicated on the plan.
2. Top Rail: run rail continuously through post caps, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.
3. Bottom Wire: Provide bottom wire. Attach bottom edge of fabric to wire using ties or clips spacing not to exceed 24” o.c.

C. Brace Assemblies

1. Install braces so posts are plumb when diagonal rod is under proper tension.

3.03 Installation

A. Fabric Connection

1. The fabric shall be stretched to proper tension between terminal posts and securely fastened to framework members as covered in the material specifications. The bottom of the fabric shall be held as uniformly as is practical ¼” to ¾” above the finished grade.
2. The chain link fabric shall be securely fastened to all terminal posts using ¼” to ¾” tension bars with heavy 11-gauge 1” wide pressed steel banks spaced approximately fourteen (14”) inches apart. Bands to be equipped with 3/8” diameter carriage bolts and nuts. The fabric to be fastened to all line posts with heavy 6-gauge wire clips spaced approximately fourteen (14”) inches apart and to the top rail with 9-guage tie wires on approximately twenty-four (24”) inch centers.

3. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

B. Stretcher Bars

1. Thread through or clamp to fabric 4” o.c. and secure to posts with metal bands spaced 15” o.c.

C. Gates

1. Shall be of widths as indicated on the contract documents.
2. Shall be full height (6’-0”) panels with manufacturer’s standard bracing system.
3. Shall have center hold-down socket, lift rod and padlocking bar.
4. Install gates plumb, level and secure for full opening without interference.
5. Install ground set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

D. Tie Wires

1. Use “U”-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
2. Tie fabric to line posts with wire ties spaced 12” o.c. Tie fabric to rails and braces with wire ties spaced 24” o.c. Tie fabric to tension wires with hog rings spaced 24” o.c.

E. Fasteners

1. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.04 Construction

A. Site Tolerances

1. Spacing
   a. Maximum 10’-0” o.c.
2. Height
   a. Eight (8’) feet above grade when erected, or as indicated on contract drawings.

3.05 Repair/Restoration

A. In the event of damage, immediately make all repairs or replacements necessary to the approval of the Aquatic Consultant and at no additional costs to the Owner and at the cost of the party responsible for the damage.

END OF SECTION

SECTION 32 91 19

TOPSOIL

PART 1 - GENERAL

1.01 Section Includes

A. Scope of Work – Work of this section includes the furnishing of all necessary labor, supervision, materials, equipment, and services to grade.

1.02 Related Sections

A. Division 31 – Earth Moving

B. 32 13 14 – Concrete Decks and Walks

1.03 References

The Publications listed below form a part this specification to the extent referenced. The Publications are referred to within the text by the basic designation only and are modified as hereafter provided. If provisions conflict, the more stringent shall apply.

A. ASTM D5268 – Standard Specification for Topsoil Used for Landscaping Purposes

1.04 Description

A. Work Includes
   1. Spreading of topsoil
   2. Finish grading of the site.

1.05 Submittals

A. Quality Assurance/Control Submittals
   1. Design Data, Test Reports
      a. Submit two (2) copies of laboratory test reports of the soils analysis performed on the fill and topsoil material in those areas other than structural fill.

1.06 Quality Assurance

A. Qualifications
   1. Provide at least one person who shall be present at all times during execution of this portion of work and who shall be thoroughly familiar with the types of materials procedures and equipment being used and who shall direct all work performed under this section.

B. Regulatory Requirements
   1. Use all means necessary to protect all materials of this section before, during, and after grading to protect all objects designated to remain.
   2. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Aquatic Consultant, and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 Materials

A. All other materials not specifically described but required for proper completion of the work of this section shall be as selected by the contractor subject to the approval of the Aquatic Consultant.

2.02 Topsoil

A. Topsoil for planting beds and sod/seeded turf areas within the project limits by the Contractor shall meet the following criteria.
   1. Topsoil shall be a suitable blend of decayed organic material (humus) and friable loam suitable for sustaining the vegetation specified on the planting plan.
   2. Obtain and submit a soils test of the proposed topsoil to the Owner as evidence of the topsoil's suitability for sustaining the specified vegetation.
   3. The composition of the soil shall generally be fertile, friable, surface soil, containing natural loam and humus and must comply with ASTM D5268.
   4. At least 50% of the nutrients shall be derived from organic sources.
   5. Provide topsoil that is free of stones larger than 1 inch in any dimension and relatively free of weeds, debris, trash, subsoil, clots, sticks, roots, or any other objectionable extraneous matter.

2.03 Source Quality Control

A. Tests, Inspection
   1. The topsoil must be tested for and free of toxic matter harmful to humans or vegetation.

B. Preferred Topsoil Location
   1. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches or more.
   2. Do not obtain from streambeds, bogs, or marshes.

PART 3 - EXECUTION

3.01 Examination

A. Examine areas to receive topsoil for drainage and other conditions affecting performance of work of this section.

B. Prior to all work of this section, coordinate with all other trades, and verify that the work of the other sections is complete to the point where this work may properly commence.

C. All irregularities in the surface of the subgrade shall be filled, smoothed, disced, or raked to provide a uniform surface and suitable bond between the subgrade and topsoil.

D. Do not proceed with work until deficient conditions are corrected.

3.02 Discrepancies

A. In the event of a discrepancy, immediately notify the Aquatic Consultant.

3.03 Preparation

A. Prepare topsoil in accordance with the topsoil's report recommendation and Paragraph 2.02 of this section

3.04 Placement

A. Do not place topsoil until the area to be covered has been shaped and trimmed

B. Spread topsoil in all areas of work not subject to pavement within the project limitations as noted in the Construction Documents.

C. Place and finish topsoil to depths as follows:
   1. 4” under sodded areas.
   2. 6” under seeded areas.
   3. 12” in all planting beds.

3.05 Grading Tolerances

A. General
   1. All grades shown are finished elevation unless specifically noted.
   2. Elevations at points between spot elevations or contours are to be determined by uniform slopes between given grades or elevations, or between such figures and existing grades.

B. Grading Tolerances:
   1. Landscaped areas: plus or minus 0.1 foot.

3.06 Repair/Restoration

A. Restore disturbed topsoil as required.

END OF SECTION

SECTION 32 92 19

SEED / FERTILIZER / MULCH

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Seeding:

a. To consist of preparation of seed beds, furnishing, transporting, and placing the seed and other materials required in the seeding operations in all the areas designated to be seeded and mulched and all areas disturbed by construction outside the confines of the pool perimeter fence.

2. Fertilizing:

a. To consist of furnishing and placing fertilizer required for the operation.

3. Mulching:

a. To consist of furnishing, spreading, and securing a mulch material on all areas seeded.

B. Related sections

1. Section 13 30 00: Submittals Procedures
2. Section 32 91 19: Topsoil
3. Section 32 92 23: Sodding

1.2 SUBMITTALS

A. Product Data: Submit copies of all tags, manufacturer's guarantees and pertinent information relating to this section.

1.3 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all work performed under this section.

1.4 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping:

1. Deliver all items to the site in their original containers with all labels intact and legible at time of Architect's inspection.

B. Storage and Protection:

1. Store seed and fertilizer in a cool dry space until use.

2. Protect seeded areas after seeding and until grass has germinated enough for mowing.
3. Protect the installed work and materials of all other trades.

C. Replacement:

1. In the event of damage or rejection, immediately repair and replace as necessary to the approval of the Architect and at no additional cost to the Owner.

1.5 PROJECT CONDITIONS

A. Environmental Requirements: Comply with environmental requirements and recommendations of seed supplier for proper installation of products.

1.6 WARRANTY

A. Applicator's Warranty: Contractor shall guarantee seeding for one year from the date of substantial completion.

1.7 MAINTENANCE

A. Maintenance Service: Provide a maintenance service contract, paid in advance covering the seeding for a period of one growing season from Substantial Completion of the Work. Such service shall be in addition to warranty service otherwise covered in the Contract and shall include all parts, labor, and consumable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fertilizer: Commercially balanced 10-6-4.

B. Grass Seed:

1. General: All grass seed shall be:

a. Free from noxious weed seeds and recleaned.
b. Grade A recent crop seed.
c. Treated with appropriate fungicide at time of mixing.
d. Delivered to site in sealed containers with the dealer's guaranteed analysis.

C. Mulch Material:

1. Mulch material shall be non-toxic to vegetation and to the germination of seed, free from noxious weeds and weed seeds and shall be approved, prior to application, by the Architect.

a. Straw: Shall be stalks of wheat, rye, oats or other approved straw, and shall be air-dried.
b. Cellulose Fiber: Shall be of commercial manufactures and approved by the Architect.

D. Miscellaneous Materials:

1. All other materials, not specifically described but required for proper completion of the work of this section, shall be as selected by the contractor, subject to the approval of the Architect.

2.2 SEED MIXES

1. Percentage of grass seed mix.
   a. 60% - Kentucky Bluegrass – Poa pratensis containing at least two (2) of the following varieties:
      1) “Adelphi”
      2) “Baron”
      3) “Glade”
      4) “Nugget”
      5) “Parade”
      6) “Touchdown”
      7) “Warren’s A 34”
   b. 20% - Red Fescue – Festuca rubra “Pennlawn” or approved equal.
   c. 20% - Perennial Rye – Lolium perenne
      1) “Manhattan”
      2) “Pennfine”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project conditions and completed Work and verify work is complete to the point that seed installation may properly commence.

B. Immediately correct all deficiencies and conditions which would cause improper execution of Work of this Section and subsequent Work.

C. Proceeding with Work of this Section shall be interpreted to mean that all conditions were determined to be acceptable prior to starting work.

3.2 PREPARATION

A. Fine Grading For Seed Bed
   1. Finish Grading: All finish grading will be performed under Section 32 91 19 of these specifications to the tolerances described therein.
   2. Fine Grading: Upon completion of finish grading, perform all fine grading required in planting areas, using top soil obtained from the site or brought in as required.
   3. The area to be seeded shall be worked to a minimum depth of 3 inches with equipment approved by the Architect.
   4. Remove all soil lumps, rocks, sticks or other deleterious material remaining.

3.3 APPLICATION

A. Fertilizing

1. Apply the specified fertilizer at the rate of 250 bulk lbs. per acre, raking lightly into the soil.

B. Sowing Grass Seed

1. Sow with a seeder approved by the Architect.
2. Sow at a rate of 200 lbs. per acre.
3. Promptly wet seed beds thoroughly after seeding.

    a. Keep all areas moist throughout the germination period.

C. Mulching

1. Method for applying and securing over seeded areas shall be approved by the Architect.
2. Cover seeded areas with mulch within 24 hours of completion.

    a. Cover slopes steeper than 3:1 the same day as the completion of seeding.

3.4 INSPECTION

A. Provide 24 hours notice to Architect of readiness of inspection.

1. Final inspection after completion of seeding: Schedule this inspection sufficiently in advance with Architect so that inspection may be conducted 24 hours after seeding.
2. Acceptance by owner

B. Corrective Actions: Replace or repair Work to eliminate deficiencies and irregularities.

3.5 CLEANING

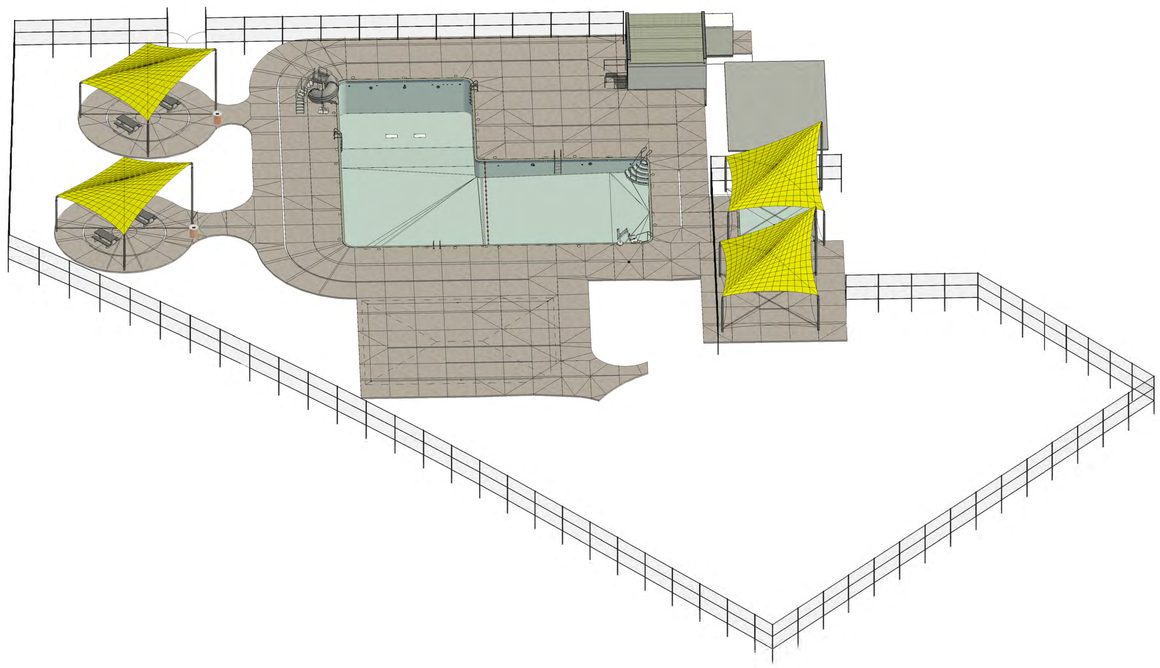
A. Cleaning: Thoroughly clean the specified Work and adjoining surfaces and areas affected by the application.

B. Legally dispose of all trash and debris

END OF SECTION

KIWANIS OUTDOOR POOL

NORTHGLENN, CO



SHEET LIST AQUATICS

SHEET NO.	SHEET NAME
PL001	COVER
D100	DEMOLITION PLAN
D101	DEMOLITION DETAILS
PL100	OVERALL AQUATIC PLAN
PL101	ADA AND DECK CLEARANCE
PL102	GENERAL DETAILS AND SCHEDULES
PL110	POOL A - EXISTING POOL PLAN
PL111	POOL A - EXISTING POOL DIMENSION PLAN
PL112	POOL A - EXISTING POOL SECTIONS
PL113	POOL A - EXISTING POOL SECTIONS
PL114	POOL A - EXISTING POOL DETAILS
PL120	POOL B - EXISTING WADING POOL
PL200	STRUCTURAL NOTES, PLAN(S) AND SCHEDULE
PL210	STRUCTURAL DETAILS
PL300	OVERALL PIPING PLAN
PL301	MECHANICAL NOTES
PL310	POOL A SKIMMER AND SUCTION PIPING PLAN
PL311	POOL A FILTRATION, FILL AND SENSOR PIPING PLAN
PL400	MECHANICAL EQUIPMENT PLAN
PL401	MECHANICAL DETAILS
PL402	MECHANICAL DETAILS
PL403	PIPE SUPPORT DETAILS
PL411	DEFENDER DETAILS (ALTERNATE)
PL500	MECHANICAL SCHEMATIC
PL501	ELECTRICAL SCHEMATIC
PL502	POOL A ELECTRICAL SCHEMATIC (ALTERNATE)
PL600	PIPE PENETRATIONS
SD100	OVERALL DECK PLAN
SD200	DECK PLAN
SD300	GRADING PLAN
SD400	FENCING AND SHADE PLAN
SD500	SITE DETAILS

SHEET LIST ARCHITECTURAL

SHEET NO.	SHEET NAME
A-101	PLANS AND ELEVATIONS
A-301	SECTIONS AND DETAILS
A-302	SECTIONS AND DETAILS

SHEET LIST STRUCTURAL

SHEET NO.	SHEET NAME
S-001	GENERAL NOTES
S-002	GENERAL INFORMATION
S-003	GENERAL STRUCTURAL DETAILS
S-101	FOUNDATION AND FRAMING PLANS, DETAILS, SCHEDULES

SHEET LIST PLUMBING

SHEET NO.	SHEET NAME
P-001	PLUMBING SYMBOLS, SCHEDULES, DETAILS, & ABBREVIATIONS
P-101	PLUMBING PLAN - SANITARY & VENT
P-111	PLUMBING PLAN - DOMESTIC WATER

SHEET LIST MECHANICAL

SHEET NO.	SHEET NAME
M-001	MECHANICAL SYMBOLS AND ABBREVIATIONS
M-101	MECHANICAL PLANS
M-601	MECHANICAL SCHEDULES AND DETAILS

SHEET LIST ELECTRICAL

SHEET NO.	SHEET NAME
ED-100	SITE DEMOLITION PLAN - ELECTRICAL
ED-101	DEMOLITION PLAN - ELECTRICAL
E-001	ELECTRICAL SYMBOLS, ABBREVIATIONS & SHEET INDEX
E-100	SITE PLAN - ELECTRICAL
E-101	FLOOR PLAN - ELECTRICAL
E-111	POOL A - ELECTRICAL POOL PLAN
E-501	ELECTRICAL DETAILS
E-601	ELECTRICAL SCHEDULES
E-701	ELECTRICAL ONE-LINE POWER DIAGRAM & PANEL SCHEDULES

2 | AREA MAP PLAN VIEW
PL001 NOT TO SCALE

3 | VICINITY MAP PLAN VIEW
PL001 NOT TO SCALE

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/27/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

COVER

PL001

GENERAL DEMOLITION NOTES:

1. ALL CONDITIONS SHOWN ON THIS DRAWING ARE EXISTING. OWNER AND ARCHITECT ASSUME NO RESPONSIBILITY FOR ACCURACY OR COMPLETENESS OF INFORMATION SHOWN. CONTRACTORS ARE RESPONSIBLE TO VISIT THE SITE AND REVIEW ALL DOCUMENTS PRIOR TO SUBMITTING THEIR BID TO COMPLETELY FAMILIARIZE THEMSELVES WITH ALL CONDITIONS.
2. DEMOLITION DRAWINGS ARE INTENDED TO BE SCHEMATIC IN NATURE, AND MAY NOT DESCRIBE ALL MISCELLANEOUS WORK NECESSARY TO COMPLETE THE DEMOLITION AND NEW WORK. CONTRACTOR SHALL INCLUDE THIS MISCELLANEOUS NECESSARY WORK IN BASE BID.
3. CONTRACTOR SHALL DISCONNECT AND REMOVE ALL EXISTING POOL EQUIPMENT WITHIN THE LIMITS INDICATED WITH HATCHING ( ). SEE DRAWING NOTES FOR EQUIPMENT THAT SHALL BE REUSED IN PLACE AND EQUIPMENT THAT SHALL BE RELOCATED AND REUSED.
4. CONTRACTOR SHALL DISCONNECT AND REMOVE ALL EXISTING ABOVE GRADE POOL RECIRCULATION SYSTEM PIPING, VALVES, FITTINGS, PIPING SUPPORTS, AND SUPPORT FASTENING HARDWARE. THIS SYSTEM PIPING TO INCLUDE BUT IS NOT LIMITED TO: POOL FILTRATION SUPPLY AND RETURN, POOL CHEMICAL TREATMENT SUPPLY AND RETURN, POOL HEATER SUPPLY AND RETURN, ACTIVITY PUMP SUPPLY AND RETURN, SLIDE PUMP SUPPLY AND RETURN.
5. CONTRACTOR SHALL DISCONNECT AND REMOVE ALL FILTRATION PUMP SUCTION PIPING, VALVES, FITTINGS, PIPING SUPPORTS.
6. UNLESS NOTED OTHERWISE ON THE PLAN, CONTRACTOR SHALL DISPOSE OF ALL REMOVED EQUIPMENT AND MATERIALS IN A LEGAL MANNER OFF SITE. COPIES OF ALL MANIFESTS SHALL BE GIVEN TO THE OWNER SHOWING FINAL DISPOSAL LOCATION OF ALL MATERIALS.
7. CONTRACTOR SHALL MAINTAIN DUST CONTROL INSIDE AND OUTSIDE OF THE BUILDING AT ALL TIMES.
8. CONTRACTOR SHALL PROTECT ALL CATCH BASINS, SEWER INLETS, ETC., FROM DEBRIS AND SEDIMENTATION DURING DEMOLITION.
9. CONTRACTOR SHALL LIMIT THE EXTENT OF HIS DISRUPTION TO THE INDICATED WORK AREA, AND TAKE CARE NOT TO DISRUPT THE SURROUNDING AREA.
10. CONTRACTOR IS RESPONSIBLE FOR COORDINATING AND TERMINATING EXISTING ELECTRICAL POWER, WATER, AND GAS LINES WITH LOCAL UTILITIES.
11. REFER TO STRUCTURAL DRAWINGS, MECHANICAL DRAWINGS, ELECTRICAL DRAWINGS, AND PLUMBING DRAWINGS FOR ADDITIONAL DEMOLITION SCOPE OF WORK.
12. REFER TO ALL OTHER DRAWINGS FOR FURTHER DETAIL ON NEW CONSTRUCTION REQUIREMENTS.

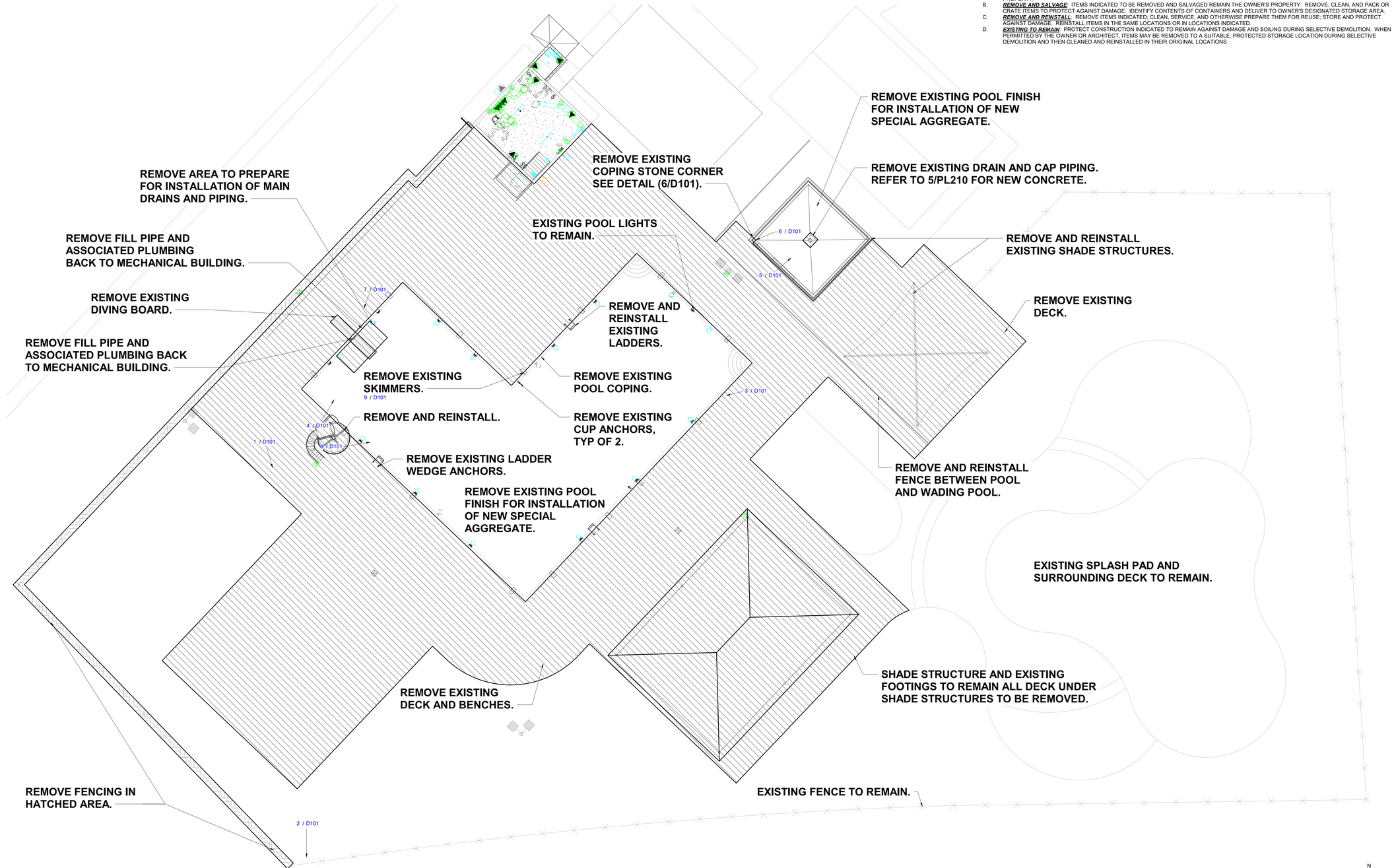
DEFINITIONS:

A. ***REMOVE***: REMOVE AND LEGALLY DISPOSE OF ITEMS EXCEPT THOSE INDICATED TO BE REINSTALLED, SALVAGED, OR TO REMAIN THE OWNER'S PROPERTY.

B. ***REMOVE AND SALVAGE***: ITEMS INDICATED TO BE REMOVED AND SALVAGED REMAIN THE OWNER'S PROPERTY. REMOVE, CLEAN, AND PACK OR CRATE ITEMS TO PROTECT AGAINST DAMAGE. IDENTIFY CONTENTS OF CONTAINERS AND DELIVER TO OWNER'S DESIGNATED STORAGE AREA.

C. ***REMOVE AND REINSTALL***: REMOVE ITEMS INDICATED; CLEAN, SERVICE, AND OTHERWISE PREPARE THEM FOR REUSE; STORE AND PROTECT AGAINST DAMAGE. REINSTALL ITEMS IN THE SAME LOCATIONS OR IN LOCATIONS INDICATED.

D. ***EXISTING TO REMAIN***: PROTECT CONSTRUCTION INDICATED TO REMAIN AGAINST DAMAGE AND SOILING DURING SELECTIVE DEMOLITION. WHEN PERMITTED BY THE OWNER OR ARCHITECT, ITEMS MAY BE REMOVED TO A SUITABLE, PROTECTED STORAGE LOCATION DURING SELECTIVE DEMOLITION AND THEN CLEANED AND REINSTALLED IN THEIR ORIGINAL LOCATIONS.



1 D100 | OVERALL DEMOLITION PLAN VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

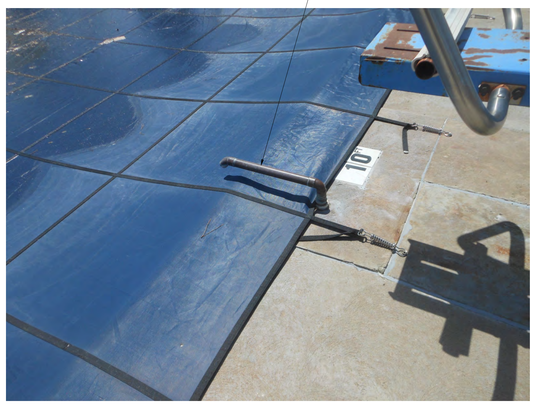
REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

DEMOLITION PLAN

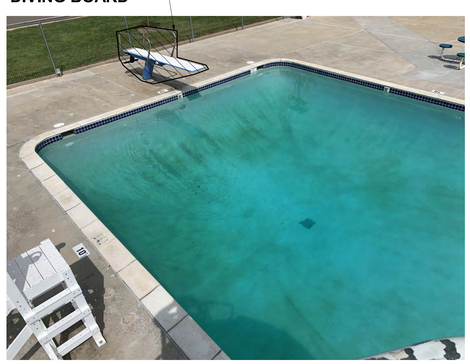
D100

REMOVE FILL PIPE AND ASSOCIATED PLUMBING BACK TO MECHANICAL BUILDING



7 D101 | EXISTING POOL FILL LINE DETAIL VIEW
1" = 10'-0"

REMOVE EXISITNG DIVING BOARD



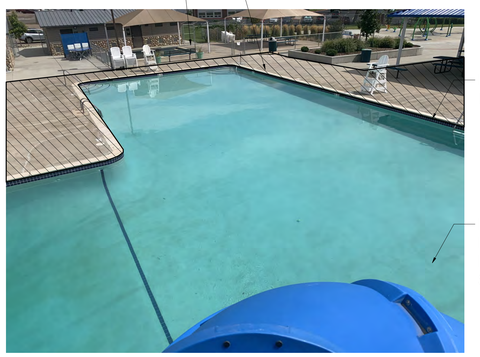
4 D101 | EXISITNG POOL DIVE HOPPER DETAIL VIEW
1" = 10'-0"

REMOVE EXISTING DECK AND BENCHES

1 D101 | EXISTING DECK DETAIL VIEW
1" = 10'-0"

REMOVE AND REINSTALL FENCE BETWEEN POOL AND WADING POOL.

REMOVE DECK AND COPING AROND POOL REFER TO (1/D100)



REMOVE EXISTING WATER LINE TILE

REMOVE EXISTING POOL FINISH FOR INSTALLATION OF NEW SPECIAL AGGREGATE.

8 D101 | EXISTING POOL SHALLOW END DETAIL VIEW
1" = 10'-0"

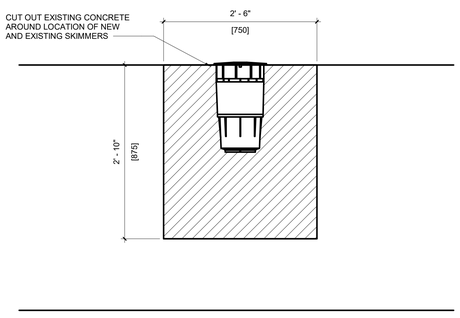
REMOVE EXISTING MAIN DRAIN

5 D101 | EXISTING WADING POOL DETAIL VIEW
1" = 10'-0"

EXISTING FENCE TO REMAIN

REMOVE EXISTING FENCE PAST THIS POST

2 D101 | EXISTING FENCE DETAIL VIEW
1" = 10'-0"



9 D101 | SKIMMER DEMO DETAIL VIEW
1" = 1'-0"

REMOVE AND REPLACE BROKEN COPING STONE

6 D101 | EXISTING WADING POOL COPING DETAIL VIEW
1" = 10'-0"

REMOVE EXISTING DIVING BOARD

REMOVE AND SALVAGE EXISTING SLIDE FOR REINSTALLATION.

3 D101 | EXISTING POOL DETAIL VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

DEMOLITION DETAILS

D101

GENERAL NOTES:

1. LOCATE LIFEGUARD CHAIRS AS REQUIRED PER STATE AND LOCAL CODES AND PER OWNER'S SAFETY CONSULTANT.
2. SCHEDULE QUANTITIES ARE SHOWN FOR VALUE ENGINEERING PURPOSES. IT IS THE INSTALLING CONTRACTORS RESPONSIBILITY TO VERIFY QUANTITIES REQUIRED.
3. CONTRACTOR SHALL CONTACT ENGINEER FOR ELECTRONIC DRAWING FILES PRIOR TO COMMENCING POOL STAKING WORK.
4. ENGINEER WILL PROVIDE ELECTRONIC PLAN VIEW OF ALL POOLS IN AUTOCAD DRAWING FORMAT FOR CONTRACTOR'S USE TO LOCATE STRUCTURES AND RELATED POOL DECK EQUIPMENT.
5. REFER TO PL100 SERIES DRAWINGS FOR ALL POOL PLAN INFORMATION, RELATED EQUIPMENT, AND DETAILS.
6. REFER TO PL200 SERIES DRAWINGS FOR ALL POOL STRUCTURAL PLANS, RELATED INFORMATION, AND DETAILS.
7. REFER TO PL300 SERIES DRAWINGS FOR ALL POOL AND DRAIN PIPING AND RELATED INFORMATION AND DETAILS.
8. REFER TO PL400 SERIES DRAWINGS FOR ALL MECHANICAL EQUIPMENT INFORMATION AND RELATED DETAILS.
9. REFER TO PL500 SERIES DRAWINGS FOR ELECTRICAL SCHEMATICS AND P&IDs.

CODES, STANDARDS AND REGULATIONS:
CONTRACTOR SHALL BE FAMILIAR WITH ALL CODES AND STANDARDS LISTED BELOW AND ALERT THE ARCHITECT/ENGINEER TO CONFLICTS IN THE DRAWINGS

CODE JURISDICTION
NORTHGLENN, COLORADO

HEALTH & SAFETY CODE:
DEPARTMENT OF PUBLIC HEALTH AND ENVIROMENT SWIMMING POOL AND MINERAL BATHS CODE 5 CCR 1003-5 AMENDED, APRIL 11, 2013

MODEL CODES:
2018 MAHC 3RD EDITION

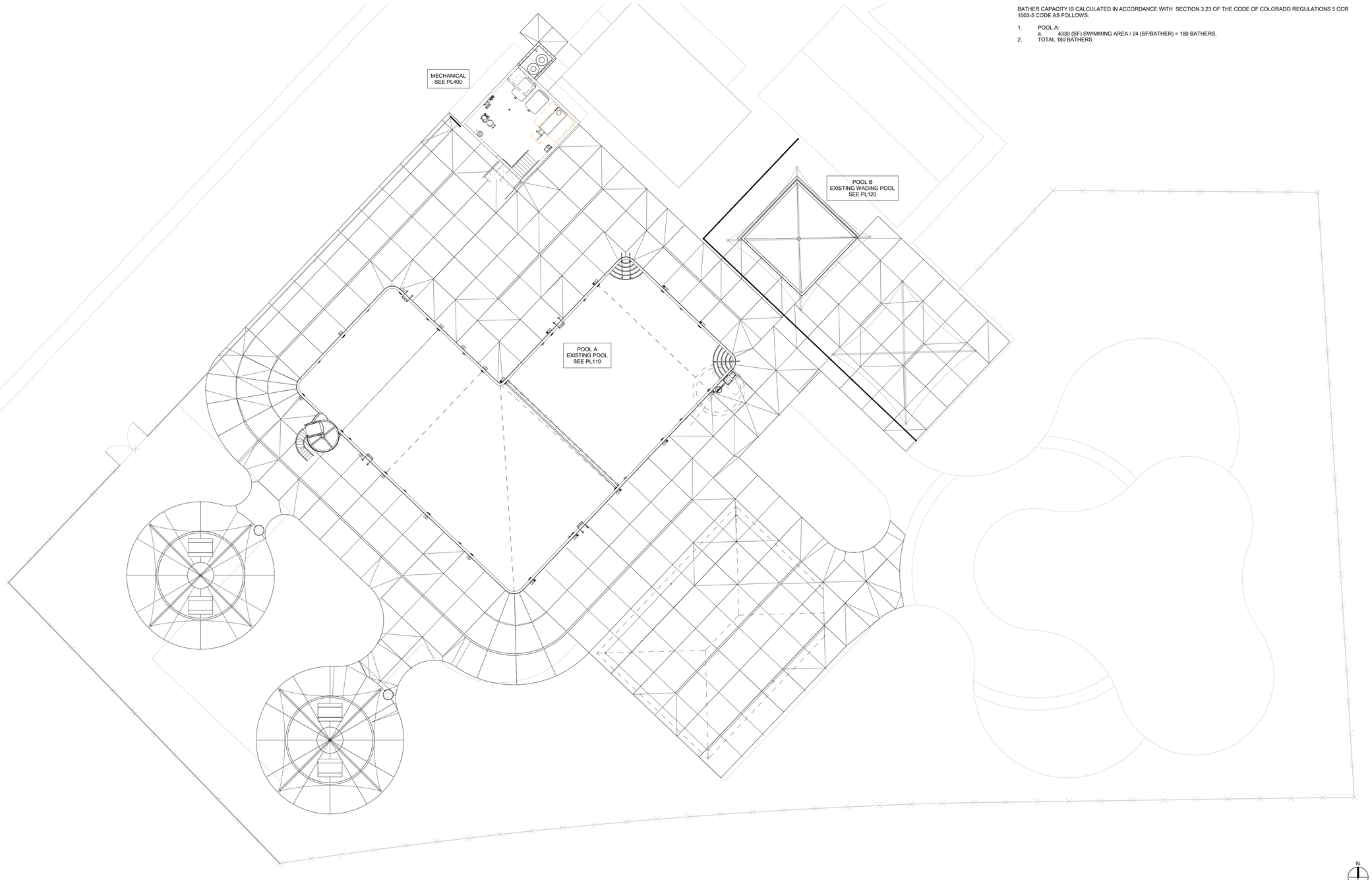
ACCESSIBILITY STANDARDS AND REGULATIONS:

UNITED STATES:
2010 ADA STANDARDS FOR ACCESSIBLE DESIGN

BATHER CAPACITY

BATHER CAPACITY IS CALCULATED IN ACCORDANCE WITH SECTION 3.23 OF THE CODE OF COLORADO REGULATIONS 5 CCR 1003-5 CODE AS FOLLOWS:

1. POOL A:
   a. 4330 (SF) SWIMMING AREA / 24 (SF/BATHER) = 180 BATHERS.
2. TOTAL 180 BATHERS



1 OVERALL AQUATIC LAYOUT
PL100 PLAN VIEW
1" = 10'-0"

N

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7376

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

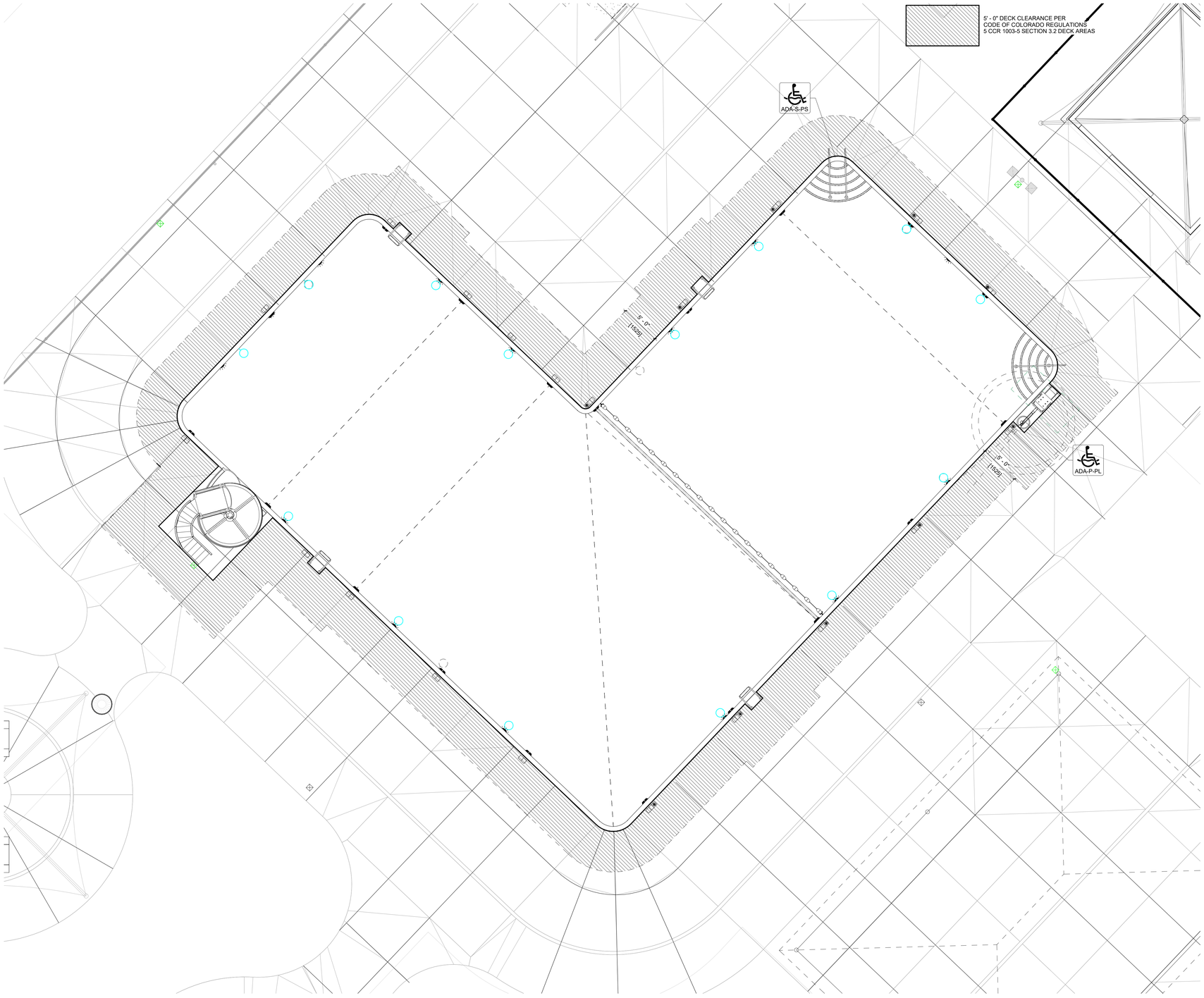
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

OVERALL AQUATIC PLAN

PL100



1 | ADA AND DECK CLEARANCE PLAN VIEW
PL101 3/16" = 1'-0"

WTI
WATER TECHNOLOGY INC
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

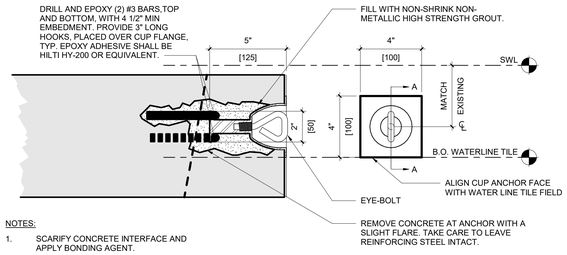
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

ADA AND DECK CLEARANCE

PL101

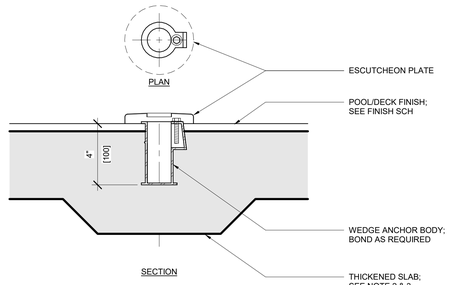


NOTES:

1. SCARIFY CONCRETE INTERFACE AND APPLY BONDING AGENT.

SECTION A-A FRONT VIEW

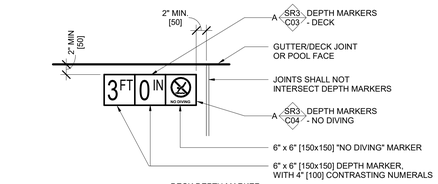
3 | ANCHOR ROPE CUP DETAIL VIEW
PL102 3" = 1'-0"



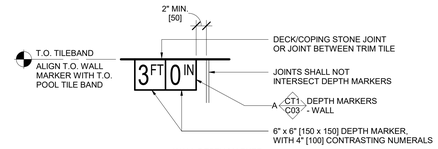
NOTES:

1. INSTALL ANCHORS IN LINE WITH RAIL.
2. CONCRETE CLEAR COVER AT ANCHOR SHALL BE 3" MINIMUM. THICKEN SLAB IF NECESSARY TO ACHIEVE MIN COVER.
3. WHEN SECOND LAYER OF CONCRETE IS LOCATED DIRECTLY BELOW SLAB IN WHICH ANCHOR IS PLACED (I.E. STAIRS), CLEAR COVER OF CONCRETE AT ANCHOR IN UPPER SLAB SHALL BE 2" MIN.

4 | ANCHOR WEDGE DETAIL VIEW
PL102 3" = 1'-0"



DECK DEPTH MARKER

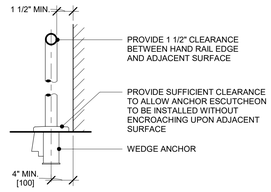


WALL DEPTH MARKER

NOTES:

1. WALL DEPTH MARKER AT LOCATIONS AS INDICATED ON PLAN BY THIS SYMBOL.
2. EXCLUDE "NO DIVING" MARKER TILES AT POOL WALL DEPTH MARKER LOCATIONS AND AT POOL DEPTHS GREATER THAN 5'-0".
3. DEPTH MARKERS SHALL BE LEGIBLE FROM INSIDE THE POOL AND FROM THE POOL DECK.
4. THE POOL CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING MARKINGS ACCURATE TO WITHIN ONE INCH OF THE CONSTRUCTED WATER DEPTHS AT LOCATIONS INDICATED ON PLAN AT A MAX. 25'-0" SPACING AND IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS.
5. DEPTH MARKER TEXT SHALL INDICATE THE ACTUAL POOL DEPTH WITHIN 3" AT NORMAL OPERATING WATER LEVEL WHEN MEASURED 3'-0" FROM POOL WALL. CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING PROPER TEXT FOR EACH MARKER LOCATION.
6. MARKINGS SHALL BE INSTALLED FLUSH WITH SURROUNDING SURFACES AND RECESSED IF NECESSARY.
7. ALL MARKINGS INSTALLED ON HORIZONTAL SURFACES SHALL HAVE A SLIP RESISTANT FINISH.

1 | DEPTH MARKER DECK & WALL DETAIL VIEW
PL102 NONE

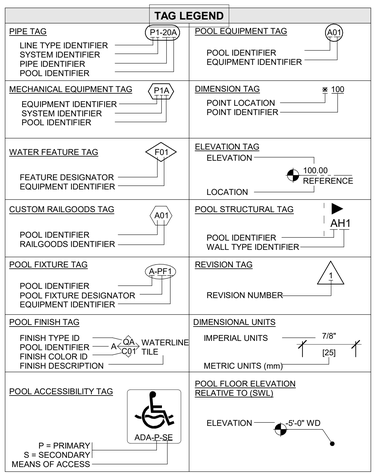


NOTES:

1. CONTRACTOR TO PURCHASE AND INSTALL RAIL GOODS IN ACCORDANCE WITH ALL APPLICABLE CODES AND STANDARDS OF PARTIES HAVING JURISDICTION.
2. CONTRACTOR TO VERIFY HANDRAIL DIMENSIONS PRIOR TO FABRICATION.

2 | RAILING OFFSET TO ADJACENT SURFACE DETAIL VIEW
PL102 3/4" = 1'-0"

TAG LEGEND



EQUIPMENT IDENTIFIER KEY

AC	-	AIR COMPRESSOR	HX	-	HEAT EXCHANGER
AF	-	AUTOFILL	P	-	PUMP
AOP	-	ADVANCED OXIDATION PROCESS	PV	-	PNEUMATIC MAIN DRAIN VALVE
AP	-	pH CONTROL PUMP	S	-	STRAINER
AS	-	pH CONTROL STORAGE	SC	-	CONTAINMENT PALLETE
BP	-	BOOSTER PUMP	SV	-	SURGE TANK FAN
C	-	CHEMICAL CONTROLLER	UV	-	ULTRA-VIOLET DISINFECTION
CP	-	CHLORINE FEED PUMP	V	-	VARIABLE FREQUENCY DRIVE
CS	-	CHLORINE STORAGE	WC	-	WATER CHILLER
EV	-	ELECTRONIC MAIN DRAIN VALVE			
F	-	FILTER			
FM	-	FLOW METER			
FP	-	FLOW METER POWER SUPPLY			
H	-	HEATER			

ABBREVIATIONS

AHJ	- AUTHORITY HAVING JURISDICTION	P&ID	- PIPING & INSTRUMENTATION DIAGRAM
BO	- BOTTOM OF	PL	- POOL LIFT
CJ	- CONTROL JOINT	PS	- POOL STAIRS
DIA	- DIAMETER	SCH	- SCHEDULE
EJ	- EXPANSION JOINT	SE	- SLOPED ENTRY
EW	- EACH WAY	SS	- STAINLESS STEEL
FFE	- FINISH FLOOR ELEVATION	SWL	- STATIC WATER LEVEL
ID	- INSIDE DIAMETER	TO	- TOP OF
MAX	- MAXIMUM	TS	- TRANSFER SYSTEM
MIN	- MINIMUM	TUBC	- TRUE UNION CHECK VALVE
NC	- NORMALLY CLOSED	TUBV	- TRUE UNION BALL VALVE
NO	- NORMALLY OPEN	TW	- TRANSFER WALL
NPS	- NOMINAL PIPE SIZE	TYP	- TYPICAL
OC	- ON CENTER	WD	- WATER DEPTH
OD	- OUTSIDE DIAMETER		
OWE	- OPERATING WATER ELEVATION		

LEGEND - FINISHES & COLOR CODES - POOL A

AREA	FINISHES		COLORS		
	FINISH ID	FINISH	COLOR ID	COLOR	NOTES
CONTRASTING TILE BAND	SR1	1"x1" SLIP RESISTANT TILE	C06	CONTRASTING TO POOL FINISH	
DEPTH MARKERS - DECK	SR3	6"x6" SLIP RESISTANT TILE	C03	BLACK ON WHITE	
DEPTH MARKERS - NO DIVING	SR3	6"x6" SLIP RESISTANT TILE	C04	BLACK AND RED ON WHITE	
DEPTH MARKERS - WALL	CT1	6"x6" CERAMIC TILE	C03	BLACK ON WHITE	
HANDHOLD	LB	LIGHT BROOM	C01	AS SELECTED BY ARCHITECT	STEGMEIER EDGE
HORIZONTAL SURFACE (DRY)	SR1	1"x1" SLIP RESISTANT TILE	C07	LIGHT COLOR	
HORIZONTAL SURFACE (WET)	QA	QUARTZ AGGREGATE	C07	LIGHT COLOR	
TILE - WATERLINE	KT1	1"x1" KEYSTONE TILE	C01	AS SELECTED BY ARCHITECT	
TRIM TILE - BULLNOSE	S862	1"x1" S-862 BULLNOSE TRIM TILE	C01	AS SELECTED BY ARCHITECT	
VERTICAL SURFACE (WET)	QA	QUARTZ AGGREGATE	C07	LIGHT COLOR	

FINISH NOTES:

1. FINISHES PER SCHEDULE UNLESS OTHERWISE INDICATED.
2. VERTICAL SURFACE (WET) AND HORIZONTAL SURFACE (WET) SHALL BE AT LEAST 6.5 ON THE MUNSELL COLOR VALUE SCALE.
3. ALL HORIZONTAL SURFACES MUST BE SLIP RESISTANT AND COMPLY WITH THE ANSI A137.1 STANDARD USING THE DCOF ACUTEST METHODOLOGY:
   3A. ON WET LEVEL SURFACES, PROVIDE DYNAMIC COEFFICIENT OF FRICTION OF =/> 0.42.
   3B. ON WET SLOPED SURFACES, PROVIDE DYNAMIC COEFFICIENT OF FRICTION OF =/> 0.65.
4. DESIGN WATERLINE SHALL HAVE A MAXIMUM CONSTRUCTION TOLERANCE WHEN FINISHED OF +/- 1/4" FOR POOLS AND SPAS WITH ADJUSTABLE SURFACE SKIMMING, AND +/- 1/8" FOR POOLS AND SPAS WITH NONADJUSTABLE SURFACE SKIMMING.

SCHEDULE - SAFETY & MAINTENANCE EQUIPMENT

QTY	PRODUCT NAME	MANUFACTURER	NOTES
1	25 PERSON AQUATIC FIRST AID KIT (OWNER PROVIDED)	WATER SAFETY PRODUCTS	25 PERSON OSHA FIRST AID KIT TO INCLUDE BIOHAZARD COMPLIANCE RESPONSE AND CPR MICROMASK WITH NITRILE GLOVES
1	AUTOMATIC VACUUM CLEANING SYSTEM (OWNER PROVIDED)	AQUAPRODUCTS ULTRAMAX GEMINI	AUTOMATIC CLEANER, RADIO REMOTE CONTROL, ULTRAKART CADDY, DIGITAL TIMER DISPLAY, 120 FT CORD
1	DEFIBRILLATOR (OWNER PROVIDED)	WATER SAFETY PRODUCTS	ZOLL AED PLUS DEFIBRILLATOR COMPLETE AED PACKAGE WITH CPR-D PADZ ELECTRODES, CPR HELP TECHNOLOGY WITH REAL-TIME DEPTH AND RATE CPR FEEDBACK, LITHIUM 123 BATTERIES WITH 5 YEAR SHELF LIFE, CARRYING CASE AND AED PRESCRIPTION
2	LIFE BUOY (OWNER PROVIDED)	WATER SAFETY PRODUCTS	30" DIA, MADE OF UNICELL SOFT FOAM WITH HARD SHELL COVERING. INCLUDE STAINLESS STEEL MOUNTING BRACKETS AND STAINLESS STEEL ANCHORS AND BOLTS. MOUNT UNIT ON WALL IN COORDINATION WITH OWNER
1	LIFE HOOK & RESCUE POLE (OWNER PROVIDED)	WATER SAFETY PRODUCTS	ANODIZED ALUMINUM POLE, WITH DOUBLE LIFE HOOK. 2 - 8 FEET SECTIONS WITH CONNECTOR & RUBBER END CAP. INCLUDE STAINLESS STEEL MOUNTING BRACKETS AND STAINLESS STEEL ANCHORS AND BOLTS. MOUNT UNIT ON WALL IN COORDINATION WITH OWNER
1	MANUAL VACUUM CLEANING SYSTEM (OWNER PROVIDED)	HAMMERHEAD	RESORT-21; (RESORT-30): 21'(30') VACUUM HEAD WITH (2) LARGE CAPACITY BAGS, 60 FOOT CORD, STAINLESS STEEL POLE SWIVEL MOUNT AND WELDED ALUMINUM CADDY W/ 20" WHEELS. PROVIDE WITH 12V DEEP CYCLE MARINE BATTERY, BATTERY CHARGER, AND 1 1/8" STANDARD POOL POLE.
4	RESCUE TUBE (OWNER PROVIDED)	WATER SAFETY PRODUCTS	50" LONG x 6" WIDE x 4" THICK. NO CLIPS, NO RINGS. 2" WIDE ADJUSTABLE SHOULDER STRAP , CONNECTED TO TUBE BY 1" STRAPPING. STRAPPING EXTENDS COMPLETELY THROUGH LENGTH OF TUBE.
1	SPINEBOARD W/ HEAD IMMOBILIZER (OWNER PROVIDED)	WATER SAFETY PRODUCTS	X-RAY TRANSLUCENT BACKBOARD WITH HEAD IMMOBILIZER AND BODY STRAPS. INCLUDE STAINLESS STEEL MOUNTING BRACKETS AND STAINLESS STEEL ANCHORS AND BOLTS. MOUNT UNIT ON WALL IN COORDINATION WITH OWNER
2	THROW LINE (OWNER PROVIDED)	WATER SAFETY PRODUCTS	60' MARINE POLYPRO LINE, WITH 3" x 5" LEMON FLOAT
1	WATER TEST KIT (OWNER PROVIDED)	TAYLOR "SERVICE COMPLETE"	FAS DPD CHLORINE KIT

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEDEL
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

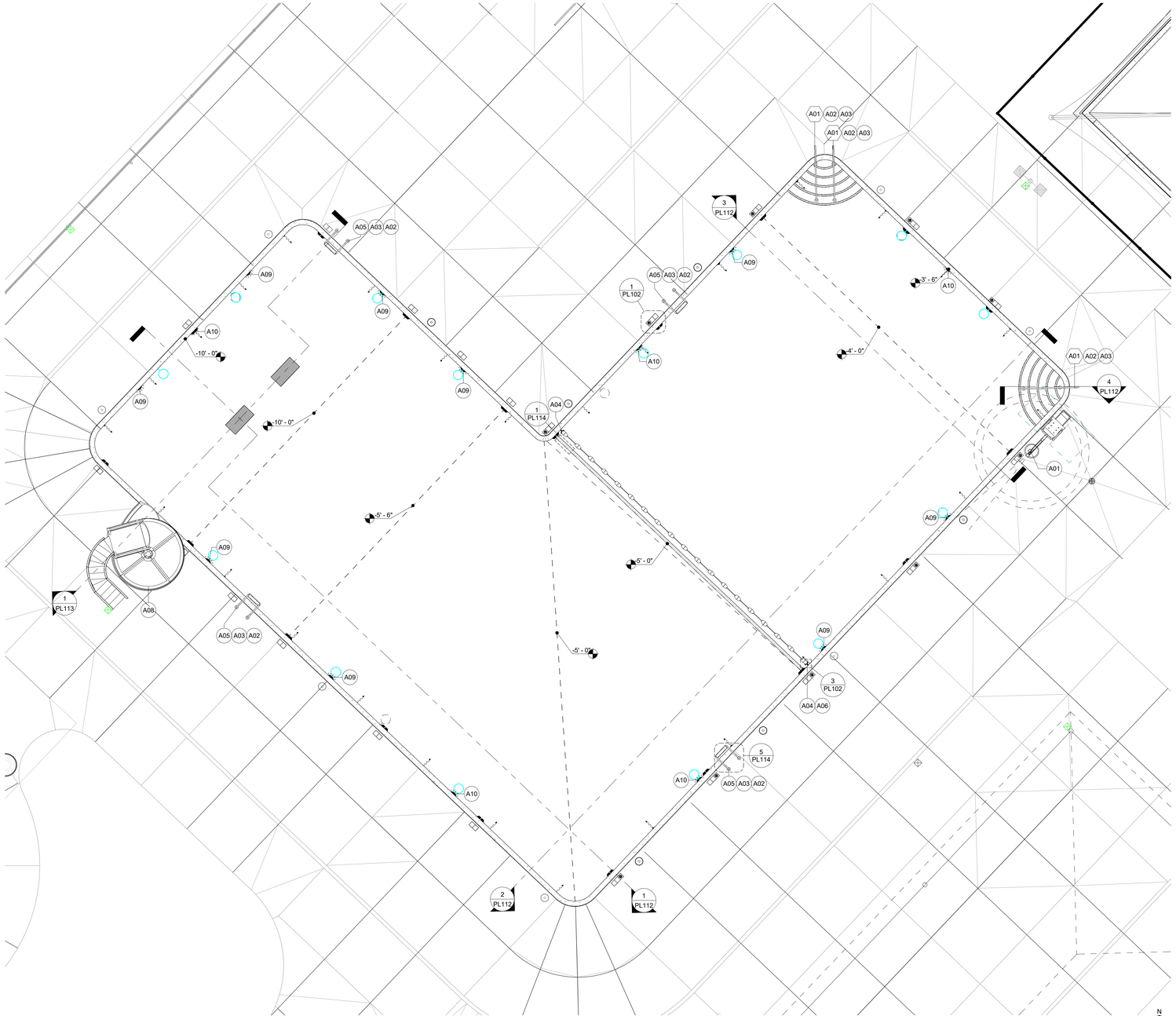
REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

GENERAL DETAILS AND SCHEDULES

PL102

NOTE: WATER DEPTHS SHOWN ARE EXISTING



1 PL110 POOL A - EXISTING LAP POOL
PLAN VIEW
3/16" = 1'-0"

POOL A-EXISTING LAP POOL DATA

DESCRIPTION	QTY	UNITS
POOL PERIMETER	304' - 6"	FEET
WATER SURFACE AREA	4,330	SQUARE FEET
POOL WATER TEMPERATURE	84	°f
POOL VOLUME	186,119	GALLONS
TOTAL VOLUME OF WATER	186,119	GALLONS
CIRCULATION RATE	775	GPM
TURNOVER/VOLUME/FLOW	240 MIN.	
FILTRATION RATE	11.34	GPM/FT²
BACKWASH FLOW	257	GPM

SCHEDULE - CUSTOM RAILGOODS - POOL A

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
A	01	HAND RAIL	3	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50 OD X .120 WALL THICKNESS, 500 GRIT FINISH MIN BARRIER RAILING WITH HTTP KNOTLESS NETTING. PROVIDE 1 3/4" INCH SQUARE MESH. COLOR BY OWNER/ARCHITECT

SCHEDULE - BASIS OF DESIGN - POOL A

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
A	01	POOL LIFT	1	SR SMITH, AQUA CREEK, OR EQUAL	STANDARD ANCHORED, ROTATIONAL POOL LIFT, WITH 400 LB MINIMUM LIFTING CAPACITY. MUST MEET ALL APPLICABLE ADA REQUIREMENTS, WHILE MAINTAINING REQUIRED DECK CLEARANCE. PACKAGE TO INCLUDE ARMRESTS, ANCHOR, LIFT COVER, BATTERY CHARGER, AND CADDY
A	02	WEDGE ANCHOR	14	SPECTRUM AQUATICS	CAST BRONZE, 4-1/4" LONG, ACCEPTS 1.500" OD TUBING
A	03	ESCUTCHEON PLATE	14	SPECTRUM AQUATICS	STAINLESS STEEL ROUND ESCUTCHEON FOR 1.50" O.D. RAILS
A	04	CUP ANCHOR	2	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	4" SQUARE 304L SS ANCHOR AND 304L SS EYE BOLT
A	05	LADDER	4	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CROSS BRACED, HEAVY DUTY, –" WIDTH, STEPS 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
A	06	SAFETY ROPE	1	PARAGON AQUATICS	3/4" POLYETHYLENE ROPE WITH 5"x9" HANDI-LOCK FLOAT, VERIFY LENGTH WITH PLANS
A	08	EXISTING VORTEX SLIDE	1	S.R. SMITH	REINSTALL EXISTING VORTEX SLIDE
A	09	LIGHT & NICHE	9	PENTAIR	INTELLIBRITE, WHITE LED POOL LIGHT, 500W EQUIVALENCY, 120V, WITH SS FACE RING, PROVIDE COMPLETE WITH PENTAIR POOL PRODUCTS LARGE SS NICHES WITH 1" REAR HUB.
A	10	NEW LIGHT INSTALLED IN EXISTING NICHE	5	PENTAIR	INTELLIBRITE, WHITE LED POOL LIGHT, 500W EQUIVALENCY, 120V, WITH SS FACE RING.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

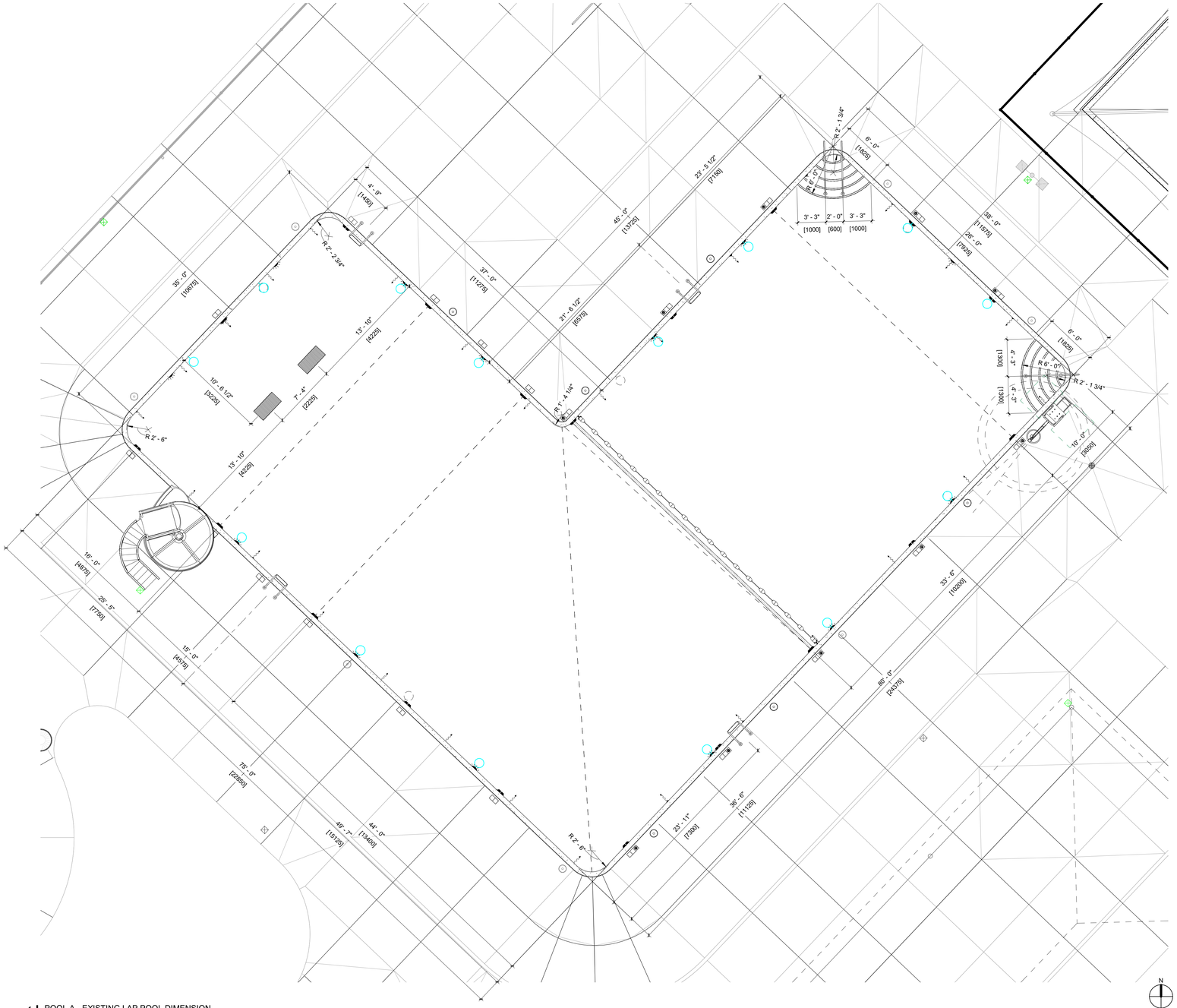
ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

POOL A - EXISTING POOL PLAN

PL110

DIMENSIONING NOTES:

1. ALL DIMENSIONS ARE SHOWN FROM POOL FINISH TO POOL FINISH (THIS SHEET)



1 POOL A - EXISTING LAP POOL DIMENSION PLAN VIEW
PL111 3/16" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEDEL
42920
PROFESSIONAL ENGINEER
01/27/2023

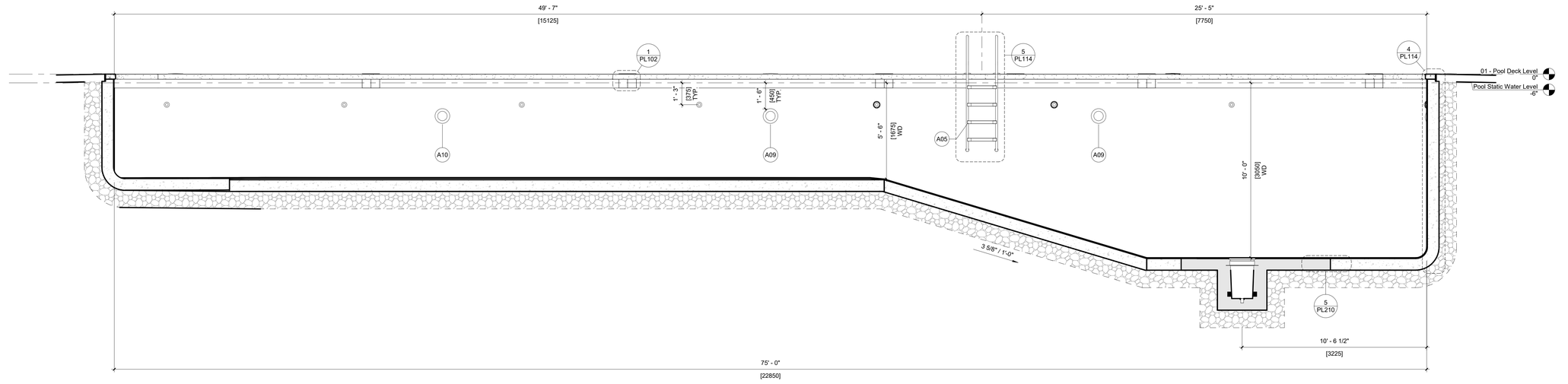
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

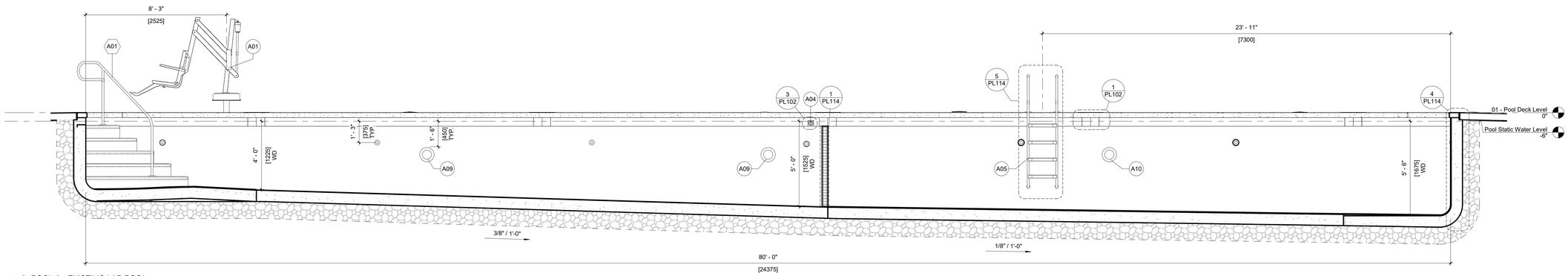
ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

POOL A - EXISTING POOL DIMENSION PLAN

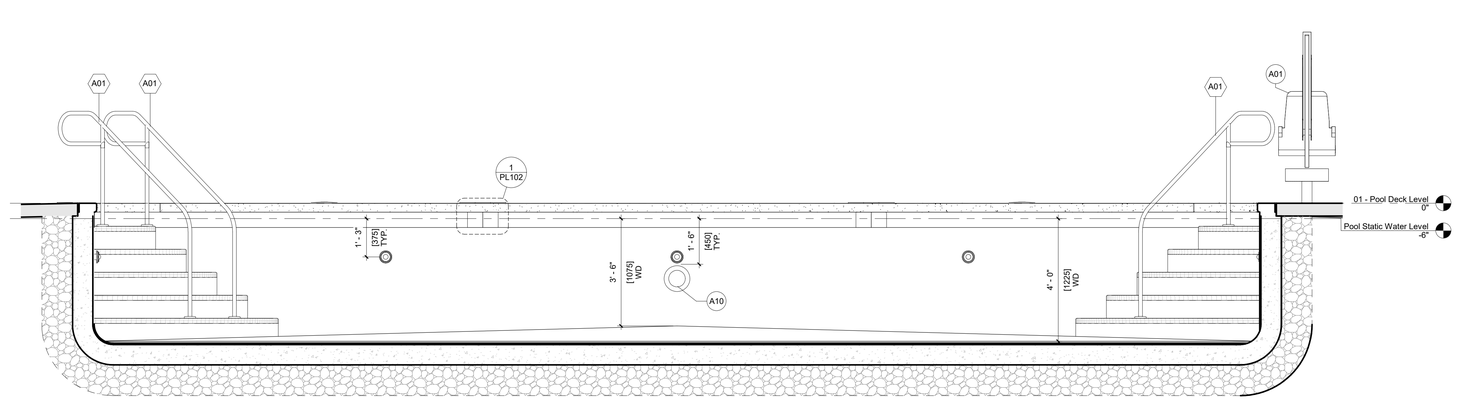
PL111



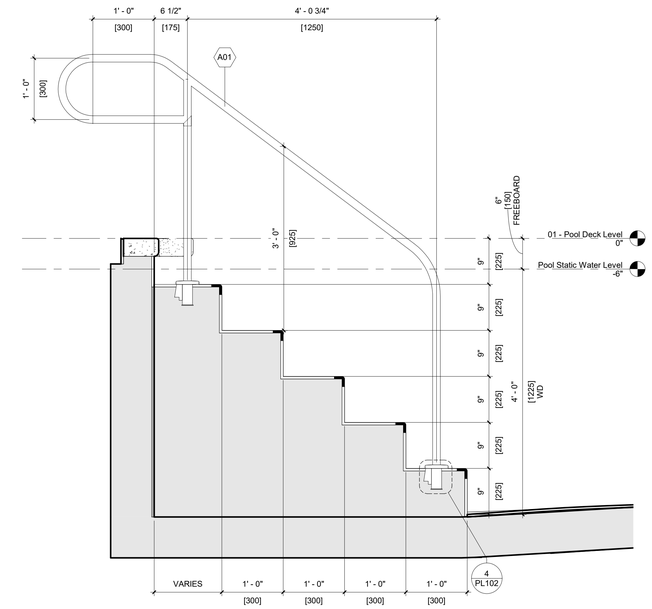
1 | POOL A - EXISTING LAP POOL SECTION VIEW
PL112 3/8" = 1'-0"



2 | POOL A - EXISTING LAP POOL SECTION VIEW
PL112 3/8" = 1'-0"



3 | POOL A - EXISTING LAP POOL SECTION VIEW
PL112 1/2" = 1'-0"



4 | POOL A - EXISTING LAP POOL STAIRS SECTION VIEW
PL112 1" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

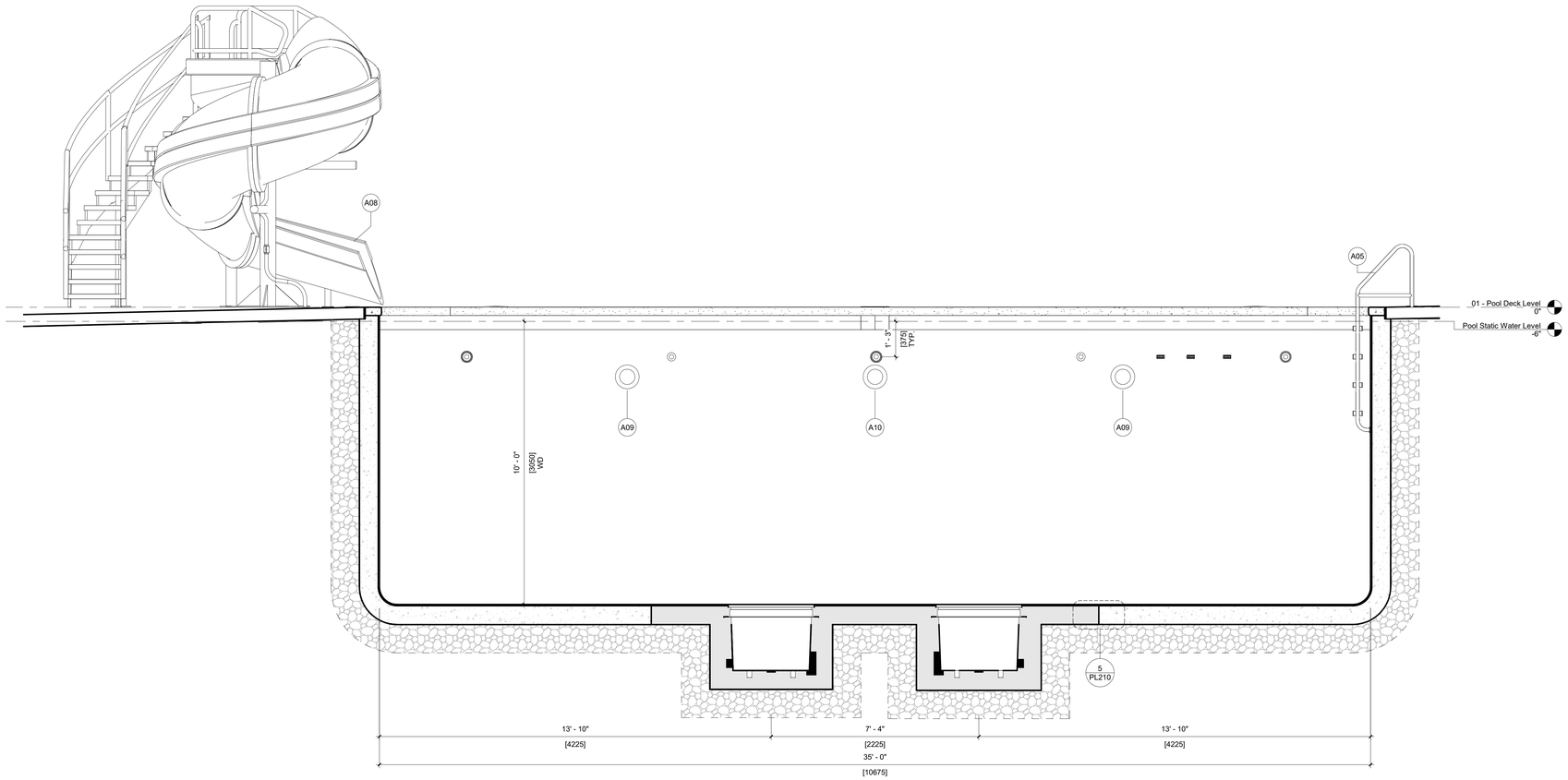
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

POOL A - EXISTING POOL SECTIONS

PL112



1 | POOL A - EXISTING LAP POOL
PL113 SECTION VIEW
1/2" = 1'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

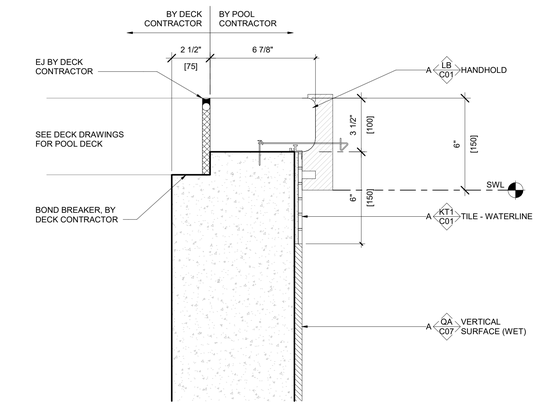
REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

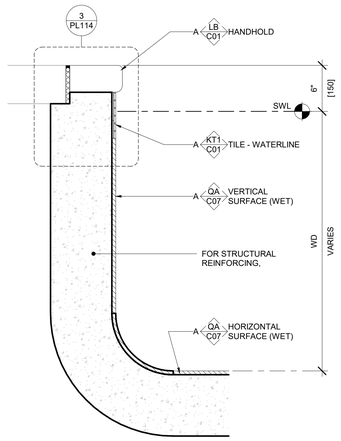
ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

POOL A - EXISTING POOL SECTIONS

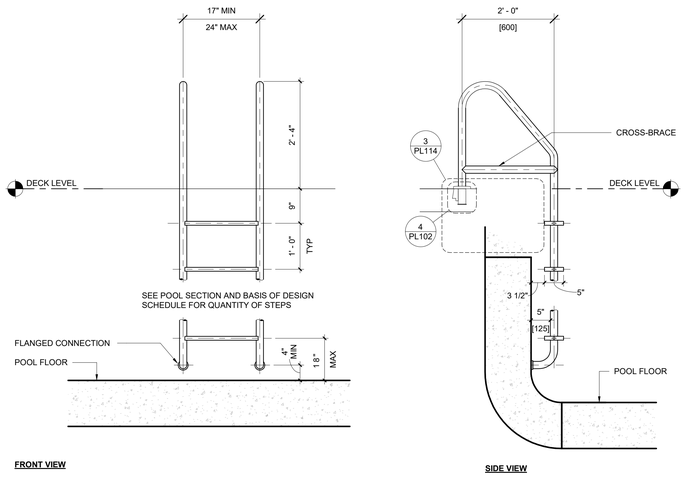
PL113



3 | PL114 POOL WALL DETAIL - FORMED EDGE
DETAIL VIEW
3" = 1'-0"

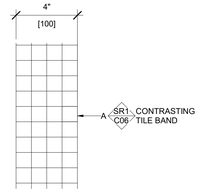


4 | PL114 POOL WALL DETAIL - FORMED EDGE
DETAIL VIEW
1 1/2" = 1'-0"



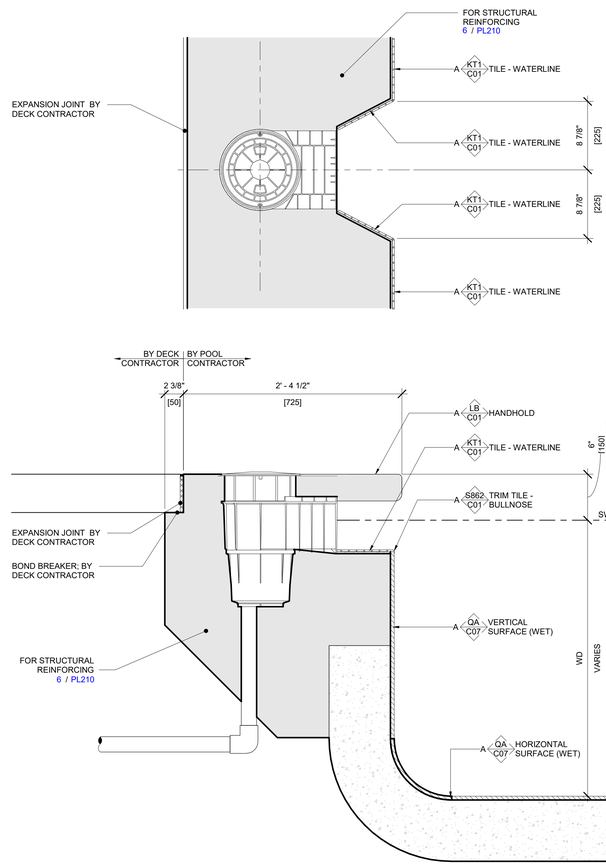
SPECIFICATIONS
LADDER FRAMES SHALL BE FABRICATED WITH SMOOTH, WRINKLE-FREE BENDS. THE PIPE SHALL BE 1.900" OD X .109" WALL THICKNESS, TYPE 316L, POLISHED TO 500 GRIT. STEPS SHALL BE SS, 5" WIDE, WITH RAISED NON-SKID RUBBER INSERT TREADS. THE ENDS OF ALL STEPS SHALL BE CURVED TO FIT THE OD OF THE LADDER FRAMES. THE BOLTS FOR ATTACHING THE LADDER STEPS SHALL HAVE SMOOTH, ROUNDED HEADS AND THE UNDERSIDE OF THE HEAD SHALL BE CURVED TO FIT THE OD OF THE TUBING. CROSS-BRACE SHALL BE NOTCHED AND WELDED TO THE LADDER FRAMES. JOINTS SHALL BE CLEANED AND BLENDED TO MATCH THE FINISH OF THE PIPE.

5 | PL114 POOL LADDER
DETAIL VIEW
3/4" = 1'-0"



NOTES:
1. 4" CONTRASTING TILE BAND @ 5'-0" WD CONTINUOUS ON POOL FLOOR AND WALLS; COLOR CONTRASTING TO POOL FINISH.

1 | PL114 CONTRASTING TILE BAND
DETAIL VIEW
3" = 1'-0"



2 | PL114 SKIMMER
DETAIL VIEW
1 1/2" = 1'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

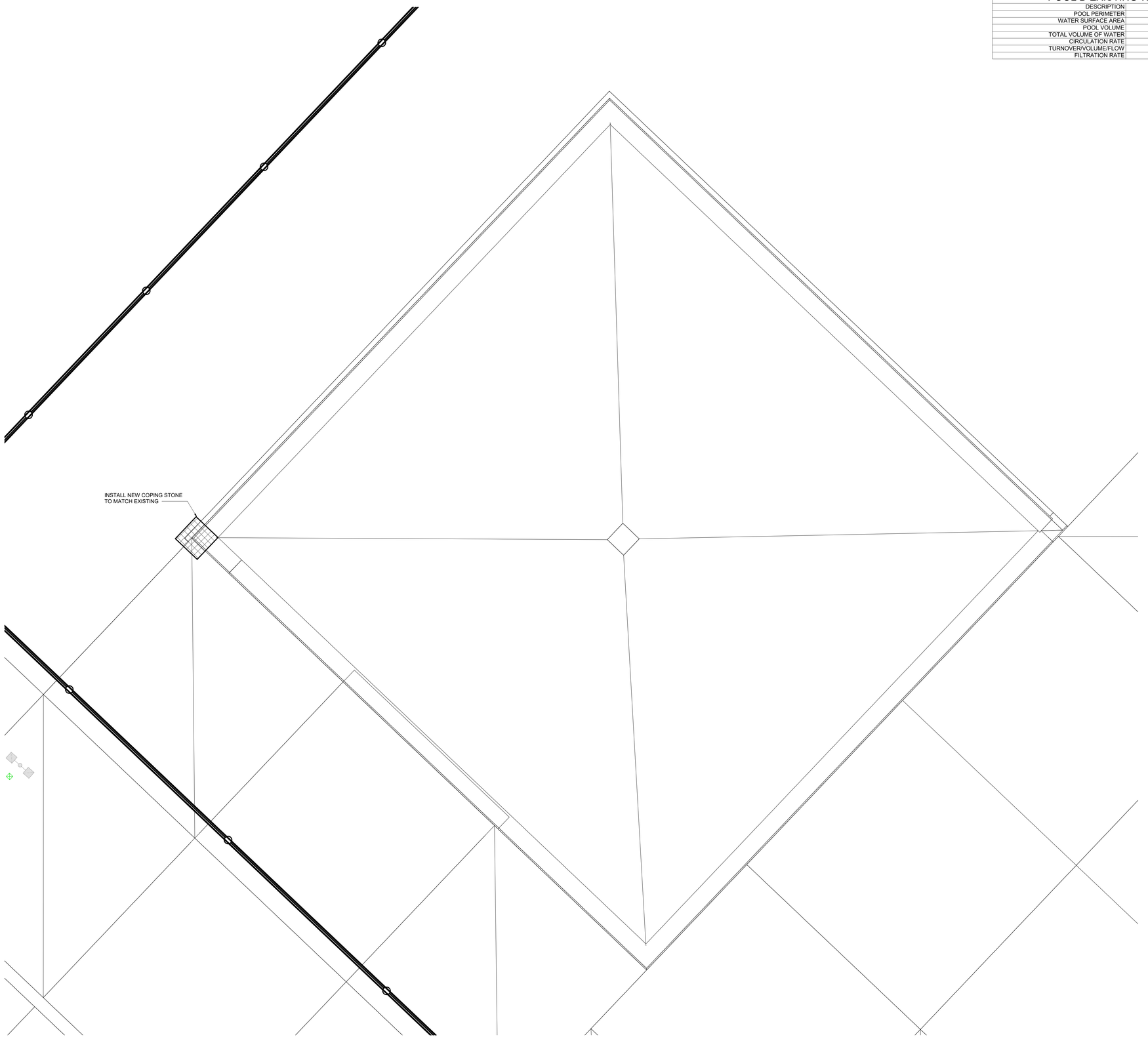
REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: BB

POOL A - EXISTING POOL DETAILS

PL114

POOL B-EXISTING WADING POOL DATA			
DESCRIPTION	QTY	UNITS	
POOL PERIMETER	78	FEET	
WATER SURFACE AREA	375	SQUARE FEET	
POOL VOLUME	4,439	GALLONS	
TOTAL VOLUME OF WATER	4,439	GALLONS	
CIRCULATION RATE	74	GPM	
TURNOVER/VOLUME/FLOW	60 MIN.	4,439 GAL.	74 GPM
FILTRATION RATE	EXISTING	GPM/FT²	



1 PL120 OVERALL AQUATIC LAYOUT Copy 1
PLAN VIEW
3/4" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

POOL B - EXISTING WADING POOL

PL120

DESIGN IS IN ACCORDANCE WITH THE BUILDING CODE 2021 OF COLORADO AND THE 2021 INTERNATIONAL BUILDING CODE AS AMENDED TO DATE.

NOTE

STRUCTURAL DRAWINGS AND POOL DRAWINGS MUST BE USED IN CONJUNCTION WITH EACH OTHER. POOL DRAWINGS DICTATE ALL FINAL CONDITIONS OF POOL, FEATURES, AND DIMENSIONS OF POOL SHELL, INCLUDING POOL FINISH. UNLESS OTHERWISE INDICATED, STRUCTURAL DIMENSIONS ARE CONCRETE TO CONCRETE, AND DICTATE REQUIRED THICKNESSES FOR STRUCTURAL INTEGRITY ONLY.

STRUCTURAL AND REINFORCEMENT NOTES

STRUCTURAL NOTES

1. REINFORCEMENT AT WALL CORNERS AND WALL BENDS SHALL BE DETAILED PER THE ASSOCIATED TYPICAL DETAILS. CORNER AND BEND BARS SHALL BE THE SAME SIZE AND SPACING AS THE TYPICAL HORIZONTAL WALL REINFORCING OF THE ASSOCIATED WALLS.
2. UNLESS OTHERWISE INDICATED, ALL WALL REINFORCEMENT BARS SHALL BE CONTINUOUS AROUND CORNERS. REINFORCEMENT SHALL BE EXTENDED INTO CONNECTING WALLS. UNLESS OTHERWISE INDICATED, CONTRACTOR MAY SPLICE CONTINUOUS SLAB BARS AT LOCATIONS OF THEIR CHOOSING, EXCEPT THAT TOP BAR SPLICES SHALL BE LOCATED AT MID-SPAN AND BOTTOM BAR SPLICES SHALL BE LOCATED AT SUPPORTS. ALL REINFORCEMENT BENDS AND LAPS, UNLESS OTHERWISE INDICATED, SHALL SATISFY THE MINIMUM REQUIREMENTS FOR CLASS B SPLICES.
3. FOR REINFORCEMENT AT WALL OR FLOOR SLAB PENETRATIONS, SEE 2 / PL200
4. MINIMUM POURED CONCRETE DESIGN STRENGTH = 4500 PSI, MINIMUM SHOTCRETE DESIGN STRENGTH = 5000 PSI
5. NEW POOL CONCRETE SHALL CONTAIN SHRINKAGE REDUCING ADMIXTURE.

REINFORCEMENT NOTES: 60KSI, A615, DEFORMED BARS

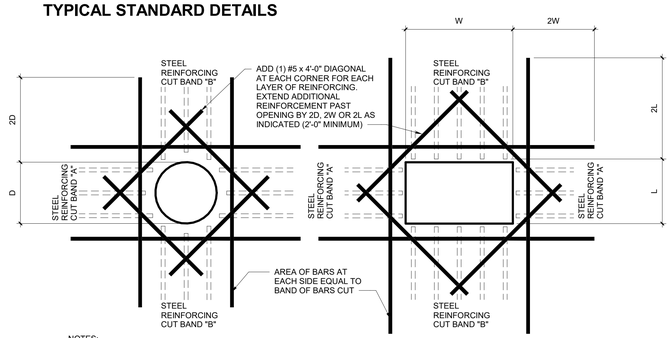
1. REINFORCEMENT SHALL BE DETAILED AND PLACED IN ACCORDANCE WITH ACI "MANUAL OF CONCRETE PRACTICE", LATEST EDITION, UNLESS OTHERWISE NOTED.
2. ALL LAPS SHALL BE CLASS "B" PER ACI 318 UNLESS OTHERWISE NOTES ON THE DESIGN DRAWINGS OR UNLESS THE DETAILER TAKES SPECIAL CARE TO PROVIDE STAGGERED LAPS. USE TOP BAR LAP LENGTHS FOR ALL HORIZONTAL WALL BARS AND FOR TOP BARS IN SLABS AND BEAMS OVER 14" DEEP
3. LAP LENGTH SHALL BE SPECIFICALLY NOTED ON PLACING DRAWINGS WHERE MORE THAN ONE BAR MAKES UP A CONTINUOUS STRING.
4. TIE POOL REINFORCING STEEL WITH 18-GAUGE ANNEALED WIRE AS SPECIFIED IN THE CRSI 63 RECOMMENDED PRACTICE FOR PLACING REINFORCING BARS. ALL TIE WIRES SHALL BE "MADE TIGHT" FOR ELECTRICAL BONDING PURPOSES, AS REQUIRED BY NEC, ARTICLE 680.
5. ALL HOOKS SHALL BE STANDARD HOOKS UNLESS NOTED OTHERWISE.

REINFORCING STEEL MINIMUM CLEAR COVER REQUIREMENTS

COORDINATE WITH REINFORCEMENT STEEL PLACING REQUIREMENTS

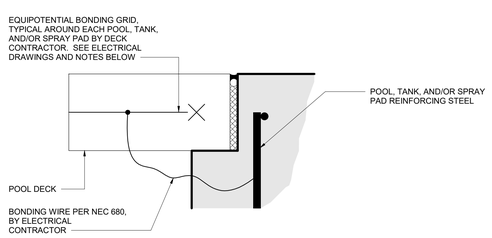
3" FOR CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH
2" TYPICAL ALL ELSE, UNLESS NOTED OTHERWISE ON DETAILS

TYPICAL STANDARD DETAILS



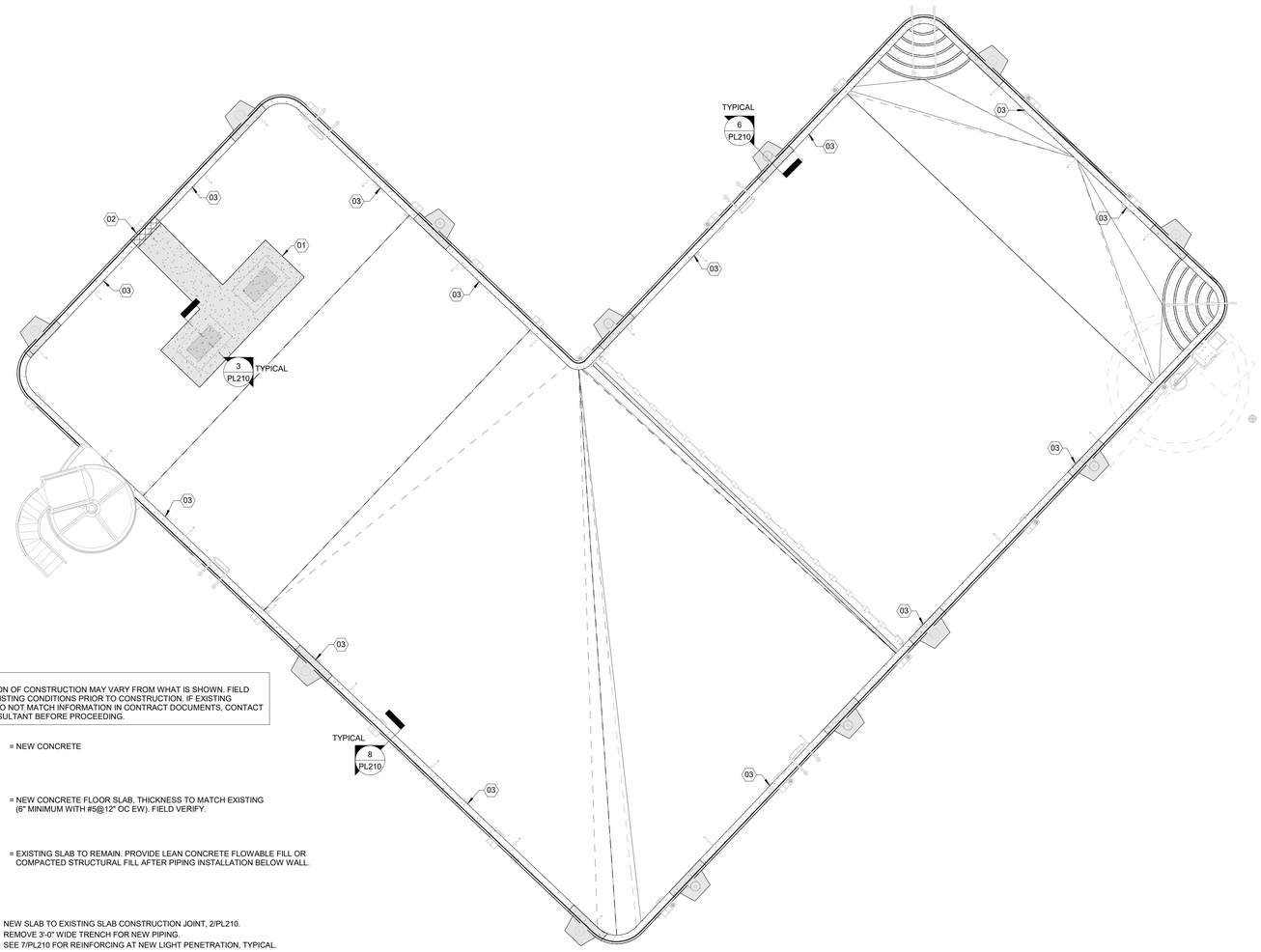
NOTES:
1. TYPICAL FOR ALL OPENINGS IN CONCRETE WALLS AND SLABS INCLUDING DRAINS UNLESS INDICATED OTHERWISE ON PLANS.
2. DO NOT WELD REINFORCEMENT TO PIPE SLEEVES AND INSERTS.
3. ALL OPENINGS THROUGH WATERTIGHT TANK REQUIRE WATERSTOPS.
4. PROVIDE MIN LAP AS NOTED OR SHOWN ON PLANS (TYP)

2 | PL200 REINFORCING - REINFORCEMENT AT OPENINGS
DETAIL VIEW
NTS



NOTES:
1. THIS DETAIL IS INTENDED TO ILLUSTRATE THE EQUIPOTENTIAL BONDING GRID AROUND EACH POOL, TANK, AND/OR SPRAY PAD AS REQUIRED BY NEC 680.
2. THE GRID SHALL CONFORM TO ALL NEC 680 REQUIREMENTS.
3. PER NEC 680, THE GRID SHALL:
   3.a. COMPLETELY SURROUND THE PERIMETER OF THE POOL, TANK, AND/OR SPRAY PAD AND EXTEND 3 FEET HORIZONTALLY FROM THE INSIDE WALLS OF THE POOL AND/OR TANK, OR PERIMETER EXPANSION JOINT AT SPRAY PADS.
   3.b. BE ARRANGED IN A 12" X 12" (OR LESS) NETWORK OF CONDUCTORS IN A UNIFORMLY SPACED PATTERN.
   3.c. BE BONDED TO THE POOL, TANK, AND/OR SPRAY PAD REINFORCING STEEL.
4. THIS DETAIL IS NOT INTENDED TO DETAIL THE WALLS, SLABS, OR THE DECKS. THE ABOVE DETAIL IS SCHEMATIC. SEE POOL, TANK, AND/OR SPRAY PAD SECTIONS AND DECK SECTIONS FOR ADDITIONAL CONSTRUCTION REQUIREMENTS.
5. SEE POOL, TANK, AND/OR SPRAY PAD ELECTRICAL DRAWINGS FOR ADDITIONAL BONDING & GROUNDING REQUIREMENTS.

3 | PL200 EQUIPOTENTIAL BONDING GRID
DETAIL VIEW
NTS



NOTE:
CONFIGURATION OF CONSTRUCTION MAY VARY FROM WHAT IS SHOWN. FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO CONSTRUCTION. IF EXISTING CONDITIONS DO NOT MATCH INFORMATION IN CONTRACT DOCUMENTS, CONTACT AQUATIC CONSULTANT BEFORE PROCEEDING.

= NEW CONCRETE

= NEW CONCRETE FLOOR SLAB. THICKNESS TO MATCH EXISTING (6" MINIMUM WITH #5@12" OC EW). FIELD VERIFY.

= EXISTING SLAB TO REMAIN. PROVIDE LEAN CONCRETE FLOWABLE FILL OR COMPACTED STRUCTURAL FILL AFTER PIPING INSTALLATION BELOW WALL.

KEYNOTES

01 NEW SLAB TO EXISTING SLAB CONSTRUCTION JOINT, 2/PL210.
02 REMOVE 3'-0" WIDE TRENCH FOR NEW PIPING.
03 SEE 7/PL210 FOR REINFORCING AT NEW LIGHT PENETRATION, TYPICAL.

1 | PL200 POOL A - EXISTING LAP POOL STRUCTURAL PLAN VIEW
3/16" = 1'-0"

N

GRAEF
Project Number: 2022-2000.XX
Phone 920 / 592 9440

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

CONSULTANTS

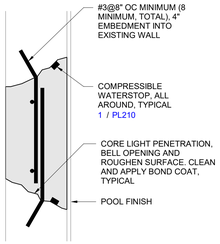
COLORADO LICENSED
MATTHEW J. KRATOCHVIL
36170
01/27/2023
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: AMZ
CHECKED BY: Checker

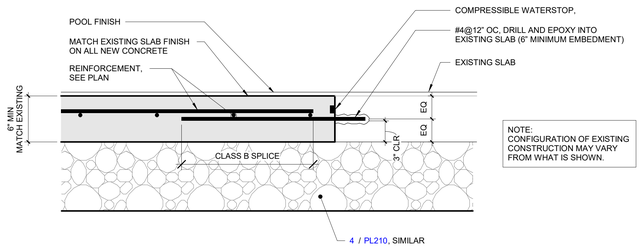
STRUCTURAL NOTES, PLAN(S) AND SCHEDULE

PL200



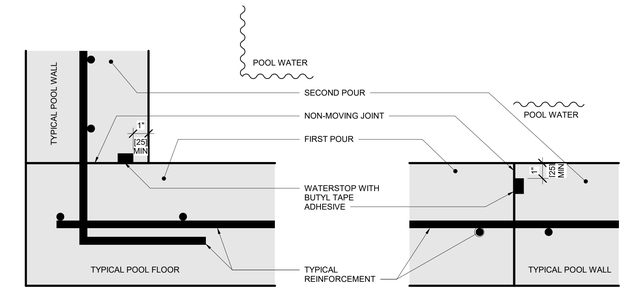
7 | PL210 | REINFORCING - NEW LIGHT PENETRATION
DETAIL VIEW
NOT TO SCALE

NOTES:
1. SCARIFY CONCRETE INTERFACE AND APPLY BONDING AGENT.
2. NEW CONCRETE SHALL CONTAIN SHRINKAGE REDUCING ADMIXTURE PER SPECIFICATIONS



NOTE:
CONFIGURATION OF EXISTING CONSTRUCTION MAY VARY FROM WHAT IS SHOWN.

5 | PL210 | REINFORCING - EXISTING TO NEW POOL FLOOR
DETAIL VIEW
NOT TO SCALE

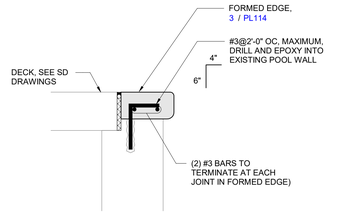


SECTION B-B FLOOR / WALL JOINT

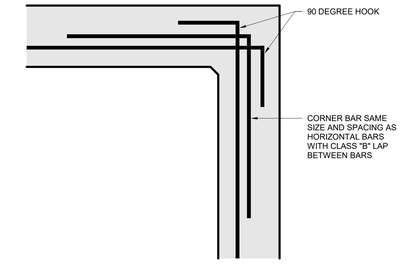
SECTION A-A: WALL / WALL JOINT OR FLOOR/FLOOR JOINT

NOTE:
1. DETAIL IS SCHEMATIC AND INDICATES CLEARANCES AND INSTALLATION INFORMATION ONLY. FOR APPLICABLE INSTALLATION LOCATIONS SEE POOL STRUCTURAL DETAILS.
2. BASIS OF DESIGN IS TYPE KBA-1510FP WATERSTOP BY ADEKA. SUBSTITUTIONS MUST BE APPROVED BY ENGINEER. NOTE THAT CLEARANCES FOR SUBSTITUTIONS MAY DIFFER. REFER TO MANUFACTURER REQUIREMENTS.
3. INSTALL WATERSTOP ON WET SIDE(S) OF REINFORCEMENT.
4. DIMENSION ABOVE IS A MIN FOR CONCRETE COVERAGE AND DOES NOT INCLUDE THE POOL FINISH. PROVIDE ADDITIONAL CONCRETE COVERAGE IF POSSIBLE.
5. PROTECT WATERSTOP FROM WATER, DIRT, DEBRIS, AND DAMAGE PRIOR TO COVERING WITH CONCRETE.
6. SEE SPECIFICATION SECTION 131120 FOR ADDITIONAL WATERSTOP REQUIREMENTS.

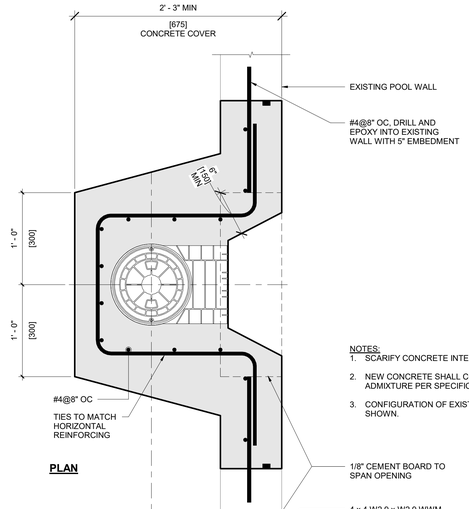
1 | PL210 | WATERSTOP - COMPRESSIBLE NON-MOVING JOINT - ADEKA
DETAIL VIEW
NOT TO SCALE



8 | PL210 | REINFORCING - FORMED EDGE
DETAIL VIEW
NOT TO SCALE

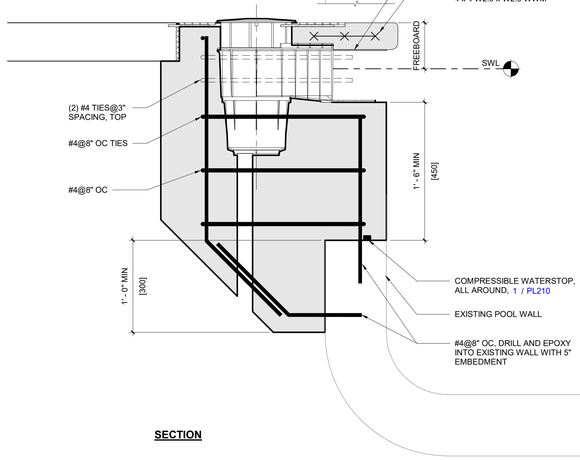


2 | PL210 | REINFORCING - SINGLE MAT REINFORCING AT CORNER
DETAIL VIEW
NOT TO SCALE



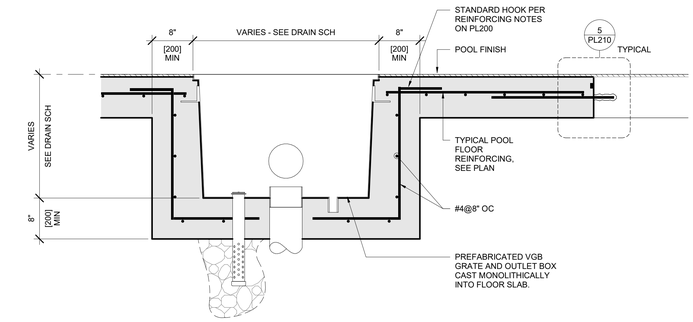
PLAN

NOTES:
1. SCARIFY CONCRETE INTERFACE AND APPLY BONDING AGENT.
2. NEW CONCRETE SHALL CONTAIN SHRINKAGE REDUCING ADMIXTURE PER SPECIFICATIONS.
3. CONFIGURATION OF EXISTING WALL MAY VARY FROM WHAT IS SHOWN.

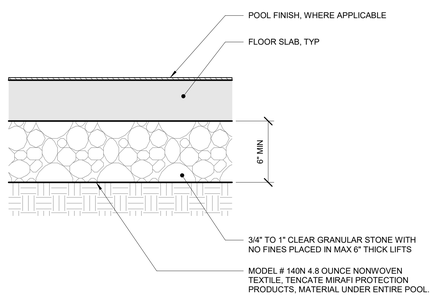


SECTION

6 | PL210 | REINFORCING - SKIMMER
DETAIL VIEW
NOT TO SCALE



3 | PL210 | REINFORCING - FLOOR OUTLET
DETAIL VIEW
NOT TO SCALE



4 | PL210 | FLOOR SUB BASE
PLAN VIEW
NTS

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

CONSULTANTS

COLORADO LICENSED
VINAY KHATAVKAR
36170
01/27/2023
PROFESSIONAL ENGINEER

REVISION SCHEDULE

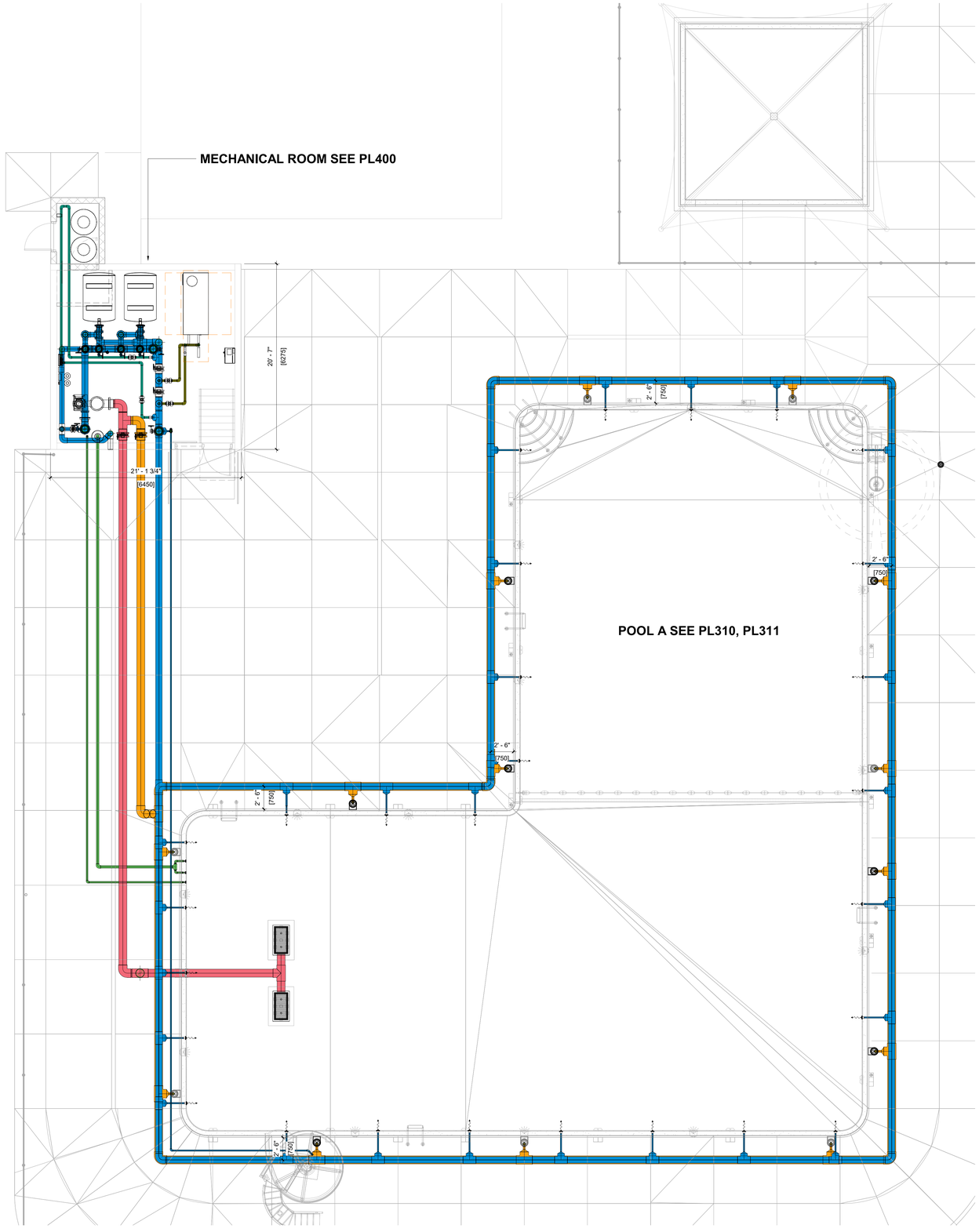
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

STRUCTURAL DETAILS

PL210

GRAEF
Project Number: 2022-2000.XX
Phone 920 / 592 9440



1 PL300 POOL A OVERALL PIPING PLAN
PLAN VIEW
3/16" = 1'-0"

SCHEDULE - POOL FIXTURES

POOL ID	EQUIPMENT ID	FIXTURE	QTY.	MANUFACTURER	DESCRIPTION
A	PF 1	DailMAX-SG-183628	2	DALDORADO	SEE DRAIN SCHEDULE
A	PF 2	WALL INLET	28	STA-RITE	1-1/2", MOLDED ABS, WHITE IN COLOR
A	PF 3	SKIMMER	14	STA-RITE	SWIMQUIP MANUFACTURED BY STA-RITE INDUSTRIES, CATALOG # 08650-1404, U-3 MOLDED ABS SKIMMER WITH WHITE LID & FRAME, 2" SLIP WITH 1 1/2" SLIP REDUCERS; INCLUDE FLOAT & CHECK VALVE AND BASKET. PROVIDE WITH ASME A112.19.8-2007 CERTIFIED, WHITE, EQUALIZER FITTING AND COVER. PLUG EQUALIZER FITTING CONNECTION
A	PF 4	SUPPLY FITTING	3	HAYWARD	FITTING & GRATE COVER, WHITE IN COLOR

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

OVERALL PIPING PLAN

PL300

PIPING LEGEND

PIPE DESCRIPTION	PIPE COLOR
AIR:	
ACTIVITY SUPPLY:	
CHEMICAL:	
INLET SUPPLY:	
GRAVITY:	
JET SUPPLY:	
PROPULSION SUPPLY:	
AUTOFILL SENSOR:	
SKIMMER SUCTION:	
SLIDE SUPPLY:	
SUCTION:	

MECHANICAL P&ID SYMBOL LEGEND

EQUIPMENT TYPE	SECTION VIEW	PLAN VIEW
PUMP		
PUMP WITH INTEGRAL STRAINER		
STRAINER		
REGENERATIVE MEDIA FILTER		
HIGH RATE SAND FILTER (HORIZONTAL)		
HIGH RATE SAND FILTER (VERTICAL)		
POOL HEATER		
HEAT EXCHANGER		
UV UNIT		
CHEMICAL CONTROLLER		
CHEMICAL FEED PUMP		
PULSAR CHLORINE FEEDER		
AXIALL CHLORINE FEEDER		
AXIALL ACID FEEDER (ACID RITE)		
CO2 FEEDER		
CHEMICAL STORAGE TANK		
CO2 STORAGE TANK		
AUTO FILL WITH SENSOR		
SURGE TANK VENTILATION FAN		
GEAR OPERATED BUTTERFLY VALVE		
LEVER OPERATED BUTTERFLY VALVE		
PNEUMATIC BUTTERFLY VALVE		
TRUE UNION BALL VALVE		
TRUE UNION CHECK VALVE		
ELECTRONIC MODULATING VALVE		
ELECTRO-PNEUMATIC MODULATING VALVE		
MODULATING FLOAT VALVE		
VENTURI		
SOLENOID VALVE		
CHECK VALVE		
WYE STRAINER		
CONCENTRIC REDUCER		
ECCENTRIC REDUCER		
FLANGED BREAK		
COMPOUND GAUGE		
THERMOMETER		
EXPANSION JOINT		
FLOW METER (SENSOR)		
FLOW SWITCH		

GENERAL POOL PIPING AND EQUIPMENT PLAN NOTES

PIPING

1. THE PIPING LAYOUTS ON THESE DRAWINGS ARE SCHEMATIC AND FOR REFERENCE ONLY. PIPING AS SHOWN IS SPREAD OUT FOR CLARITY. CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING FINAL PIPE ROUTING AND ELEVATIONS.
2. REDUCE THE USE OF FITTINGS AND LONG PIPE RUNS TO MINIMIZE HEAD LOSS IN THE SYSTEM.
3. ALL OUTDOOR PIPING SHALL BE INSTALLED IN A PIPE TRENCH WITH BEDDING AND COVER MATERIALS PER SPECIFICATIONS. PIPING MAY BE STACKED IN THE PIPE TRENCH.
4. ARROWS DENOTE DIRECTION OF FLOW.
5. REFER TO ALL DISCIPLINES DOCUMENTATION AND COORDINATE ALL PIPING AND EMBEDMENTS WITH AFFECTED TRADES.
6. ALL GRAVITY PIPING SHALL BE INSTALLED AT A MINIMUM SLOPE OF 1" DROP PER 10' LENGTH. ALL OUTDOOR PIPING SHALL BE INSTALLED WITH A SLOPE TO ALLOW COMPLETE DRAINING. PROVIDE WINTERIZING/DRAINING INSTRUCTIONS AND SCHEMATICS TO OWNER.
7. CONTRACTOR SHALL USE SWING JOINTS OR OTHER MEANS AND METHODS AS REQUIRED TO PROVIDE POOL INLET FITTINGS FLUSH AND PERPENDICULAR WITH THE POOL FLOOR AND AS REQUIRED FOR PROPER SLOPE TO DRAIN FOR WINTERIZATION.
8. SUPPORT PIPES PER PL403-1 THRU 7.
9. ALL SUPPORTS, BRACING, FASTENERS AND HARDWARE IN THE SURGE TANK(S) SHALL BE STAINLESS STEEL.
10. THE INTENT OF THESE DRAWINGS IS NOT TO BE INCLUSIVE OF ALL VALVES OR FITTINGS REQUIRED FOR THIS PROJECT. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE ALL VALVES AND FITTINGS REQUIRED.

PIPE PENETRATIONS

1. SEE BUILDING STRUCTURAL DRAWINGS FOR ALL WALL DIMENSIONS AND WALL/REINFORCING STEEL DIMENSIONS AND DETAILS, INCLUDING REINFORCING REQUIREMENTS AROUND ALL PIPE PENETRATIONS.
2. THE POOL CONTRACTOR SHALL FURNISH ALL SLEEVES FOR THE PENETRATIONS SHOWN ON THE POOL DRAWINGS.
3. THE SLEEVES SHALL BE INSTALLED BY THE BUILDING CONTRACTOR DURING THE STEEL AND FORMWORK PLACEMENT. BUILDING CONTRACTOR SHALL COORDINATE WITH THE POOL CONTRACTOR DURING PLACEMENT AND OBTAIN SLEEVE LOCATION APPROVAL FROM THE POOL CONTRACTOR PRIOR TO POURING THE WALLS.
4. THE POOL CONTRACTOR SHALL PROVIDE ALL LINK-SEALS REQUIRED IN THE PIPE PENETRATIONS
5. ALL PIPE PENETRATION DRAWINGS AND DIMENSIONS ARE SPECIFIC TO THE WTI BASIS OF DESIGN POOL EQUIPMENT AND LAYOUTS AS SHOWN. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING FINAL PENETRATION LOCATIONS AND SIZES BASED ON ENGINEER APPROVED EQUIPMENT SELECTIONS AND ACTUAL SITE CONDITIONS. PROVIDE SHOP DRAWINGS TO POOL ENGINEER
6. REFER TO PL200-2 FOR REINFORCEMENT AT PIPE PENETRATIONS.
7. REFER TO STRUCTURAL DRAWINGS FOR FUTURE CORED OPENINGS.
8. SEE PENETRATION SCHEDULE FOR ALL PIPE PENETRATIONS SHOWN IN THE ELEVATION DETAILS ON PL600.

MECHANICAL EQUIPMENT

1. CONTRACTOR SHALL PROVIDE EQUIPMENT LAYOUTS PER PLANS. IF ALTERNATE LAYOUT IS REQUESTED, CONTRACTOR SHALL PROVIDE SCALED DRAWING LAYOUT FOR REVIEW INDICATING POOL EQUIPMENT, PIPING, PIPE SUPPORTS, REQUIRED CLEARANCES, AND SERVICE ACCESS.
2. REFER TO ARCHITECTURAL PLANS FOR ACTUAL ROOM DIMENSIONS AND FINISHED FLOOR ELEVATIONS.
3. VERIFY EQUIPMENT PAD HEIGHT REQUIREMENTS FROM MANUFACTURER AND PROVIDE SHOP DRAWINGS TO POOL ENGINEER
4. PROVIDE MINIMUM 30" SERVICE ACCESS BETWEEN PUMPS. CONTRACTOR SHALL PROVIDE THE GREATER OF MANUFACTURER OR CODE REQUIRED CLEARANCES AROUND AND ABOVE ALL OTHER POOL EQUIPMENT.
5. HEATER FLOW IS MINIMUM PROVIDED BY MANUFACTURER.

POOL CHEMICAL STORAGE AND PIPING NOTES

1. ALL CHEMICAL ROOM DOORS AND CONTAINERS SHALL BE PROVIDED WITH SIGNAGE AS REQUIRED BY FIRE CODE. SEE ARCHITECTURAL DRAWING FOR THE DOOR LABEL REQUIREMENTS.
2. PROVIDE ALL CHEMICAL FEED PUMPS WITH "TUBE FAILURE DETECTION". THIS TECHNOLOGY DETECTS TUBING FAILURE AND WILL AUTOMATICALLY SHUT OFF THE PUMP AND ENERGIZE A RELAY. INSTALL RELAY TO PERMIT COMMUNICATIONS WITH THE CHEMICAL CONTROLLER SO THAT THE OPERATOR CAN BE NOTIFIED OF THE PUMP STATUS BEING IN AN ALARM/OFF CONDITION.
3. DO NOT LOCATE CHEMICAL INJECTION POINTS ABOVE DOORWAY, CHEMICAL FEED PUMPS, OR ELECTRICAL OUTLETS.
4. CHEMICAL TANKS WITHIN THE CHLORINE ROOM SHALL BE FILLED USING A TRANSFER METHOD IN COMPLIANCE WITH STATE & LOCAL FIRE CODES. BULK LIQUID DELIVERY SHALL BE PUMPED FROM A TRUCK TO THE TANK VIA AN AIR DRIVEN PUMP ON THE TRUCK. THE TRUCK PUMPING SYSTEM SHALL HAVE A ONE YEAR AND 5 YEAR TANK INSPECTION AS REQUIRED BY DOT. THIS INSPECTION SHALL INCLUDE TANK INTEGRITY, ALL ASSOCIATED PLUMBING, PUMPS AND CONNECTIONS. INSPECTIONS ARE TO PREVENT ACCIDENTAL LEAKS OR SPILLS DURING THE PUMPING FUNCTION.
5. THE DIRECTION OF FLOW FOR THE RECIRCULATION EQUIPMENT SHALL BE LABELED CLEARLY WITH DIRECTIONAL SYMBOLS SUCH AS ARROWS ON ALL PIPING IN THE EQUIPMENT AREA PER REQUIREMENTS OF 13 11 20 SPECIFICATIONS.
6. PLUMBING LINES SHALL BE LABELED CLEARLY WITH THE SOURCE OR DESTINATION DESCRIPTIONS PER REQUIREMENTS OF 13 11 20 SPECIFICATIONS.
7. EACH VALVE SHALL BE INSTALLED IN THE EQUIPMENT AREA AND LABELED AS TO ITS PURPOSE PER REQUIREMENTS OF 13 11 20 SPECIFICATIONS.
8. PER SPECIFICATIONS SECTION 13 11 13, SUBMIT AN ELECTRONIC VERSION OF THE PIPE AND VALVE CHART FOR EACH PIPING SYSTEM TO THE ARCHITECT/ENGINEER FOR APPROVAL. CHART TO CONSIST OF ISOMETRIC DRAWINGS OR PIPING LAYOUTS SHOWING AND IDENTIFYING EACH VALVE AND DESCRIBING ITS FUNCTION. UPON COMPLETION OF THE WORK HANG IN A CONSPICUOUS LOCATION IN THE EQUIPMENT ROOM ONE (1) COPY OF EACH CHART TO A RIGID BACKBOARD WITH CLEAR LACQUER PLACED UNDER GLASS AND FRAMED.

PIPING NOTES

REFER TO DIVISION 13 SPECIFICATION FOR DETAILS

PIPING:

a. ALL PIPING SHALL BE IN ACCORDANCE WITH THE COLORADO STATE PLUMBING CODE AND COLORADO DEPARTMENT OF PUBLIC HEALTH CODE. THE A.S.T.M. DESIGNATION NUMBER D-1785, AND THE NSF SEAL FOR POTABLE WATER.
b. ALL PIPING DESIGNED FOR 6'/SECOND MAX SUCTION, 10'/SECOND MAX PRESSURE, AND 3'/SECOND MAX GRAVITY.
c. MAIN DRAIN PIPING SHALL CARRY 100% OF RECIRCULATION RATE AT A VELOCITY NOT TO EXCEED 5'/SECOND.
d. ALL GUTTER AND INLET SUPPLY PIPING MUST BE LAID ON A GRADE SO IT WILL DRAIN COMPLETELY BY GRAVITY TO PREVENT DAMAGE DURING FREEZING WEATHER. MAIN DRAIN LINE PIPING MUST BE LAID ON A GRADE SO; (A) ALL PIPING FROM BENEATH THE POOL TO THE ELEVATION CHANGE SHALL PITCH TO DRAIN TO THE POOL MAIN DRAIN SUMPS AND; (B) ALL PIPING FROM THE ELEVATION CHANGE TO THE MECHANICAL ROOM SHALL PITCH TO DRAIN. IN ALL INSTANCES WHERE GRAVITY DRAINAGE IS NOT PROVIDED; THE CONTRACTOR SHALL INSTALL DRAIN VALVES SO THAT ALL LINES CAN BE DRAINED COMPLETELY TO MECHANICAL ROOM OR ANOTHER APPROVED LOCATION. DRAINAGE PLUGS SHALL BE PROVIDED IN THE PIPING SYSTEM TO ALLOW FOR DRAINING OF POOL PIPING. CONTRACTOR SHALL PROVIDE OPERATION AND WINTERIZATION INSTRUCTIONS TO OWNER.
e. ALL ELEVATIONS TO BE FIELD VERIFIED TO ALLOW FOR PROPER PITCH AND DRAINAGE. PITCH - APPROXIMATE 1"/ 10'-0". POOL CONTRACTOR SHALL MAKE EVERY EFFORT TO CURTAIL THE USE OF FITTINGS TO REDUCE HEAD.
f. THIS DRAWING IS INTENDED FOR SCHEMATIC USE ONLY!! FINAL LOCATIONS SHALL BE FIELD VERIFIED WITH ALL OTHER TRADES, BY CONTRACTOR.
g. CONTRACTOR SHALL COORDINATE ALL WORK WITH ARCHITECTURAL, MECHANICAL, ELECTRICAL AND STRUCTURAL DRAWINGS.

DRAINS:

a. ALL DRAIN FITTINGS TO CARRY 100% OF RECIRCULATION RATE AT A VELOCITY NOT TO EXCEED 1.5'/SECOND THROUGH THE CLEAR AREA OF THE GRATE.
b. ALL DRAINS AND OUTLETS SHALL CONFORM WITH ANSI/APSP-16 2011 OR ANY SUCCESSOR STANDARD.

PRESSURE GAUGES:

a. PRESSURE/VACUUM GAUGES TO BE INSTALLED ON ALL PUMP SUCTION AND DISCHARGE LINES.

VALVES:

a. EACH VALVE SHALL HAVE A PERMANENT IDENTIFYING LABEL OR TAG ATTACHED TO IT. THE SEQUENCE OF OPERATION, BRIEFLY STATED, SHALL BE PROMINENTLY DISPLAYED.

FLOW METERS:

a. FLOW METER SHALL BE PROVIDED IN THE FILTRATION PUMP DISCHARGE LINE AND IN EACH INLET RETURN LINE AS INDICATED ON THE DRAWINGS. FLOW METERS SHALL BE INSTALLED ON A STRAIGHT LENGTH OF PIPE WITHOUT ANY VALVE, ELBOW OR OTHER SOURCE OF TURBULENCE (UNINTERRUPTED FLOW). PROVIDE A MIN OF 10 PIPE DIA UPSTREAM AND 5 PIPE DIA DOWNSTREAM FROM THE FLOW METER OF UNINTERRUPTED FLOW OR INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
b. MAIN FLOWMETER SHALL BE USED TO MONITOR BACKWASH RATE.

FILTERS:

a. FILTER SHALL BE PROVIDED WITH THE FOLLOWING APPROPRIATELY LOCATED ACCESSORIES: PRESSURE GAUGES, BACKWASH SIGHT GLASS ON WASTE DISCHARGE LINE AND AN AIR RELIEF VALVE AT THE HIGH POINT OF THE FILTER.

HEATERS:

a. EQUIPPED WITH THERMOMETERS, 80-240 DEGREES F WITH 2 DEGREE GRADUATIONS; AUTOMATIC TEMPERATURE LIMITING DEVICE; FLOW SWITCH; HEATER BYPASS VALVE; ALL INFLUENT/EFFLUENT HEATER PIPING TO BE COPPER; PRESSURE RELIEF VALVE TO BE PROVIDED AND PIPED TO WITHIN 6" OF FLOOR. THE AUTOMATIC TEMPERATURE SWITCH ON THE POOL HEATER SHALL BE SET FOR A MAX OF 100 DEGREES. FURNISH AND INSTALL THERMOMETERS IN INLET AND OUTLET PIPING TO HEATER AND DOWNSTREAM IN THE BLENDED WATER SYSTEM.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FINCH
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

MECHANICAL NOTES

PL301

DRAIN SCHEDULE

DRAIN / GRATE ID	DETAIL #	DRAIN/GRATE MFGR SPECIFICATIONS						DESIGN DATA						
		MFGR & MODEL #	DIMENSIONS		OPEN AREA		MAX ALLOWABLE FLOW PER GRATE	CONNECTED PUMPS	SYSTEM TOTAL DESIGN FLOW	DRAIN / GRATE QTY	FLOW PER GRATE	VELOCITY	SYSTEM MAXIMUM	
			WIDTH	LENGTH	PER GRATE	TOTAL							FLOW PER GRATE	VELOCITY
			(ft)	(ft)	(in2)	(in2)	(gpm)		(gpm)		(gpm)	(fps)	(gpm)	(fps)
A-PF1	2/PL310	DALDORADO: DalMAX-SG-183628	1.5	3.0	401.00	802.00	2480	P1A	775	2	388	0.31	676	0.54

NOTE: THE SYSTEM MAXIMUM FLOW RATE AND VELOCITY HAS BEEN DETERMINED BY USING THE FLOW RATE AT THE END OF THE PUMP MANUFACTURER'S PUMP CURVE. ALL DRAIN/OUTLET SYSTEMS SHALL CONFORM WITH THE VIRGINIA GRAEME BAKER ACT AND TO CURRENT ANSI/APSP-16 STANDARD.

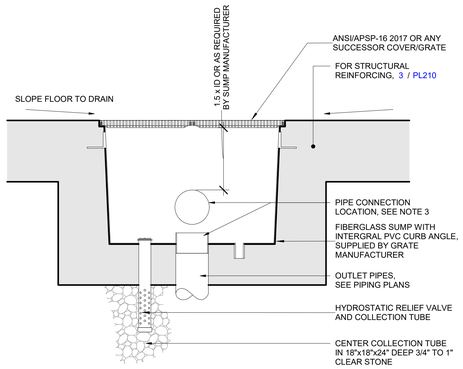
POOL A - EXISTING LAP POOL PIPE SCHEDULE

PIPE ID	TYPE	NPS	FLOW	VELOCITY	DESCRIPTION
		(in)	(gpm)	(fps)	
S1-1A	PVC SCH 80	10	775	3.5	FILTRATION PUMP SUCTION - MAIN DRAIN
S1-10A	PVC SCH 80	10	775	3.5	FILTRATION PUMP SUCTION - SKIMMER
S1-11A	PVC SCH 80	2.5	55	4.3	SKIMMER CONNECTION

SCHEDULE - POOL FIXTURES

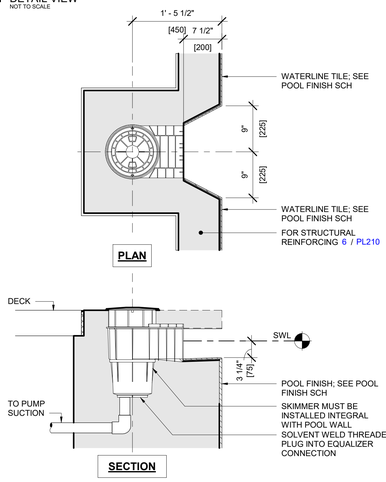
POOL ID	EQUIPMENT ID	FIXTURE	QTY.	MANUFACTURER	DESCRIPTION
A	PF 1	DalMAX-SG-183628	2	DALDORADO	SEE DRAIN SCHEDULE
A	PF 2	WALL INLET	28	STA-RITE	1-1/2", MOLDED ABS, WHITE IN COLOR
A	PF 3	SKIMMER	14	STA-RITE	SWIMQUIP MANUFACTURED BY STA-RITE INDUSTRIES, CATALOG # 08650-1404, U-3 MOLDED ABS SKIMMER WITH WHITE LID & FRAME, 2" SLIP WITH 1 1/2" SLIP REDUCERS; INCLUDE FLOAT & CHECK VALVE AND BASKET. PROVIDE WITH ASME A112.19.8-2007 CERTIFIED, WHITE, EQUALIZER FITTING AND COVER. PLUG EQUALIZER FITTING CONNECTION
A	PF 4	SUPPLY FITTING	3	HAYWARD	FITTING & GRATE COVER, WHITE IN COLOR

NOTE:
N = NEW LOCATION AND NEW SKIMMER
E = EXISTING LOCATION AND NEW SKIMMER



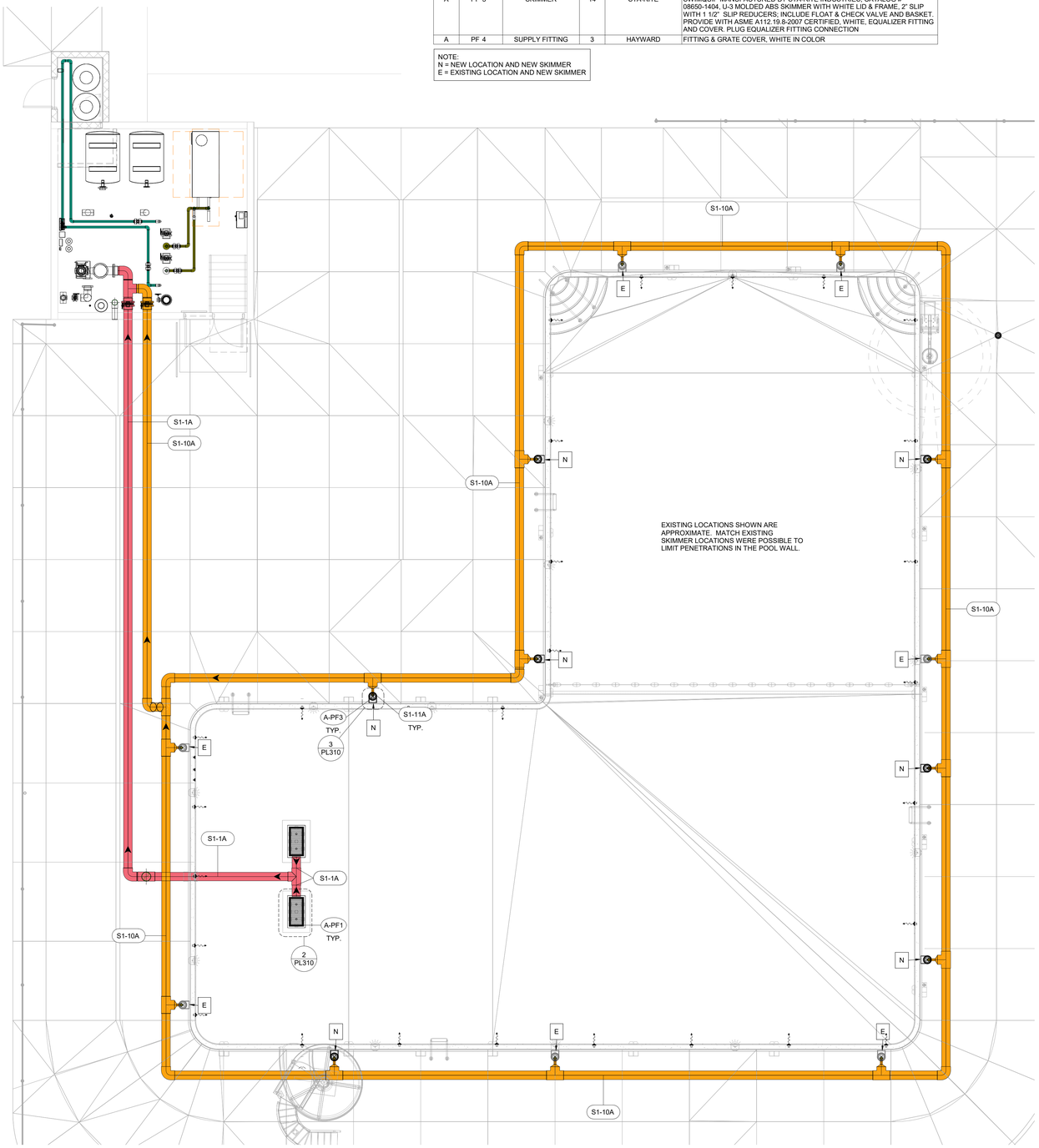
NOTES:
1. ALL DRAIN/OUTLET SYSTEMS SHALL CONFORM WITH THE VIRGINIA GRAEME BAKER ACT AND TO CURRENT ANSI/APSP-16 STANDARD. VERIFY GRATE DIMENSIONS AND OUTLET REQUIREMENTS WITH GRATE/SUMP MANUFACTURER PRIOR TO SUBMITTING SHOP DRAWINGS.
2. THE FIBERGLASS SUMP SHALL BE SUPPLIED WITH THE GRATE AS INDICATED IN THE DRAIN SCH. SUMP MATERIALS SHALL MEET OR EXCEED THE SCHEDULED MANUFACTURER'S SPECIFICATION. 8 OZ. FIBERGLASS MAT WITH MARINE GRADE WHITE GELCOAT AND 2" MINIMUM FRP WATERSTOP AROUND THE OUTSIDE PERIMETER.
3. AT CONTRACTOR'S OPTION, SUMP MAY HAVE BOTTOM OR SIDE OUTLET PIPE CONNECTION.
4. CONTRACTOR SHALL INCLUDE ALL POOL DRAIN/WINTERIZATION PIPE CONNECTIONS AS SHOWN ON PIPING DRAWINGS.
5. ALL SUMPS REQUIRE A MINIMUM OF ONE HYDROSTATIC RELIEF PORT AND 2" VALVE. (HAYWARD MODEL SP1056) WITH COLLECTION TUBE PER SUMP. UNLESS OTHERWISE NOTED. VERTICALLY INSTALLED SUMPS, ELEVATED POOLS AND/OR POOLS CONSTRUCTED ON A VOID FORM DO NOT REQUIRE A HYDROSTATIC RELIEF VALVE SYSTEM. UNUSED HYDROSTATIC PORTS SHALL BE PLUGGED.
6. SEE DRAIN SCHEDULE AND PIPE PLANS.
7. SECURE ALL GRATING TO DRAIN SUMP WITH CORROSION RESISTANT FASTENERS IN ACCORDANCE WITH MANUFACTURER REQUIREMENTS. FASTENERS SHALL NOT BE REMOVABLE WITHOUT THE USE OF A TOOL AND SHALL MEET ALL CURRENT ANSI/APSP/ICC-16 REQUIREMENTS. INSPECT ALL GRATING AND EACH FASTENER TO ASSURE THEY ARE IN PLACE AND PROPERLY SECURED PRIOR TO OPENING THE POOL FOR PUBLIC USE.
8. PROTECT DRAIN FROM EXTERNAL PRESSURE DURING INSTALLATION.
9. PROVIDE A REMOVABLE PLYWOOD AND A REUSABLE 1/4" PVC TOP COVER PROTECTOR WITH STAINLESS STEEL HARDWARE TO SHIELD THE INTERNALS OF EACH DRAIN SUMP FROM DEBRIS DURING CONSTRUCTION AND FOR FUTURE OWNER USE DURING WINTERIZATION AND/OR SHUTDOWN.
10. SUPPLY EACH SUMP CONNECTION PORT WITH A THREADED OR FLANGED ADAPTOR CONNECTION INSIDE THE SUMP. INCLUDE CORRESPONDING THREADED/FLANGED ADAPTOR PLUGS/FITTINGS AND STAINLESS STEEL HARDWARE FOR THE PURPOSES OF 50 PSI PRESSURE TESTING AND FUTURE WINTERIZATION AND/OR SHUTDOWN.

2 | MAIN DRAIN DETAIL VIEW
PL310 NOT TO SCALE



SKIMMER SPECIFICATIONS:
1. SURFACE SKIMMER SHALL CONSIST OF A PRECISION MOLDED CYCOLAC HOUSING WITH A HEAVY DUTY COMPRESSION MOLDED THERMOSETTING PHENOLIC BASE.
2. THE BASE SHALL INCORPORATE TWO 2" NPT THREADED APERTURE WHICH SHALL ENABLE TESTING OF PIPING FROM INSIDE THE SKIMMER AS WELL AS EXTERNAL PIPE CONNECTIONS TO PUMP. BASE SHALL BE AN INTEGRAL PART OF THE SKIMMER BODY.
3. A 10" DIA NON-CORROSIVE, HEAVY DUTY, NON-SLIP DECK PLATE & FRAME SHALL BE PROVIDED FOR EASY ACCESS TO THE SKIMMER INTERIOR. THE FRAME SHALL BE MOLDED CYCOLAC & SHALL INCORPORATE A FLANGE BELOW DECK LEVEL FOR KEYING INTO CONCRETE & SHALL BE ADJUSTABLE TO PERMIT VARIATIONS IN HEIGHT & ANGLE OF DECK IN RELATION TO THE SKIMMER BODY. THE ACCESS PLATE SHALL BE MOLDED CYCOLAC & SHALL BE SECURED TO THE FRAME BY MEANS OF TWO SS SCREWS TO PREVENT VANDALISM.
4. THE SKIMMER THROAT SHALL HAVE AN INTEGRAL MOLDED WEIR STOP WITH A CUSHION ATTACHED. THE SKIMMER THROAT SHALL BE WITH AN 8" WIDE HEAVY DUTY MOLDED WEIR & HINGE WHICH AUTOMATICALLY ADJUSTS TO VARIATIONS IN POOL WATER LEVEL, WITHIN A 4" RANGE.
5. A REMOVABLE 7 1/2" DIA x 5 1/8" DEEP SYNTHETIC DEBRIS BASKET SHALL BE PROVIDED IN THE SKIMMER BODY.
6. A REMOVABLE FLOAT VALVE HOUSING ASSEMBLY SHALL BE REMOVED & DISCARDED.
7. AN ADJUSTABLE TRIMMER VALVE SHALL BE FITTED TO THE SKIMMER BASE TO PROVIDE AN ACCURATE FLOW ADJUSTMENT, THUS PERMITTING EQUALIZATION OF FLOW OF ALL SKIMMERS.
8. SURFACE SKIMMER SHALL BE COMMERICAL RENEGADE GUNITE IN-GROUND SKIMMER WITH NSF50 APPROVAL FOR 75 GPM FLOW RATE MANUFACTURED BY WATERWAY PLASTICS, CATALOG #540-6350. MATERIALS: MOLDED PVC PLASTIC SKIMMER WITH ROUND WHITE LID & FRAME, 2.5" SPIGOT x 2" NPT x 2" NPT CONNECTIONS, FLOAT/CHECK VALVE AND REMOVABLE CLEANING BASKET. PLUG EQUALIZER FITTING CONNECTION.

3 | SKIMMER PIPING DETAIL VIEW
PL310 NOT TO SCALE



1 | POOL A SKIMMER AND SUCTION PIPING PLAN PLAN VIEW
PL310 3/16" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7376

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

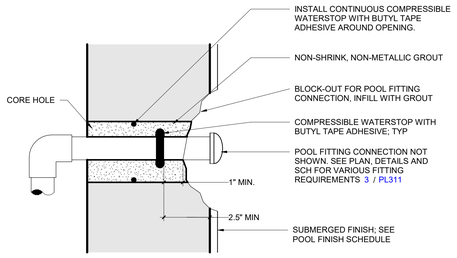
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

POOL A SKIMMER AND SUCTION PIPING PLAN

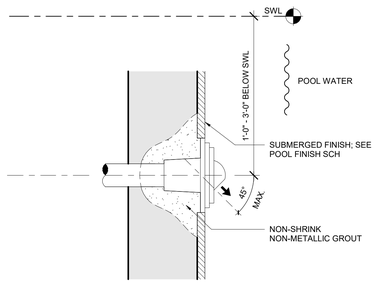
PL310



FLOOR / WALL SECTION

NOTES:
1. DETAIL ILLUSTRATES COMPRESSIBLE WATERSTOP FOR PIPE PENETRATIONS THROUGH POOL SHELL. SEE PIPING PLANS AND DETAILS FOR APPLICABLE INSTALLATION LOCATIONS.
2. BASIS OF DESIGN FOR 6" OD PIPES OR LARGER IS TYPE KBA-1510FP COMPRESSIBLE WATERSTOP BY ADEKA. FOR PIPES SMALLER THAN 6" OD USE SYNKOFLEX FLEXIBLE WATERSTOP. SUBSTITUTIONS MUST BE APPROVED BY ENGINEER.
3. DIMENSION ABOVE IS A MIN FOR CONCRETE COVERAGE AND DOES NOT INCLUDE THE POOL FINISH. PROVIDE ADDITIONAL CONCRETE COVERAGE IF POSSIBLE.
4. PROTECT WATERSTOP FROM WATER, DIRT, DEBRIS, AND DAMAGE PRIOR TO COVERING WITH CONCRETE.
5. SEE SPECIFICATION SECTION 131120 FOR ADDITIONAL WATERSTOP REQUIREMENTS.
6. STEEL REINFORCEMENT OMITTED FOR CLARITY. SEE STRUCTURAL DETAILS FOR TYPICAL WALL/FLOOR REINFORCING STEEL REQUIREMENTS AND STEEL REQUIREMENTS AROUND PIPE PENETRATIONS. SPACING BETWEEN REINFORCING STEEL AND WATERSTOP SHALL BE NO LESS THAN 1.5xDIAMETER OF THE LARGEST AGGREGATE IN THE APPROVED CONCRETE MIX. INSTALL WATERSTOP ON POOL FINISH SIDE OF REINFORCING STEEL.

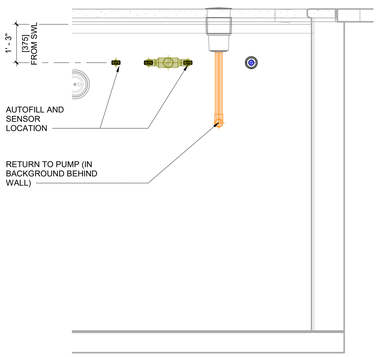
2 PL311 | WATERSTOP DETAIL - TYPICAL POOL PIPE PENETRATION DETAIL VIEW
NOT TO SCALE



WALL SECTION

NOTE:
1. ADJUSTMENT BY CONTRACTOR SHALL BE NECESSARY ON SITE TO BALANCE FLOW

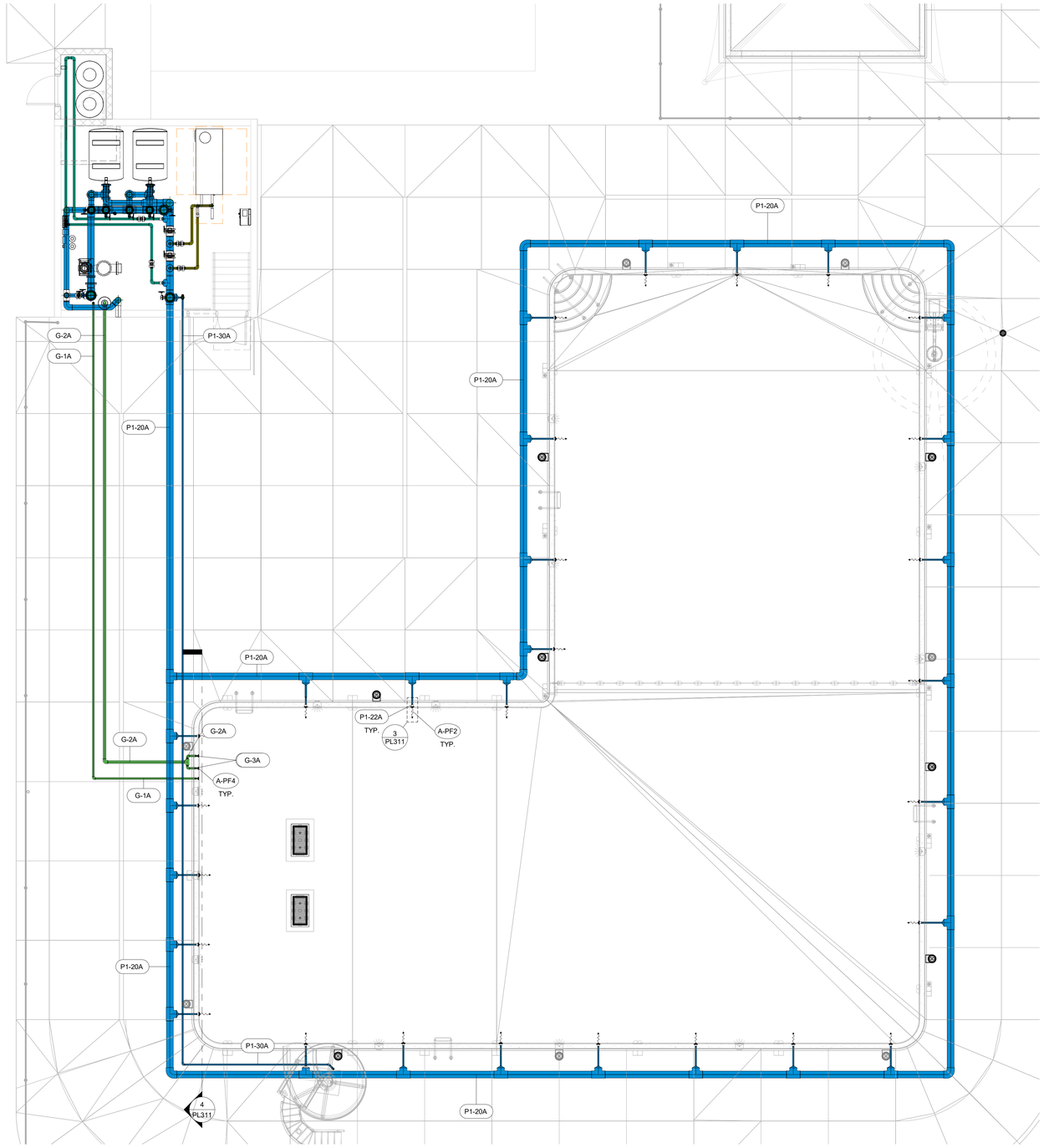
3 PL311 | WALL INLET DETAIL VIEW
NOT TO SCALE



4 PL311 | FILL AND SENSOR LOCATION SECTION VIEW
NOT TO SCALE

POOL A - EXISTING LAP POOL PIPE SCHEDULE

PIPE ID	TYPE	NPS (in)	FLOW (gpm)	VELOCITY (fps)	DESCRIPTION
"	"	"	"	"	"
S1-10A	PVC SCH 80	10	775	3.5	FILTRATION PUMP SUCTION -...
"	"	"	"	"	"
P1-20A	PVC SCH 80	8	775	5.5	INLET SUPPLY
P1-21A	PVC SCH 80	2	55	6.2	INLET SUPPLY
P1-22A	PVC SCH 80	1.5	28	5.2	TYPICAL INLET SUPPLY CONNECTION
P1-30A	PVC SCH 80	1.5	30	5.6	SLIDE SUPPLY
G-1A	PVC SCH 40	2	0	0.0	SENSOR
G-2A	PVC SCH 40	3	50	2.2	FILL LINE
G-3A	PVC SCH 40	2	25	2.4	FILL LINE



1 PL311 | POOL A FILTRATION, FILL AND SENSOR PIPING PLAN
PLAN VIEW
3/16" = 1'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

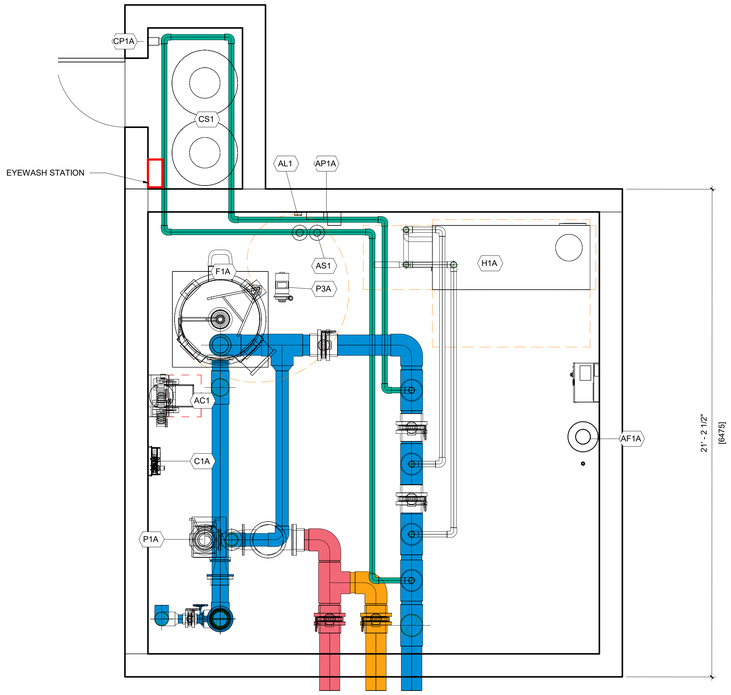
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

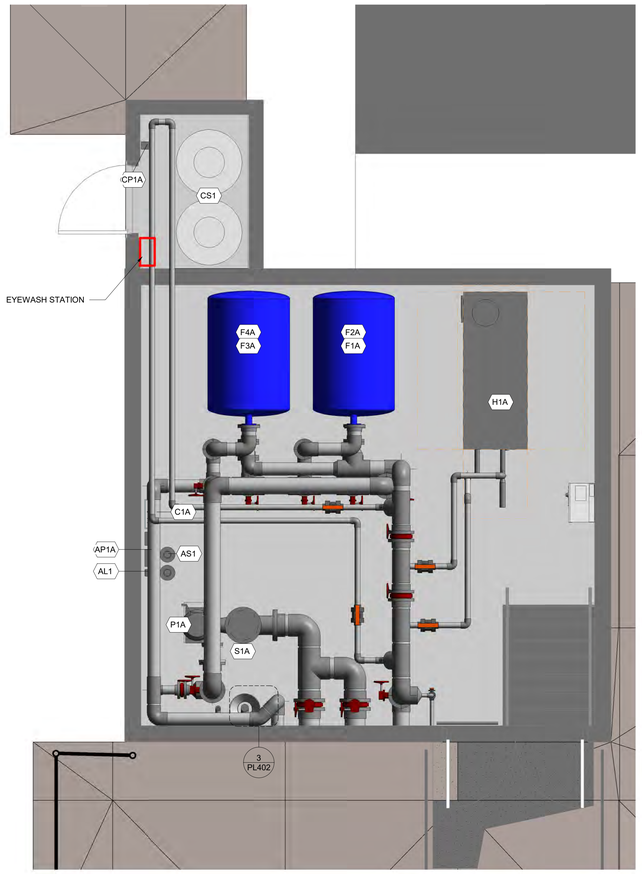
POOL A FILTRATION, FILL AND SENSOR PIPING PLAN

PL311

POOL A-EXISTING LAP POOL DATA		
DESCRIPTION	QTY	UNITS
POOL PERIMETER	304' - 6"	FEET
WATER SURFACE AREA	4,330	SQUARE FEET
POOL WATER TEMPERATURE	84	°F
POOL VOLUME	186,119	GALLONS
TOTAL VOLUME OF WATER	186,119	GALLONS
CIRCULATION RATE	775	GPM
TURNOVER/VOLUME/FLOW	240 MIN.	
FILTRATION RATE	11.34	GPM/FT²
BACKWASH FLOW	257	GPM



2 | ALTERNATE MECHANICAL ROOM PLAN VIEW
PL400 3/8" = 1'-0"



1 | MECHANICAL EQUIPMENT PLAN PLAN VIEW
PL400 3/8" = 1'-0"

EQUIPMENT SCHEDULE					
ID	ITEM	DETAIL	QTY	MANUFACTURER	BASIS OF DESIGN
P1A	PUMP		1	AURORA	VERTICAL 3801, 5x6x11, 30 HP, 208 VOLT, 3 PHASE, 1800 RPM, 775 GPM, @ 80' TDH, TEFC MOTOR, END SUCTION, CLOSE COUPLED, 316 STAINLESS STEEL IMPELLOR AND FITTED (SF), EPOXY COATED VOLUTE
S1A	STRAINER		1	NEPTUNE BENSON	10x6 ECCENTRIC REDUCING BASKET STRAINER, FIBERGLASS BODY, TRANSPARENT ACRYLIC LID, STAINLESS STEEL BASKET. PROVIDE WITH EXTRA STAINLESS STEEL BASKET.
F1A, F2A, F3A, F4A	FILTER		4	NEPTUNE BENSON	SHFFG SERIES, #4248, 42" DIAMETER FIBERGLASS TANK, 69.75" LENGTH, 68.4 SQUARE FEET OF TOTAL SURFACE AREA (17.1 SF PER FILTER),11.3 GPM/SF (FILTER MEDIA RATE), PROVIDE WITH DUAL LEVER STAINLESS STEEL LINKAGE, MANUALLY BACKWASH ONE TANK AT A TIME AT 256.5 GPM
H1A	HEATER		1	LOCHINVAR	COPPERFIN 2, CPN1802, 1,800,000 BTU/HOUR INPUT, 2" GAS CONNECTION, 2.5" WATER CONNECTION, 14" DIAMETER FLUE. CUPRO NICKEL HEAT EXCHANGER, MANUAL RESET HIGH LIMIT AND MULTI-STACK STAND. FURTHER PROVIDE WITH A.S.M.E. LABEL, RELIEF VALVE, FLOW SWITCH, OPTIONAL PUMP ON/OFF RELAY. AND ALL SAFETY DEVICE PACKAGES PER STATE AND LOCAL CODES. PROVIDE WITH 2.5" FLOWVIS FLOWMETER ON HEATER INFLUENT PIPING AS SHOWN IN DETAIL
C1A	CHEMICAL CONTROLLER		1	BECS TECHNOLOGY	BECSys7 CONTROLLER: WITH CONTINUOUS MONITORING. SEE CHEMICAL CONTROLLER SPECIFICATION FOR OPTIONS.
AP1A	pH CONTROL		1	NEPTUNE BENSON	20-200 SCFH HIGH OUTPUT C02 pH CONTROL SYSTEM, INCLUDING: CO2 SINGLE TANK PRESSURE REGULATOR P/N 11471. CO2 INLINE HEATER P/N 12707, C02 FEED SYSTEM P/N 12705, DIFFUSER ASSEMBLY P/N 145NBCO2DF.
AS1	pH STORAGE		1	CHEMICAL SUPPLIER	TWO STANDARD 50 POUND CO2 STORAGE CYLINDER SYSTEMS COMPLETE WITH GAUGES, CYLINDER CHANGEOVER VALVE, RESTRAINTS, AND TUBING. INSTALL SYSTEM USING STAINLESS STEEL CYLINDER/TANK RESTRAINTS PER CODE. PLUMB WITH 3/16" ID 1000PSI BRAIDED TUBING FROM CYLINDERS TO REGULATOR AND 3/8" O.D. POLYTUBING FROM REGULATOR TO FEEDER.
CP1A	CHLORINE FEEDER		1	BLUE/WHITE	A-100N SERIES, MODEL #A1N20A-7T, 0 TO 76 GALLONS PER DAY OUTPUT, 120 VOLTS, USE SODIUM HYPOCHLORITE FOR DISINFECTANT. PROVIDE WITH WEIGHTED FOOT STRAINER.
CS1	CHLORINE STORAGE		2	CHEM-TAINER INDUSTRIES, INC.	DC SERIES DOUBLE WALL BULK STORAGE TANK, 150 GALLON, 34" DIAMETER, 48" HEIGHT, 16" MANWAY, PROVIDE EACH WITH A BULKHEAD FITTING CONSTRUCTED OF MATERIAL CHEMICALLY COMPATABLE WITH THE CONTAINED PRODUCT
AL1	CO2 SENSOR		1	LOGIC02	LOGICO2 CO2 Mk90 STAND-ALONE CO2 SAFETY SYSTEM. INCLUDE Mk90 CO2 SENSOR WITH DISPLAY, HORN/STROBE, CABLING AND SIGNAGE. PROVIDE SETTINGS THAT COMPLY WITH ALL LOCAL SAFETY CODES AND LEGISLATION. LOCATE SYSTEM NEAR CO2 TANKS. INSTALL PER MANUFACTURER'S REQUIREMENTS.
AF1A	WATER LEVEL CONTROL		1	BECS TECHNOLOGY	BECSys PLX POINT SWITCH WITH SUBMERSIBLE CABLE: MODEL BECSys PLX-AS. PROVIDE WITH ASCO 8221 1.5" SLOW CLOSING SOLENOID VALVE, BRASS BODY, BUNA "N" DISC, 110 V, NORMALLY CLOSED, WATERTIGHT ENCLOSURE. NOTE: ONE LOOP POWER SUPPLY IS REQUIRED IN THE BECSsy7 CONTROLLER FOR THIS.
FM1A	FLOW METER		1	SIGNET	2551 MAG METER, INSERTION STYLE MAGNETIC FLOW SENSOR, MODEL #3-2551-P1-12. FLOW TO BE DISPLAYED ON VFD. PROVIDE WITH PVC-U CLAMP-ON SADDLE MODEL NUMBER. PROVIDE WITH IRON STRAP-ON SADDLE MODEL NUMBER IR8S080...

ALTERNATE EQUIPMENT SCHEDULE					
ID	ITEM	DETAIL	QTY	MANUFACTURER	BASIS OF DESIGN
F1A	FILTER		1	NEPTUNE BENSON	REGENERATIVE MEDIA FILTER, MODEL SP 41-48-1038, 812 SQUARE FEET OF FILTER AREA, .96 GPM/SF (FILTER MEDIA RATE), PROVIDE WITH PERLITE MEDIA OR APPROVED EQUAL
P3A	FILTER BACKWASH PUMP		1	NEPTUNE BENSON	NEPTUNE BENSON, INC CAST IRON SEWAGE TRASH PUMP, MODEL 393A-95 2X2X5, 5 HP, 230/460V, 3 PHASE, 3450RPM, TEFC ENCLOSED FAN COOLED MOTOR, PROVIDE WITH THREADED/FLANGE CONNECTION AND REDUCERS FOR INLET AND OUTLET, MOUNT DIRECTLY TO FLOOR.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEDT
42920
PROFESSIONAL ENGINEER
01/27/2023

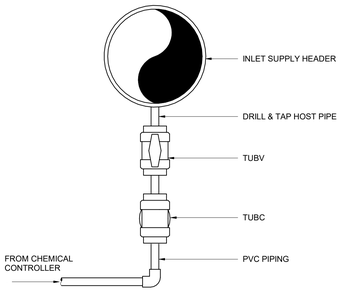
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

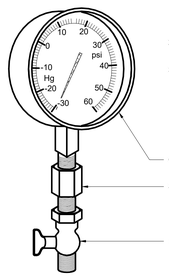
ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

MECHANICAL EQUIPMENT PLAN

PL400

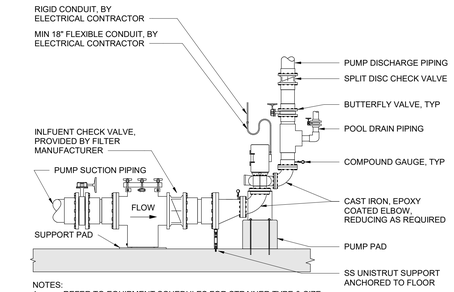


7 | CHEMICAL SAMPLING DETAIL VIEW
PL401 NOT TO SCALE



NOTES:
1. PRESSURE GAUGES SHALL BE INSTALLED BY MEANS OF DRILLING & TAPPING PIPE TO BE MONITORED. THE GAUGE SHALL THEN BE THREADED INTO THE PIPE. PROVIDE WITH SNUBBER & PET COCK.
2. GAUGE MAY BE USED WHEREVER CRUCIAL VACUUM OR PRESSURE READINGS ARE ESSENTIAL.
3. 4 1/2" SS CASED LIQUID FILLED PRESSURE GAUGES SHALL HAVE A DIAL RANGE PRESSURE OF 60psi & VACUUM RANGE OF 30" Hg THE MINOR GRADUATIONS SHALL HAVE A PRESSURE OF 2psi & VACUUM OF 2"Hg. 1/4" NPT AS MANUFACTURED BY WEKSLER, MARSH, WINTERS OR APPROVED EQUAL.

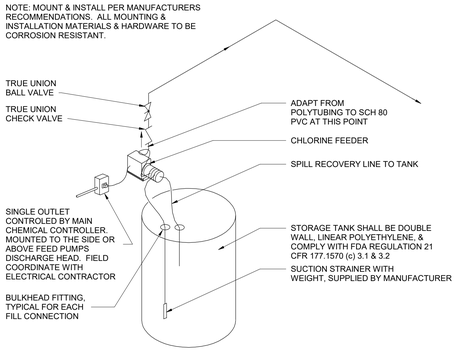
4 | COMPOUND GAUGE DETAIL VIEW
PL401 NOT TO SCALE



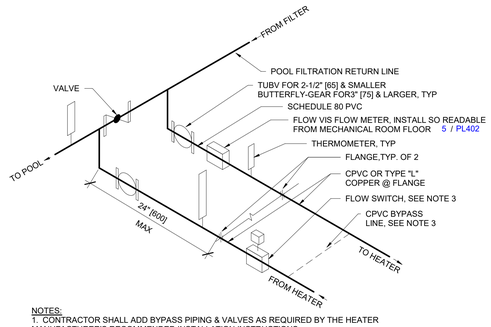
NOTES:
1. REFER TO EQUIPMENT SCHEDULES FOR STRAINER TYPE & SIZE.
2. SUPPLY AND INSTALL ECCENTRIC REDUCER ON SUCTION SIDE AS NECESSARY.
3. INSTALL COMPOUND GAUGES USING 1/4" NPT TAPS PROVIDED ON SUCTION AND DISCHARGE FLANGES.
4. INSTALL CHECK VALVE PER MANUFACTURER'S RECOMMENDATIONS.
5. LOCATE PRECOAT VALVE AND SPACE FLANGES AS REQUIRED TO AVOID CONFLICTS WITH THE DISCHARGE PLUMBING FLANGES AND VALVES.

1 | PUMP INSTALLATION - SAND FILTER DETAIL VIEW
PL401 NOT TO SCALE

NOTE: MOUNT & INSTALL PER MANUFACTURERS RECOMMENDATIONS. ALL MOUNTING & INSTALLATION MATERIALS & HARDWARE TO BE CORROSION RESISTANT.

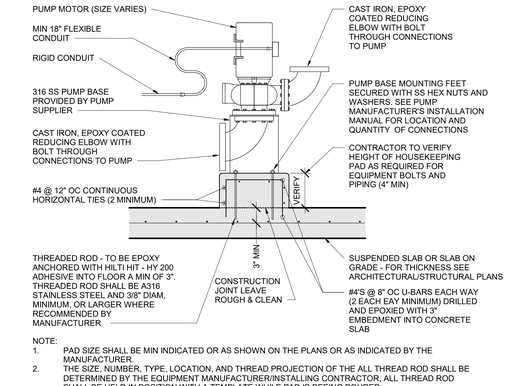


8 | CHLORINE ISOMETRIC DETAIL VIEW
PL401 NOT TO SCALE



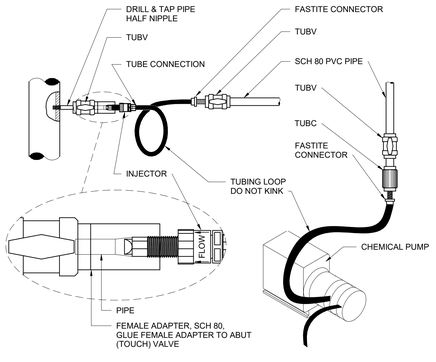
NOTES:
1. CONTRACTOR SHALL ADD BYPASS PIPING & VALVES AS REQUIRED BY THE HEATER MANUFACTURER'S RECOMMENDED INSTALLATION INSTRUCTIONS.
2. PIPING FROM FLANGES TO HEATER SHALL BE CPVC OR TYPE "L" COPPER. MATERIAL SHALL BE CONSISTENT FOR LENGTH OF RUN AND A MINIMUM OF 10 LINEAR FEET [3000].
3. INSTALL FLOW SWITCH ON EFFLUENT SIDE OF HEATER AS CLOSE TO HEATER CONNECTION AS POSSIBLE AND IN CONFORMANCE WITH MANUFACTURER'S INSTALLATION REQUIREMENTS.
4. CONTRACTOR SHALL PROVIDE AND CONFORM TO ANY ADDITIONAL INSTALLATION REQUIREMENTS PER MANUFACTURER OR CODE REQUIREMENT.
5. TEE CONNECTIONS ON THE POOL FILTRATION RETURN LINE TO THE HEATER INFLUENT AND EFFLUENT CONNECTIONS SHALL BE POSITIONED IN THE DOWNWARD POSITION.

5 | HEATER LOOP DETAIL VIEW
PL401 NOT TO SCALE



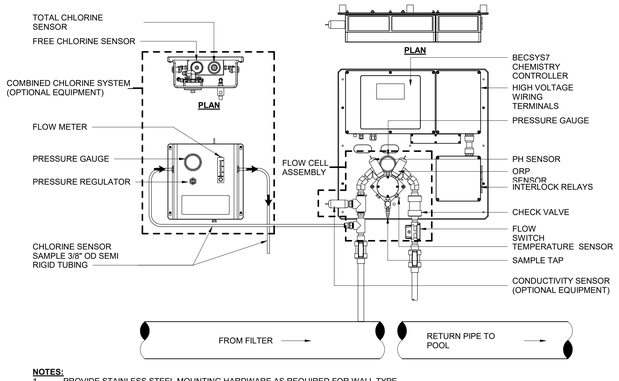
NOTE:
1. PAD SIZE SHALL BE MIN INDICATED OR AS SHOWN ON THE PLANS OR AS INDICATED BY THE MANUFACTURER.
2. THE SIZE, NUMBER, TYPE, LOCATION, AND THREAD PROJECTION OF THE ALL THREAD ROD SHALL BE DETERMINED BY THE EQUIPMENT MANUFACTURER/INSTALLING CONTRACTOR, ALL THREAD ROD SHALL BE HELD IN POSITION WITH A TEMPLATE WHILE PAD IS BEEING POURED.
3. EQUIPMENT BASES SHALL BE INSTALLED LEVEL UNLESS SPECIFIED OTHERWISE. EQUIPMENT BASES SHALL BE PROVIDED AND INSTALLED BY CONTRACTOR. SIZES AND LOCATIONS TO BE VERIFIED BY CONTRACTOR.
4. PROVIDE SUPPORT FOR PUMP SUCTION AND DISCHARGE PIPING WHILE ALLOWING FOR PUMP REMOVAL.

2 | PUMP PAD DETAIL VIEW
PL401 NOT TO SCALE



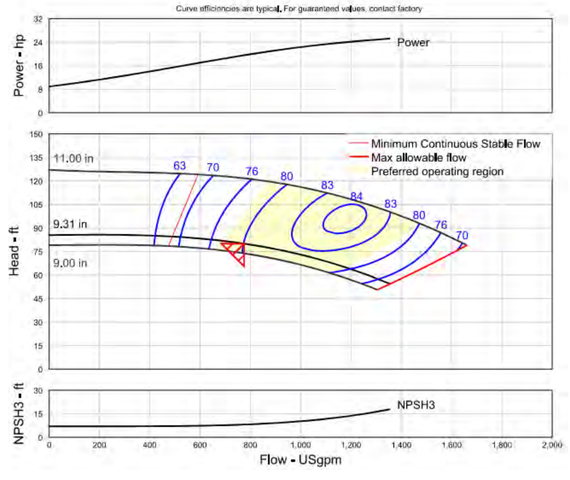
NOTE: FOR PIPING USE FASTITE CONNECTOR OR SIMILAR COMPRESSION FITTING.

9 | CHEMICAL INJECTION PLAN VIEW
PL401 NONE



NOTES:
1. PROVIDE STAINLESS STEEL MOUNTING HARDWARE AS REQUIRED FOR WALL TYPE.
2. INTERLOCK CHEMICAL CONTROL RELAYS WITH FILTRATION PUMP.
3. SEE CHEMICAL CONTROLLER SPECIFICATIONS FOR REQUIRED OPTIONAL EQUIPMENT.
4. RIGIDLY SECURE BACK PANEL TO BUILDING WALL, APPROXIMATELY 5'-8" ABOVE FINISHED FLOOR, IN LOCATION INDICATED IN PLAN.
5. CHEMICAL SAMPLING STREAMS SHALL TERMINATE AT THE AUTOFILL WITH 6" AIR GAP.

6 | CHEMICAL CONTROLLER DETAIL VIEW
PL401 NOT TO SCALE



3 | P1A PUMP CURVE DETAIL VIEW
PL401 NOT TO SCALE

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEND
42920
PROFESSIONAL ENGINEER
01/27/2023

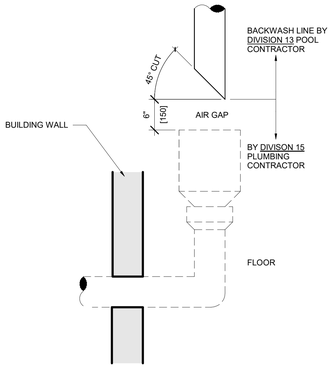
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

MECHANICAL DETAILS

PL401

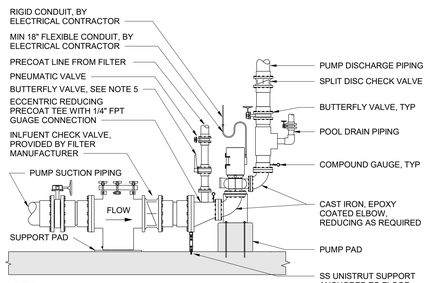


THIS TABLE SPECIFIES THE MINIMUM RECOMMENDED DIA. OF THE BACKWASH HUB.

FILTER BACKWASH LINE SIZE	RECOMMENDED BACKWASH HUB SIZE
1"	4"
1.5"	4"
2"	6"
2.5"	6"
3"	8"
4"	10"
6"	12"
8"	16"
10"	20"
12"	24"

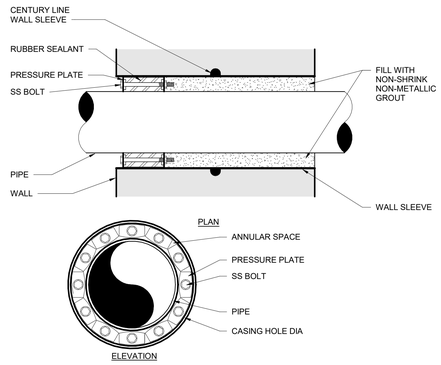
NOTES:
1. THE DRAIN LINE PIPE SIZE TO THE SANITARY OR STORM SEWER MUST BE DETERMINED BT THE CIVIL/MECHANICAL ENGINEER, BASED ON FLOW VELOCITY IN THE DRAIN PIPING.
2. PROVIDE ADEQUATE HEIGHT FOR BACKWASH HUB!
3. REFER TO PLUMBING DRAWINGS FOR DETAILS AND PIPE CONTINUATION.

7 PL402 | BACKWASH HUB DETAIL VIEW
NOT TO SCALE

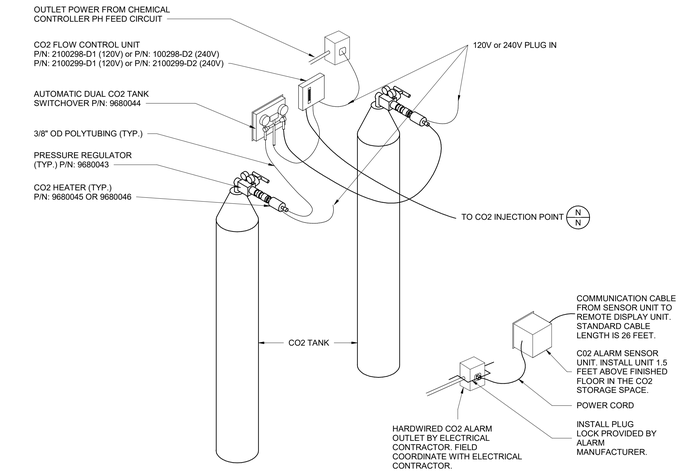


NOTES:
1. REFER TO EQUIPMENT SCHEDULES FOR STRAINER TYPE & SIZE.
2. SUPPLY AND INSTALL ECCENTRIC REDUCER ON SUCTION SIDE AS NECESSARY.
3. INSTALL COMPOUND GAUGES USING 1/4" NPT TAPS PROVIDED ON SUCTION AND DISCHARGE FLANGES.
4. INSTALL CHECK VALVE PER MANUFACTURER'S RECOMMENDATIONS.
5. LOCATE PRECOAT VALVE AND SPACE FLANGES AS REQUIRED TO AVOID CONFLICTS WITH THE DISCHARGE PLUMBING FLANGES AND VALVES.

8 PL402 | PUMP INSTALLATION - RM FILTER (ALTERNATE) DETAIL VIEW
NOT TO SCALE



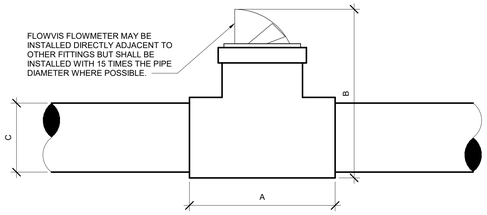
4 PL402 | WALL SLEEVE / LINK SEAL DETAIL VIEW
NOT TO SCALE



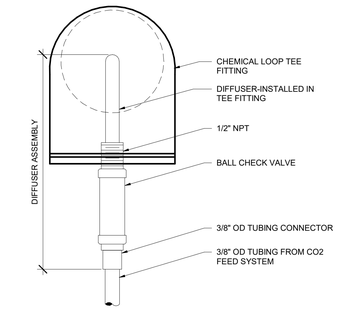
NOTE: INSTALL TANK RESTRAINTS PER LOCAL BUILDING CODE.

1 PL402 | CO2 ISOMETRIC DETAIL VIEW
NOT TO SCALE

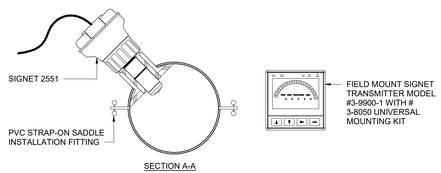
MODEL	A	B	C
FV-C-15	6.5" (165.1)	5.875" (149.23)	SCHEDULE 40 - 1.5"
FV-C	6.5" (165.1)	5.875" (149.23)	SCHEDULE 40 - 2" SLIP AND 2.5" WITH COUPLING
FV-3	8.0" (203.2)	9.5" (241.3)	SCHEDULE 80 - 3"
FV-4	9.5" (241.3)	9.75" (247.65)	SCHEDULE 80 - 4"



5 PL402 | FLOW METER DETAIL VIEW
NOT TO SCALE

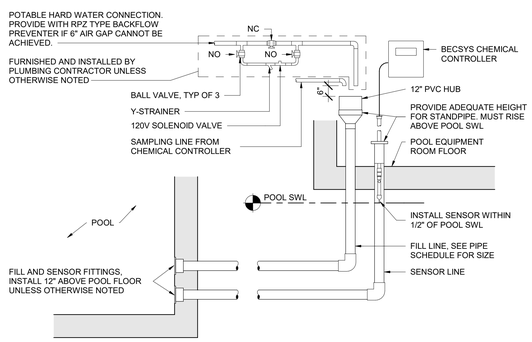


2 PL402 | CO2 INJECTION DETAIL VIEW
NOT TO SCALE



NOTES:
1. INSTALL PIPE SUCH THAT AIR CANNOT GET TRAPPED IN AREA OF SENSOR. DO NOT INSTALL IN PIPES WITH FLOW MOVING DOWNWARD OR IN HORIZONTAL SECTIONS OF PIPE THAT ARE HIGHER THAN ADJACENT HORIZONTAL PIPE.
2. FOR HORIZONTAL PIPE INSTALLATIONS, INSTALL FLOWMETER FACING UPWARD AT A 45º ANGLE TO MINIMIZE ADVERSE EFFECTS OF AIR POCKETS AND SEDIMENT.
3. FIELD MOUNT TRANSMITTER APPROXIMATELY 4'-6" (1350) ABOVE FINISHED FLOOR OR GRADE UTILIZING THE #3-8050 UNIVERSAL MOUNTING KIT.

6 PL402 | FLOW METER DETAIL VIEW
NOT TO SCALE



3 PL402 | AUTOFILL/WATER LEVEL CONTROL DETAIL VIEW
NOT TO SCALE

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

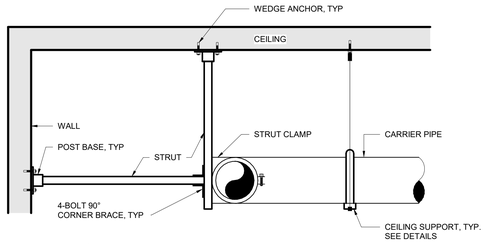
REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

MECHANICAL DETAILS

PL402

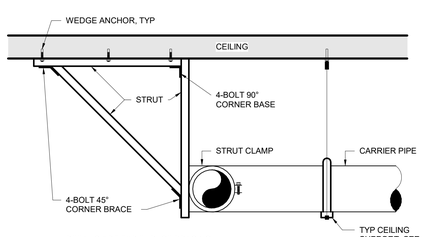


DETAILS ARE TYP THRUST BRACING METHODS & ARE NOT INCLUSIVE OF ALL SITE CONDITIONS. CONTRACTOR TO PROVIDE SHOP DRAWINGS OF BRACING METHODS FOR APPROVAL.

5 PL403 | PIPE THRUST BRACING
DETAIL VIEW
NOT TO SCALE

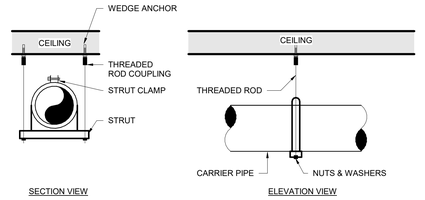
MAX ALLOWABLE SUPPORT SPACING FOR PVC PIPE (IN FT)										
NOMINAL PIPE SIZE	SCHEDULE 40					SCHEDULE 80				
	TEMPERATURE (°F)					TEMPERATURE (°F)				
	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°
1/2"	4.5	4.5	4	2.5	2.5	5	4.5	4.5	3	2.5
3/4"	5	4.5	4	2.5	2.5	5.5	5	4	3	2.5
1"	5.5	5	4.5	3	2.5	6	5.5	5	3.5	3
1 1/4"	5.5	5.5	5	3	3	6	6	5.5	3.5	3
1 1/2"	6	5.5	5	3.5	3	6.5	6	5.5	3.5	3.5
2"	6	5.5	5	3.5	3	7	6.5	6	4	3.5
2 1/2"	7	6.5	6	4	3.5	7.5	7.5	6.5	4.5	4
3"	7	7	6	4	3.5	8	7.5	7	4.5	4
4"	7.5	7	6.5	4.5	4	9	8	7.5	5	4.5
6"	8.5	8	7.5	5	4.5	10	9.5	9	6	5
8"	9	8.5	8	5	4.5	11	10.5	9.5	6.5	5.5
10"	10	9	8.5	5.5	5	12	11	10	7	6
12"	11.5	10.5	9.5	6.5	5.5	12	11	10	7	6

1 PL403 | PIPE SUPPORT SCHEDULE
DETAIL VIEW
NOT TO SCALE



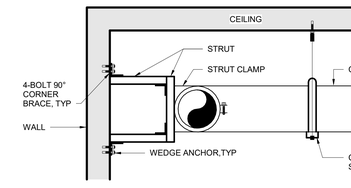
DETAILS ARE TYP THRUST BRACING METHODS & ARE NOT INCLUSIVE OF ALL SITE CONDITIONS. CONTRACTOR TO PROVIDE SHOP DRAWINGS OF BRACING METHODS FOR APPROVAL.

6 PL403 | PIPE THRUST BRACING
DETAIL VIEW
NOT TO SCALE



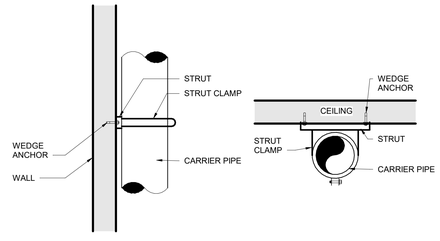
NOTES:
1. DETAILS ARE TYP SUPPORT METHODS AND ARE NOT INCLUSIVE OF ALL SITE CONDITIONS.
2. ALL PIPING SHALL BE RIGIDLY SUPPORTED LATERALLY AND VERTICALLY. SUPPORT SYSTEM SHALL PROVIDE ZERO MOVEMENT IN PIPING DURING ALL OPERATING CONDITIONS.
3. PROVIDE THRUST RESTRAINT AT ALL HORIZONTAL/HORIZONTAL, HORIZONTAL/VERTICAL AND VERTICAL/HORIZONTAL CHANGES IN DIRECTIONS.
4. SEE DIVISION 13 SPECIFICATIONS FOR ADDITIONAL SUPPORT REQUIREMENTS AND MATERIALS.
5. SEE PIPE SUPPORT TABLE ON DRAWINGS.

2 PL403 | PIPE SUPPORT
DETAIL VIEW
NOT TO SCALE



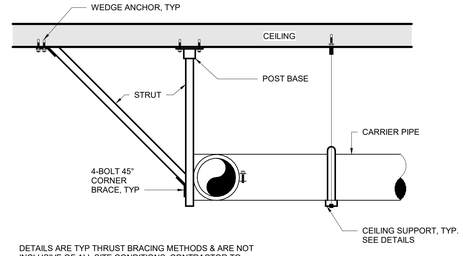
DETAILS ARE TYP THRUST BRACING METHODS & ARE NOT INCLUSIVE OF ALL SITE CONDITIONS. CONTRACTOR TO PROVIDE SHOP DRAWINGS OF BRACING METHODS FOR APPROVAL.

7 PL403 | PIPE THRUST BRACING
DETAIL VIEW
NOT TO SCALE



NOTES:
1. DETAILS ARE TYP SUPPORT METHODS AND ARE NOT INCLUSIVE OF ALL SITE CONDITIONS.
2. ALL PIPING SHALL BE RIGIDLY SUPPORTED LATERALLY AND VERTICALLY. SUPPORT SYSTEM SHALL PROVIDE ZERO MOVEMENT IN PIPING DURING ALL OPERATING CONDITIONS.
3. PROVIDE THRUST RESTRAINT AT ALL HORIZONTAL/HORIZONTAL, HORIZONTAL/VERTICAL AND VERTICAL/HORIZONTAL CHANGES IN DIRECTIONS.
4. SEE DIVISION 13 SPECIFICATIONS FOR ADDITIONAL SUPPORT REQUIREMENTS AND MATERIALS.
5. SEE PIPE SUPPORT TABLE ON DRAWINGS.

3 PL403 | PIPE SUPPORT
DETAIL VIEW
NOT TO SCALE



DETAILS ARE TYP THRUST BRACING METHODS & ARE NOT INCLUSIVE OF ALL SITE CONDITIONS. CONTRACTOR TO PROVIDE SHOP DRAWINGS OF BRACING METHODS FOR APPROVAL.

4 PL403 | PIPE THRUST BRACING
DETAIL VIEW
NOT TO SCALE

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

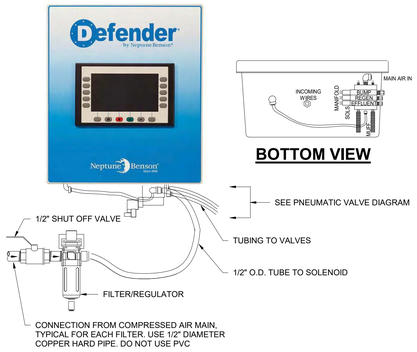
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

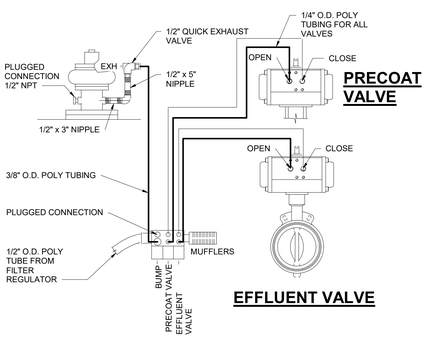
ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

PIPE SUPPORT DETAILS

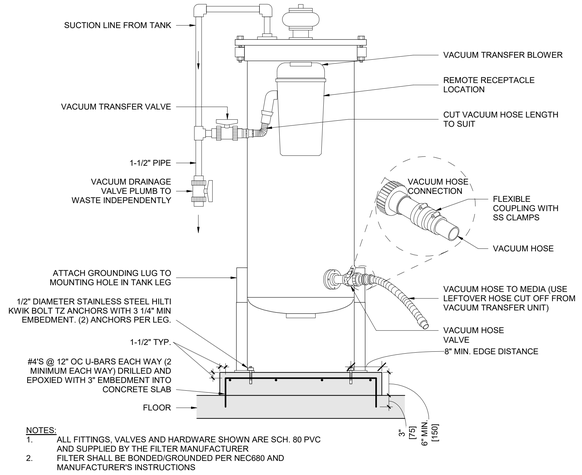
PL403



2 | PL411 | FILTER CONTROL PANEL
PLAN VIEW
NONE

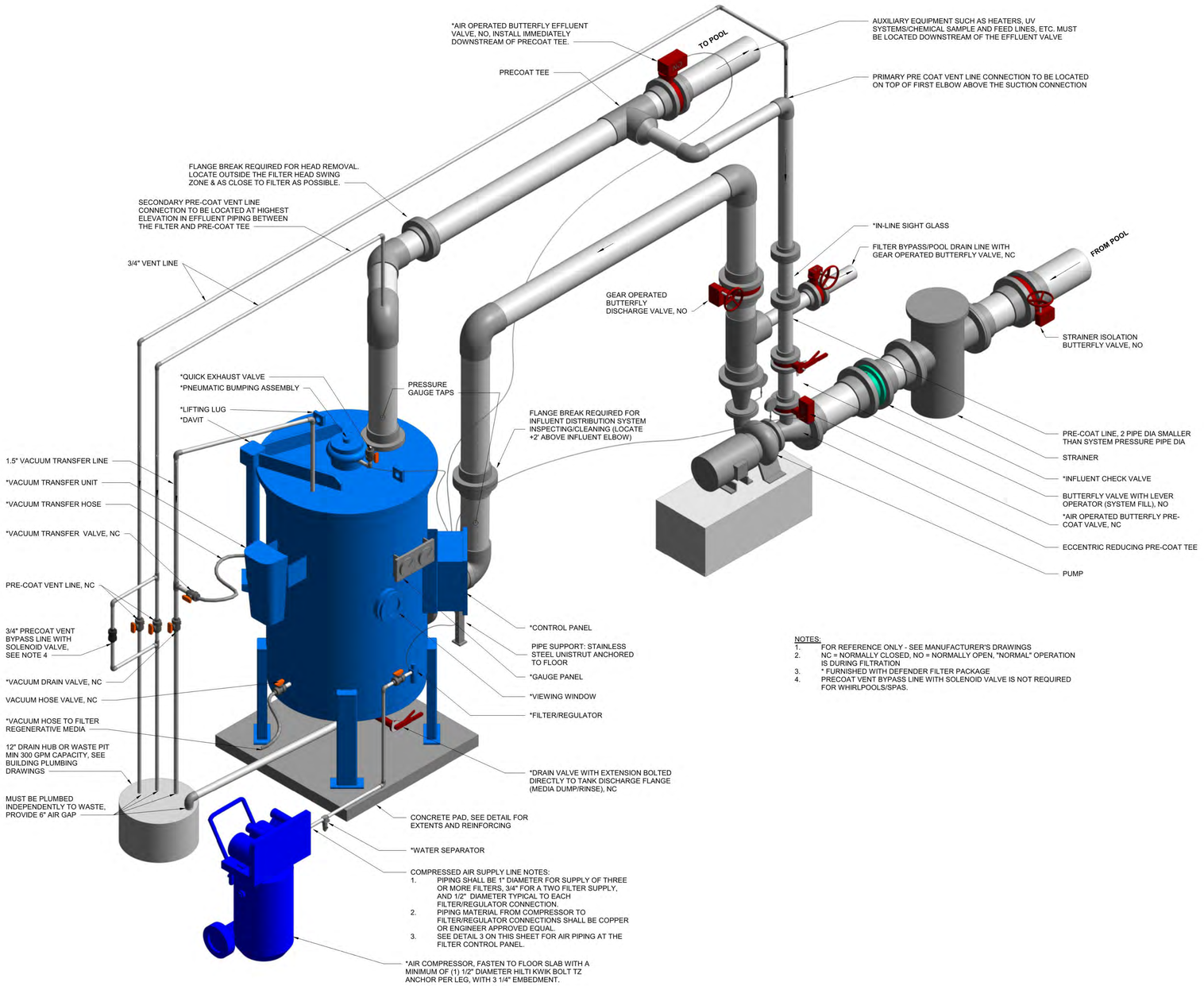


3 | PL411 | PNEUMATIC VALVE DIAGRAM
PLAN VIEW
NONE



NOTES:
1. ALL FITTINGS, VALVES AND HARDWARE SHOWN ARE SCH. 80 PVC AND SUPPLIED BY THE FILTER MANUFACTURER
2. FILTER SHALL BE BONDED/GROUNDED PER NEC680 AND MANUFACTURER'S INSTRUCTIONS

4 | PL411 | VACUUM TRANSFER SYSTEM AND FILTER PAD DETAIL
PLAN VIEW
NONE



NOTES:
1. FOR REFERENCE ONLY - SEE MANUFACTURER'S DRAWINGS
2. NC = NORMALLY CLOSED, NO = NORMALLY OPEN, "NORMAL" OPERATION IS DURING FILTRATION
3. * FURNISHED WITH DEFENDER FILTER PACKAGE
4. PRECOAT VENT BYPASS LINE WITH SOLENOID VALVE IS NOT REQUIRED FOR WHIRLPOOLS/SPAS.

1 | PL411 | DEFENDER FILTER SCHEMATIC
NONE

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEDT
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

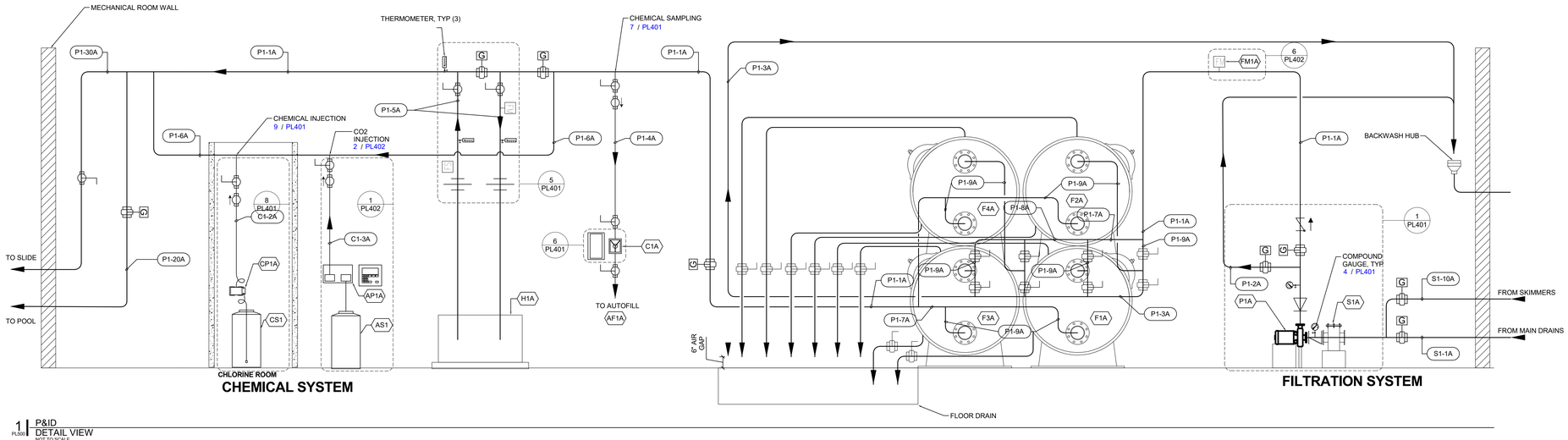
DEFENDER DETAILS (ALTERNATE)

PL411

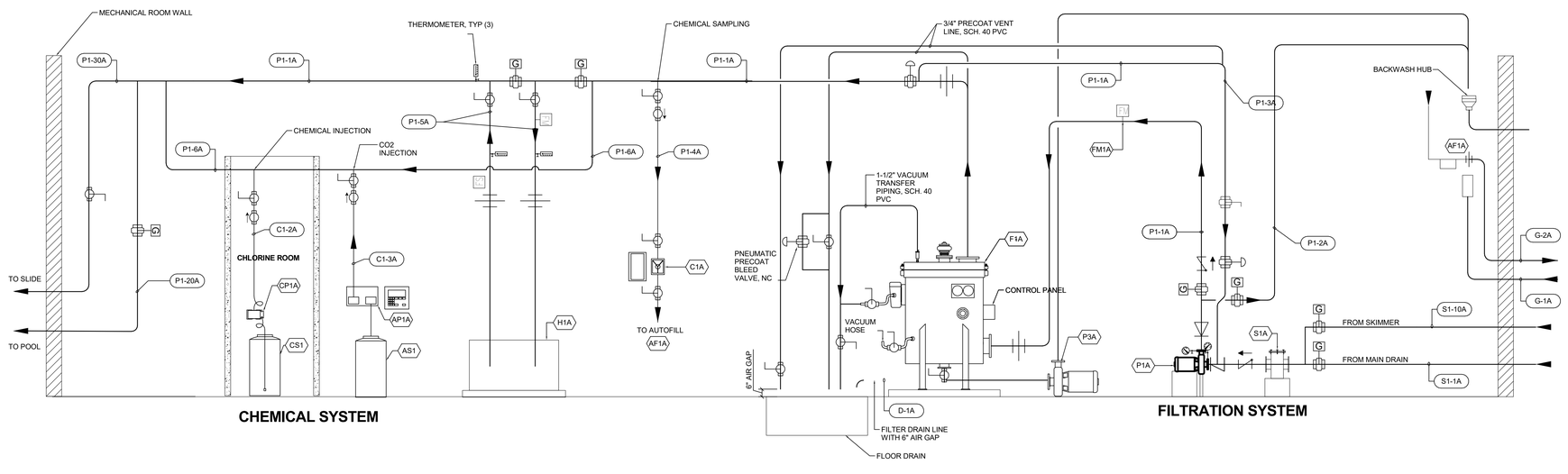
POOL A - EXISTING LAP POOL PIPE SCHEDULE

PIPE ID	TYPE	NPS (in)	FLOW (gpm)	VELOCITY (fps)	DESCRIPTION
S1-1A	PVC SCH 80	10	775	3.5	FILTRATION PUMP SUCTION - MAIN DRAIN
S1-10A	PVC SCH 80	10	775	3.5	FILTRATION PUMP SUCTION - SKIMMER
-	-	-	-	-	-
P1-1A	PVC SCH 80	8	775	5.5	FILTRATION SUPPLY
P1-2A	PVC SCH 80	4	300	8.5	POOL DRAIN LINE
P1-3A	PVC SCH 80	4	257	7.3	FILTER BACKWASH
P1-4A	PVC SCH 80	0.75	10	7.8	CHEMICAL SAMPLING
P1-5A	CPVC SCH 80	2.5	40	3.1	HEATER LOOP
P1-6A	PVC SCH 80	2.5	40	3.1	CHEMICAL LOOP
P1-7A	PVC SCH 80	6	582	7.3	FACE PIPING
P1-8A	PVC SCH 80	6	388	4.9	FACE PIPING
P1-9A	PVC SCH 80	4	194	5.5	FACE PIPING
-	-	-	-	-	-
P1-20A	PVC SCH 80	8	775	5.5	INLET SUPPLY
P1-30A	PVC SCH 80	1.5	30	5.6	SLIDE SUPPLY

NOTE P1-20A IS SIZED FOR MAXIMUM POSSIBLE FLOW WHEN THE SLIDE IS NOT IN USE.



1 PL500 P&ID DETAIL VIEW
NOT TO SCALE



ALTERNATE FILTER DESIGN

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

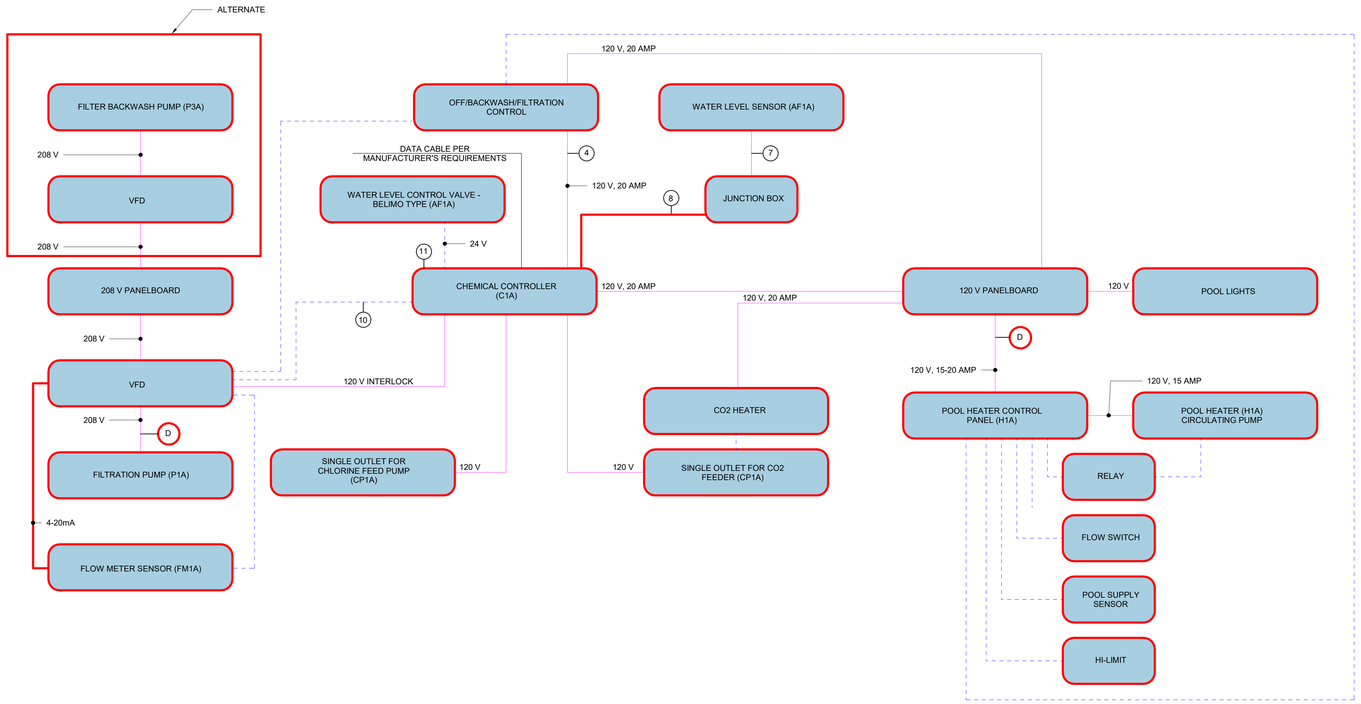
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

MECHANICAL SCHEMATIC

PL500



SEQUENCE OF OPERATIONS - SWIMMING POOL WITH MANUAL BACKWASH SAND FILTER SYSTEM

FILTRATION PUMP MOTOR STARTER SELECTOR SWITCH ("OFF/BACKWASH/FILTRATION"):
- A THREE POSITION SELECTOR SWITCH SHALL BE PROVIDED FOR THE MOTOR STARTER/VFD WITH POSITIONS LABELED "OFF", "BACKWASH", AND "FILTRATION".

"FILTRATION" POSITION:
- PLACE THE SWITCH IN THE "FILTRATION" POSITION FOR THE NORMAL FILTRATION OPERATING MODE OF THE SYSTEM.
- WITH THE FILTRATION PUMP SELECTOR SWITCH IN THE "FILTRATION" POSITION, THE FILTRATION PUMP SHALL RUN AT DESIGN FLOW (FREQUENCY) AND THE CHEMICAL CONTROLLER SHALL BE CAPABLE OF ENERGIZING THE CHEMICAL FEED SYSTEM OUTLETS.
- THE ACTUAL FLOW INFORMATION SHALL BE PROVIDED TO THE VFD BY THE FM TRANSMITTER. THE VFD SHALL ADJUST FREQUENCY AS REQUIRED TO ACHIEVE SYSTEM DESIGN FLOW.
- THE CHEMICAL CONTROLLER SHALL BE WIRED TO THE CHEMICAL FEED OUTLETS AND SHALL ENERGIZE/DE-ENERGIZE THESE OUTLETS BASED UPON POOL WATER CHEMISTRY.
- THE ACID FEED PUMP IS POWERED ON/OFF BY THE CHEMICAL CONTROLLER PH FEED OUTLET.
- IF THE FILTRATION PUMP LOSES POWER WHILE IN THE "FILTRATION" MODE THE CHEMICAL CONTROLLER SHALL NOT BE CAPABLE OF ENERGIZING THE CHEMICAL FEED OUTLETS AND THE POOL HEATER SHALL BE INACTIVE.

"BACKWASH" POSITION:
- PLACE THE SWITCH IN THE "BACKWASH" POSITION WHEN BACKWASHING THE FILTERS.
- WITH THE FILTRATION PUMP SELECTOR SWITCH IN THE "BACKWASH" POSITION, THE FILTRATION PUMP SHALL RUN, BUT THE CHEMICAL CONTROLLER SHALL NOT BE CAPABLE OF ENERGIZING THE CHEMICAL FEED SYSTEM OUTLETS AND THE POOL HEATER SHALL BE INACTIVE.

"OFF" POSITION:
- PLACE THE SWITCH IN THE "OFF" POSITION TO TURN THE PUMP AND FILTRATION SYSTEM OFF.
- WITH THE FILTRATION PUMP SELECTOR SWITCH IN THE "OFF" POSITION, THE FILTRATION PUMP SHALL BE OFF AND THE CHEMICAL CONTROLLER SHALL NOT BE CAPABLE OF ENERGIZING THE CHEMICAL FEED SYSTEM OUTLETS AND THE POOL HEATER SHALL BE INACTIVE.

CHEMICAL CONTROLLER & CHEMICAL FEED OUTLETS:
- THE CHEMICAL CONTROLLER CPU SHALL BE POWERED AT ALL TIMES.
- THE CHEMICAL FEED OUTLETS SHALL BE INTERLOCKED SUCH THAT IF THE FILTRATION PUMP LOSES POWER WHILE IN THE "FILTRATION" MODE, THE IN-LINE FLOW SWITCH IS NOT MADE OR THE SELECTOR SWITCH IS IN THE OFF OR BACKWASH POSITIONS; THE FEED OUTLETS ARE INACTIVE.
- CHEMICAL CONTROLLER FEED OUTLETS ENERGIZES / DE-ENERGIZES SANITIZER AND pH FEED BASED UPON POOL WATER CHEMISTRY.

CHEMICAL FEED PUMPS
- THE CHEMICAL FEED PUMPS ARE ENERGIZED BY THE CHEMICAL FEED OUTLETS.

CO2 FEED SOLENOID
- THE CO2 FEED SOLENOID IS ACTIVATED BY THE CHEMICAL FEED OUTLETS.

POOL HEATER:
- THE POOL HEATER SHALL BE INTERLOCKED SUCH THAT IF THE FILTRATION PUMP LOSES POWER WHILE IN THE FILTRATION MODE OR IF THE SELECTOR SWITCH IS IN THE OFF OR BACKWASH POSITIONS, THE HEATER IS INACTIVE.
- THE POOL HEATER CIRCULATING PUMP IS CONTROLLED BY THE POOL HEATER CONTROLLER.
- POOL HEATER CYCLES ON AND OFF AS NEEDED BASED UPON POOL WATER TEMPERATURE.
- POOL HEATER IS INTERLOCKED WITH MANUFACTURER SUPPLIED FLOW SWITCH AND HI-LIMIT TEMP SENSORS.

FLOW METER:
- WHEN FLOW METER POWER SUPPLY IS ENERGIZED, THE FLOW METER SENSOR SHALL PROVIDE THE FLOW READOUT IN GPM.
- THE FLOW METER SHALL PROVIDE FLOW DATA TO THE INDICATED VFD AND CONTROL SPEED OF THE VFD BASED ON FLOW.

POOL EQUIPMENT OPERATING MODES

FILTRATION PROGRAMMER OPERATING MODE	FILTRATION PUMP	CHEMICAL CONTROLLER	CHLORINE FEED	CO2 FEED	HEATER
OFF	O	X	O	O	O
BACKWASH	X	X	O	O	O
FILTRATION	X	X	X	X	X

"X" INDICATES THE EQUIPMENT IS ENERGIZED/RUNNING.
"O" INDICATES THE EQUIPMENT IS NOT ENERGIZED.

NOTES:
1. LOW VOLTAGE <=24V. ALL LOW VOLTAGE WIRING IS SUPPLIED, INSTALLED AND CONNECTED BY THE POOL CONTRACTOR.
2. IF CONDUIT IS REQUIRED BY CODE FOR LOW VOLTAGE WIRING, THEN THIS MUST BE SPECIFIED BY THE ELECTRICAL CONSULTANT AND INSTALLED BY THE ELECTRICAL CONTRACTOR.
3. IF CODE REQUIRES THAT LOW VOLTAGE WIRING IS INSTALLED BY A LICENSED ELECTRICAL CONTRACTOR THEN THIS MUST BE SPECIFIED BY THE ELECTRICAL CONSULTANT.
4. CONDUIT, WIRE SIZES, AND SHIELDING REQUIREMENTS SHALL BE DETERMINED & SPECIFIED BY THE ELECTRICAL CONSULTANT AS NEEDED PER LOCAL BUILDING AND ELECTRICAL CODE REQUIREMENTS.
5. THIS SCHEMATIC DRAWING IS NOT AN ELECTRICAL INSTALLATION DIAGRAM AND IS FOR REFERENCE ONLY. IT IS THE RESPONSIBILITY OF THE POOL CONTRACTOR TO COORDINATE ALL INTERLOCKS WITH THE ELECTRICAL CONTRACTOR. THE POOL CONTRACTOR IS RESPONSIBLE TO PROVIDE AN OPERATING SYSTEM PER THE SEQUENCE OF OPERATIONS.

KEYNOTES: (#)
1. NOT USED.
2. NOT USED.
3. NOT USED.
4. POWER FOR THE CHEMICAL FEEDERS . WHEN FILTER SELECTOR SWITCH POSITION IS OFF, BACKWASH, OR THE FILTRATION PUMP LOSES POWER WHILE IN FILTRATION MODE, THIS CONNECTION SHALL INACTIVE CHEMICAL FEED TO THE SYSTEM.
5. NOT USED.
6. NOT USED.
7. SENSOR CABLE FROM WATER LEVEL SENSOR. FURNISHED WITH WATER LEVEL SENSOR AND INSTALLED BY POOL CONTRACTOR.
8. CONDUCTOR CABLE CONTAINS POWER AND SIGNAL CABLES. COORDINATE REQUIREMENTS WITH WATER LEVEL SENSOR AND CHEMICAL CONTROLLER MANUFACTURERS.
9. NOT USED.
10. VFD ANALOG OUTPUT REPEAT FLOW METER DATA TO CHEMICAL CONTROLLER.
11. A FLOW CELL WITH SHUT-OFF SWITCH SHALL COME PREASSEMBLED AND WIRED TO THE CHEMICAL CONTROLLER. POOL CONTRACTOR SHALL ASSURE CHEMICAL CONTROLLER FLOW CELL ASSEMBLY IS WORKING PROPERLY AND DEACTIVATES CHEMICAL FEED UNDER A NO FLOW CONDITION.

LEGEND:
- LOW VOLTAGE
- LINE VOLTAGE
- CONTRACTOR TO COORDINATE WITH EQUIPMENT REQUIREMENTS
- (D) DISCONNECT - LOCATE AT EQUIPMENT PER CODE REQUIREMENTS

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7375

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

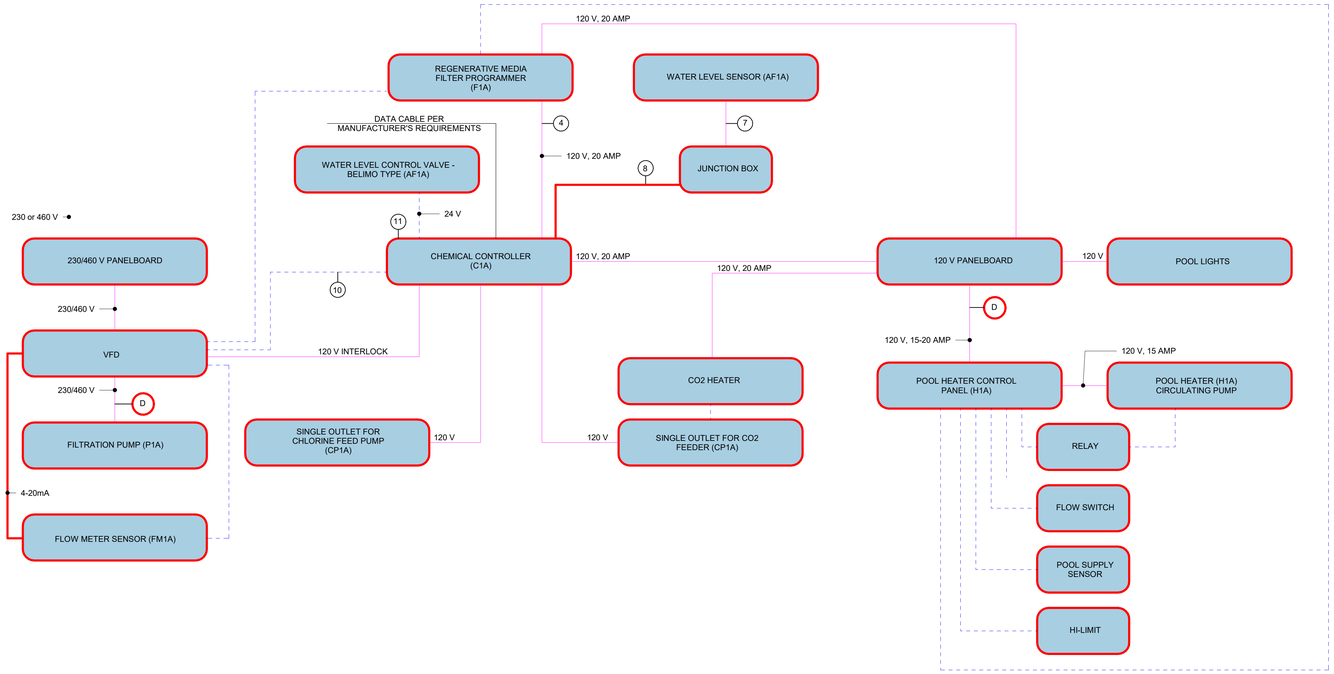
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: BB
CHECKED BY: Checker

ELECTRICAL SCHEMATIC

PL501



1 PL502 POOL A REGENERATIVE MEDIA ELECTRICAL (ALTERNATE) PLAN VIEW
1/2" = 1'-0"

SEQUENCE OF OPERATIONS - SWIMMING POOL WITH REGENERATIVE MEDIA FILTER SYSTEM

FILTRATION PUMP:
- THE NORMAL OPERATING POSITION OF THE FILTRATION PUMP VFD HOA SWITCH IS THE "AUTO" POSITION. IN THE "AUTO" POSITION THE FILTRATION PUMP SHALL RUN AT DESIGN FLOW (FREQUENCY).
- THE FILTRATION PUMP SHALL RUN WHEN THE FILTER PROGRAMMER IS IN THE FILTRATION MODE.
- THE FILTRATION PUMP SHALL RUN AT REDUCED SPEED WHEN THE FILTER PROGRAMMER IS IN THE PRECOAT MODE. COORDINATE SPEED SETTING WITH FILTER COMISSIONING AGENT.
- THE FILTRATION PUMP SHALL NOT RUN WHEN THE FILTER PROGRAMMER IS IN THE BUMP OR OFF MODES.

FILTER PROGRAMMER:
- THE FILTER PROGRAMMER'S NORMAL OPERATION IS IN FILTRATION MODE.
- THE FILTER BUMP CYCLE IS ACTIVATED BY THE FILTER PROGRAMMER EITHER AUTOMATICALLY OR BY A PUSH BUTTON.
- THE FILTER PROGRAMMER SHALL RECEIVE A FEEDBACK SIGNAL FROM THE FILTRATION PUMP VFD THAT THE FILTRATION PUMP IS OPERATING.
- THE FILTER PROGRAMMER IS SUPPLIED WITH AUXILIARY CONTACTS TO DISABLE OTHER POOL EQUIPMENT WHEN THE FILTRATION PUMP IS NOT RUNNING DUE TO PUMP FAILURE (FEEDBACK SIGNAL FROM VFD) OR THE PROGRAMMER IS IN THE BUMP OR OFF MODES.

CHEMICAL BOOSTER PUMP & IN-LINE FLOW SWITCH:
- THE CHEMICAL BOOSTER PUMP IS NORMALLY ON.
- THE CHEMICAL BOOSTER PUMP SHALL BE INTERLOCKED SUCH THAT IF THE FILTRATION PUMP LOSES POWER WHILE IN FILTRATION MODE, OR THE FILTER PROGRAMMER IS IN THE OFF OR BACKWASH MODE; THE CHEMICAL BOOSTER PUMP IS INACTIVE.
- THE IN-LINE FLOW SWITCH IS USED TO PROVE FLOW TO THE CHEMICAL CONTROLLER.

CHEMICAL CONTROLLER & CHEMICAL FEED OUTLETS:
- THE CHEMICAL CONTROLLER CPU SHALL BE POWERED AT ALL TIMES.
- THE CHEMICAL CONTROLLER AND CHEMICAL FEED OUTLETS SHALL BE INTERLOCKED SUCH THAT IF THE FILTRATION PUMP FAILS (SIGNAL VIA THE FILTER PROGRAMMER), THE IN-LINE FLOW SWITCH IS NOT MADE OR THE FILTRATION PROGRAMMER IS IN THE BUMP OR OFF MODE; THE FEED OUTLETS ARE INACTIVE.
- CHEMICAL CONTROLLER FEED OUTLETS ENERGIZES / DE-ENERGIZES SANITIZER AND pH FEED BASED UPON POOL WATER CHEMISTRY.
- SWITCH BETWEEN ACID OUTLET AND CO2 OUTLET IS ACCOMPLISHED MANUALLY BY OPERATOR. LABEL OUTLETS AND SWITCH AS CO2 AND ACID, RESPECTIVELY.
- CHEMICAL CONTROLLER FEED OUTLETS ENERGIZES / DE-ENERGIZES ENZYME FEED BASED UPON TIMED DELIVERY.

CHEMICAL FEED PUMPS
- THE CHEMICAL FEED PUMPS ARE ENERGIZED BY THE CHEMICAL FEED OUTLETS.

CO2 FEED SOLENOID
- THE CO2 FEED SOLENOID IS ACTIVATED BY THE CHEMICAL FEED OUTLETS.

POOL HEATER:
- THE POOL HEATER SHALL BE INTERLOCKED SUCH THAT IF THE FILTRATION PUMP FAILS (SIGNAL VIA THE FILTER PROGRAMMER), OR THE FILTRATION PROGRAMMER IS IN THE BUMP OR OFF MODE; THE HEATER IS INACTIVE.
- THE POOL HEATER CIRCULATING PUMP IS CONTROLLED BY THE POOL HEATER CONTROLLER.
- POOL HEATER CYCLES ON AND OFF AS NEEDED BASED UPON POOL WATER TEMPERATURE.
- POOL HEATER IS INTERLOCKED WITH MANUFACTURER SUPPLIED FLOW SWITCH AND HI-LIMIT TEMP SENSORS.

FLOW METER:
- WHEN FLOW METER POWER SUPPLY IS ENERGIZED, THE FLOW METER SENSOR SHALL PROVIDE THE FLOW READOUT IN GPM.
- THE FLOW METER SHALL PROVIDE FLOW DATA TO THE INDICATED VFD AND CONTROL SPEED OF THE VFD BASED ON FLOW.

POOL EQUIPMENT OPERATING MODES

FILTRATION PROGRAMMER OPERATING MODE	FILTRATION PUMP	CHEMICAL CONTROLLER	CHLORINE FEED	CO2 FEED	HEATER
OFF	O	X	O	O	O
BACKWASH	X	X	O	O	O
FILTRATION	X	X	X	X	X

"X" INDICATES THE EQUIPMENT IS ENERGIZED/RUNNING.
"O" INDICATES THE EQUIPMENT IS NOT ENERGIZED.

NOTES:
1. LOW VOLTAGE <=24V, ALL LOW VOLTAGE WIRING IS SUPPLIED, INSTALLED AND CONNECTED BY THE POOL CONTRACTOR.
2. IF CONDUIT IS REQUIRED BY CODE FOR LOW VOLTAGE WIRING, THEN THIS MUST BE SPECIFIED BY THE ELECTRICAL CONSULTANT AND INSTALLED BY THE ELECTRICAL CONTRACTOR.
3. IF CODE REQUIRES THAT LOW VOLTAGE WIRING IS INSTALLED BY A LICENSED ELECTRICAL CONTRACTOR THEN THIS MUST BE SPECIFIED BY THE ELECTRICAL CONSULTANT.
4. CONDUIT, WIRE SIZES, AND SHIELDING REQUIREMENTS SHALL BE DETERMINED & SPECIFIED BY THE ELECTRICAL CONSULTANT AS NEEDED PER LOCAL BUILDING AND ELECTRICAL CODE REQUIREMENTS.
5. THIS SCHEMATIC DRAWING IS NOT AN ELECTRICAL INSTALLATION DIAGRAM AND IS FOR REFERENCE ONLY. IT IS THE RESPONSIBILITY OF THE POOL CONTRACTOR TO COORDINATE ALL INTERLOCKS WITH THE ELECTRICAL CONTRACTOR. THE POOL CONTRACTOR IS RESPONSIBLE TO PROVIDE AN OPERATING SYSTEM PER THE SEQUENCE OF OPERATIONS.

KEYNOTES: (#)
1. NOT USED.
2. NOT USED.
3. NOT USED.
4. POWER FOR THE CHEMICAL FEEDERS . WHEN FILTER SELECTOR SWITCH POSITION IS OFF, BACKWASH, OR THE FILTRATION PUMP LOSES POWER WHILE IN FILTRATION MODE, THIS CONNECTION SHALL INACTIVE CHEMICAL FEED TO THE SYSTEM.
5. NOT USED.
6. NOT USED.
7. SENSOR CABLE FROM WATER LEVEL SENSOR. FURNISHED WITH WATER LEVEL SENSOR AND INSTALLED BY POOL CONTRACTOR.
8. CONDUCTOR CABLE CONTAINS POWER AND SIGNAL CABLES. COORDINATE REQUIREMENTS WITH WATER LEVEL SENSOR AND CHEMICAL CONTROLLER MANUFACTURERS.
9. NOT USED.
10. VFD ANALOG OUTPUT REPEAT FLOW METER DATA TO CHEMICAL CONTROLLER.
11. A FLOW CELL WITH SHUT-OFF SWITCH SHALL COME PREASSEMBLED AND WIRED TO THE CHEMICAL CONTROLLER. POOL CONTRACTOR SHALL ASSURE CHEMICAL CONTROLLER FLOW CELL ASSEMBLY IS WORKING PROPERLY AND DEACTIVATES CHEMICAL FEED UNDER A NO FLOW CONDITION.

LEGEND:
- LOW VOLTAGE
- LINE VOLTAGE
- CONTRACTOR TO COORDINATE WITH EQUIPMENT REQUIREMENTS
- (D) DISCONNECT - LOCATE AT EQUIPMENT PER CODE REQUIREMENTS

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

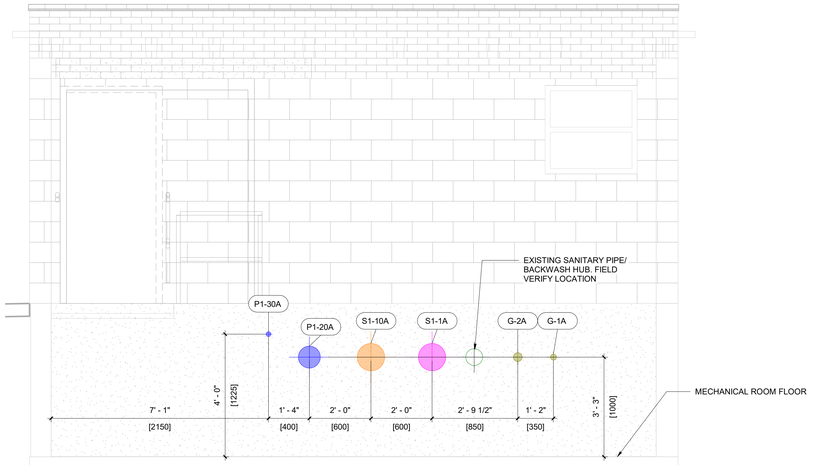
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

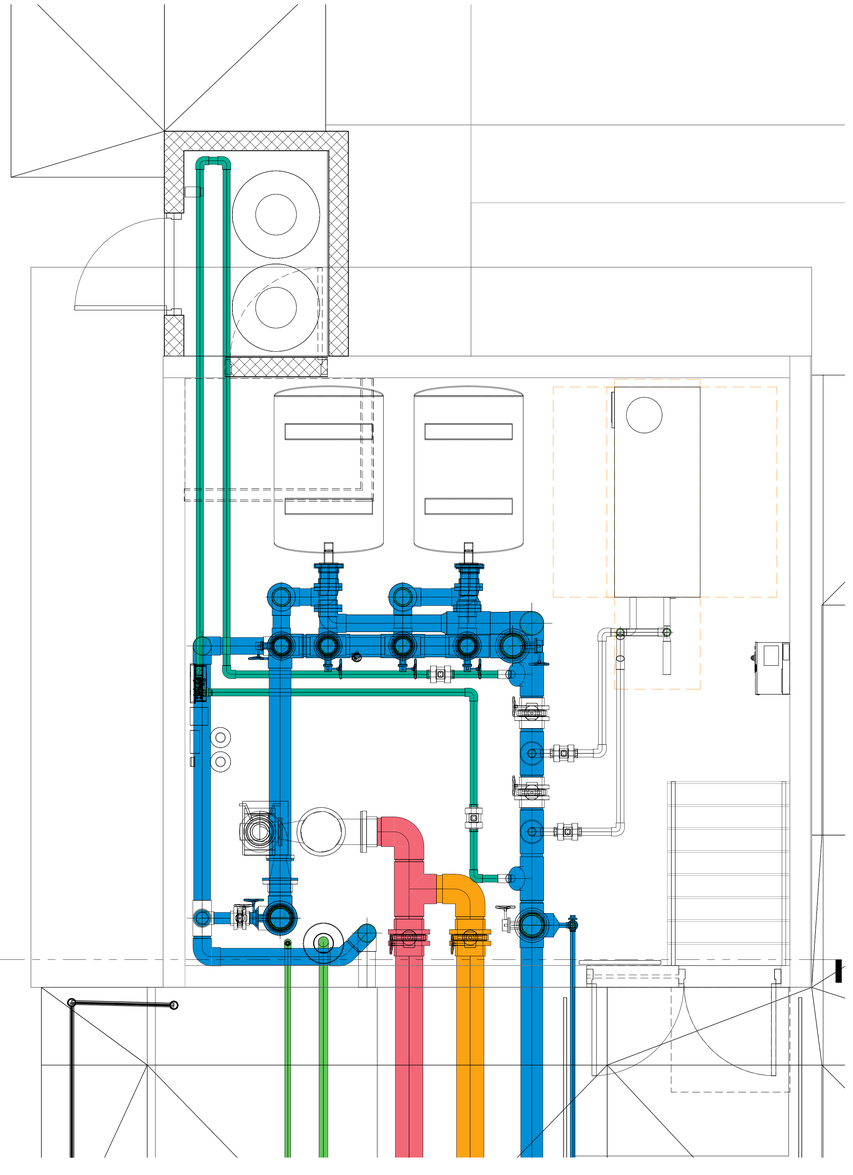
POOL A ELECTRICAL SCHEMATIC (ALTERNATE)

PL502

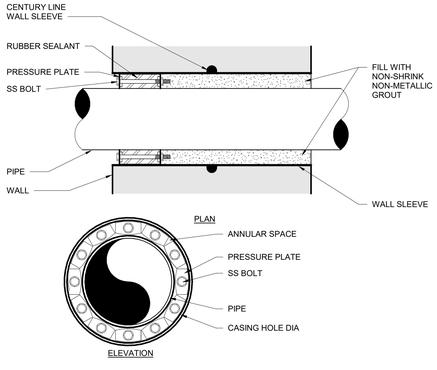
POOL A - EXISTING LAP POOL PENETRATION SCHEDULE				
PIPE ID	DETAIL	NPS (in)	SLEEVE MODEL #	DESCRIPTION
S1-1A	3/PL600	10	CS-14	FILTRATION PUMP SUCTION - MAIN DRAIN
S1-10A	3/PL600	10	CS-14	FILTRATION PUMP SUCTION - SKIMMER
-		-		-
P1-20A	3/PL600	8	CS-12	INLET SUPPLY
P1-30A		1.5	CS-3-1/2	SLIDE SUPPLY
G-1A	3/PL600	2	CS-4	SENSOR
G-2A	3/PL600	3	CS-5	FILL LINE



2 | Section 13
PL600 | PLAN VIEW
1/2" = 1'-0"



1 | PIPE PENETRATIONS
PL000 | PLAN VIEW
1/2" = 1'-0"



3 | WALL SLEEVE / LINK SEAL DETAIL VIEW
PL600 | NOT TO SCALE

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

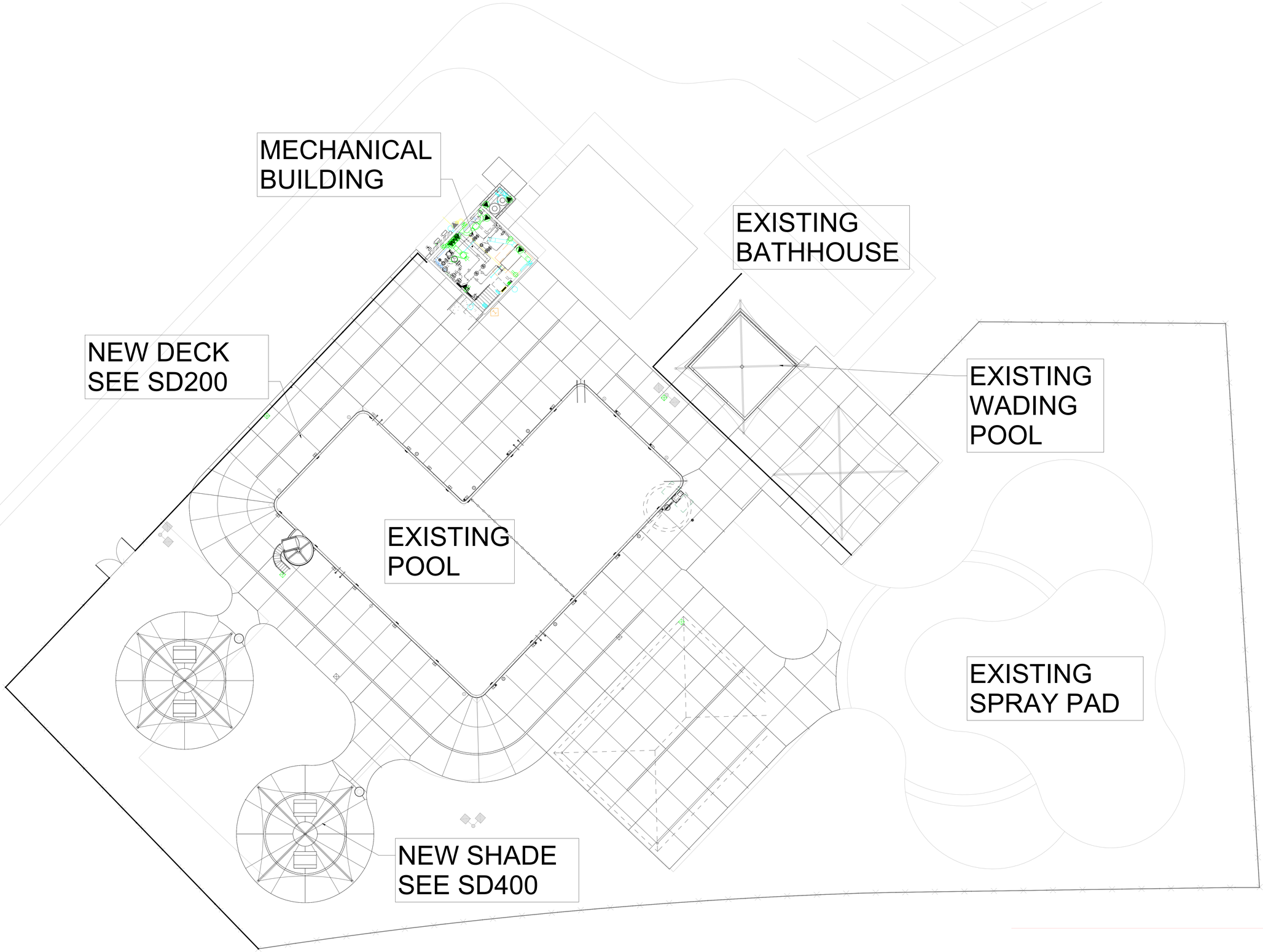
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

PIPE PENETRATIONS

PL600



1 SD100 OVERALL DECK PLAN
PLAN VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

OVERALL DECK PLAN

SD100

1 SD200 DECK PLAN
PLAN VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY, INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIGO
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

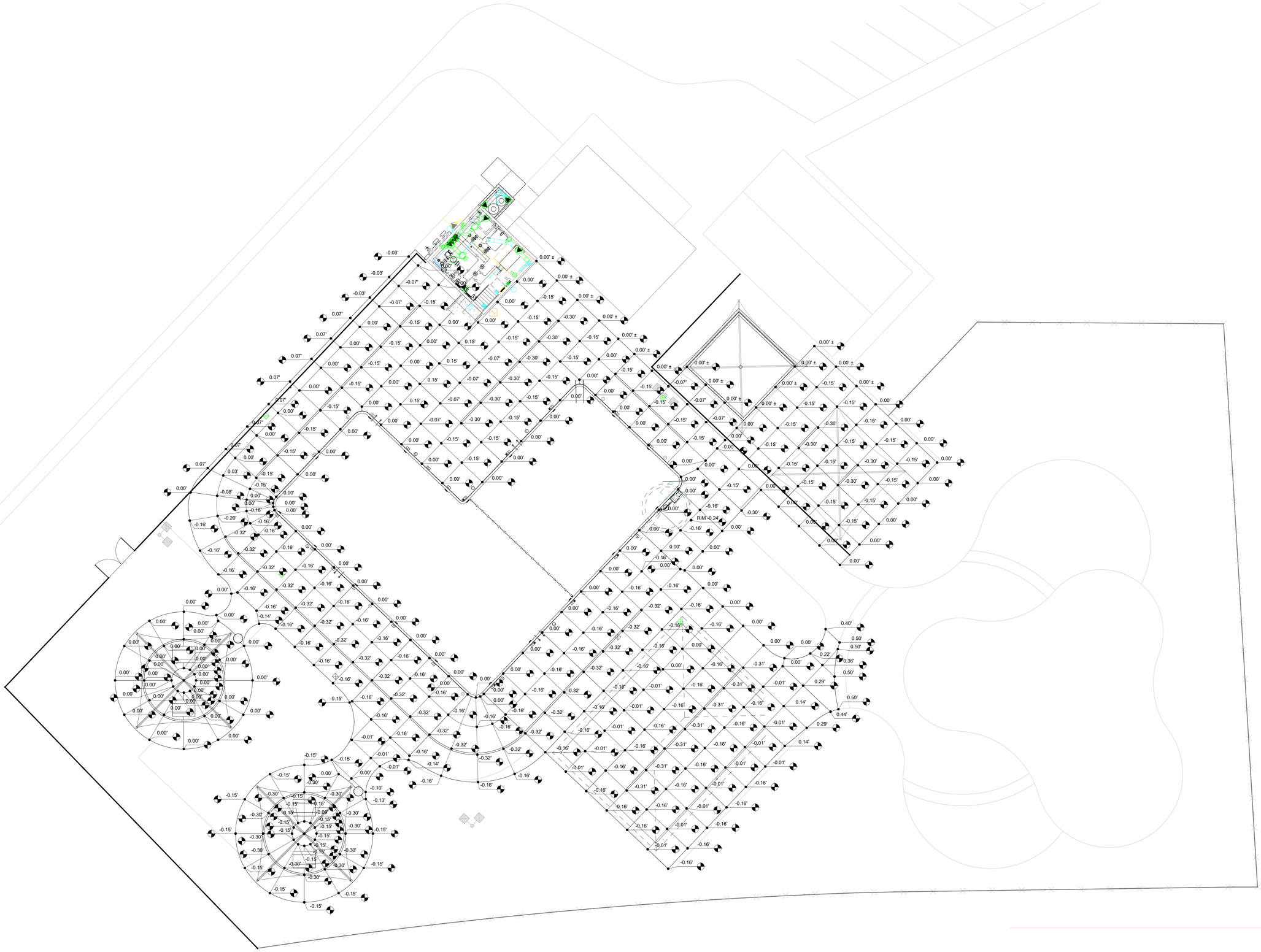
REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

DECK PLAN

SD200



1 SD300 GRADING PLAN
PLAN VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/13/23
PROJECT NUMBER: 22232
DRAWN BY: APP
CHECKED BY: WRB

GRADING PLAN

SD300

1 SD400 SHADE AND FENCE PLAN
PLAN VIEW
1" = 10'-0"

WTI
WATER TECHNOLOGY INC
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIEDL
42920
PROFESSIONAL ENGINEER
01/27/2023

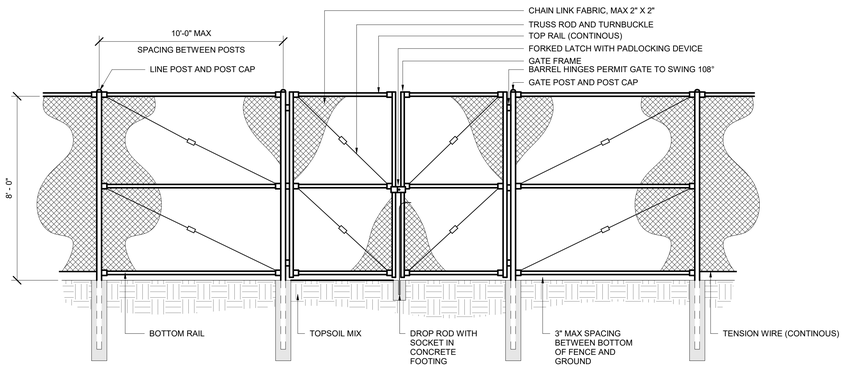
CONSULTANTS

REVISION SCHEDULE		
Number	Description	Date
	PERMIT SET	01/27/23

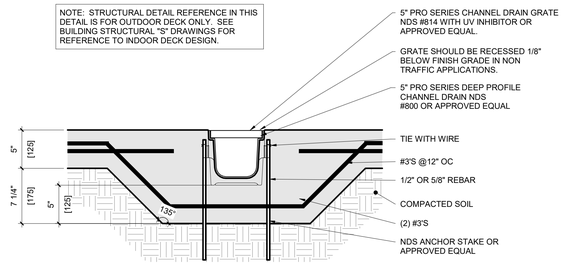
ISSUE DATE: 01/13/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

FENCING AND SHADE PLAN

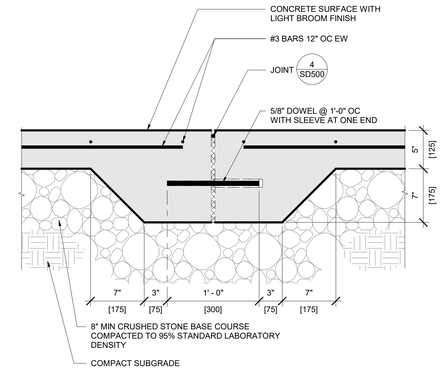
SD400



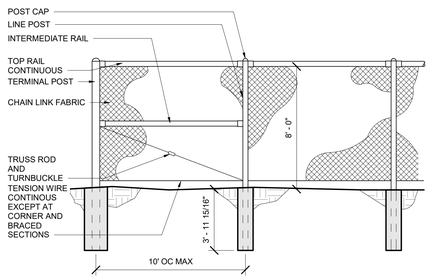
9 SD500 CHAIN LINK DOUBLE SWING GATE
PLAN VIEW
3/8" = 1'-0"



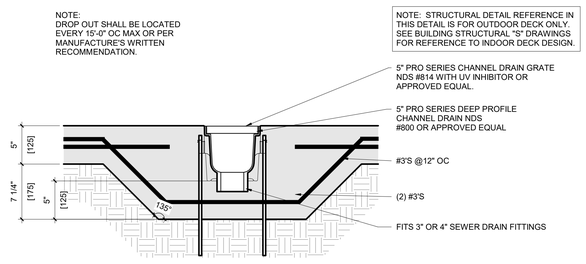
5 SD500 CHANNEL DRAIN
PLAN VIEW
1 1/2" = 1'-0"



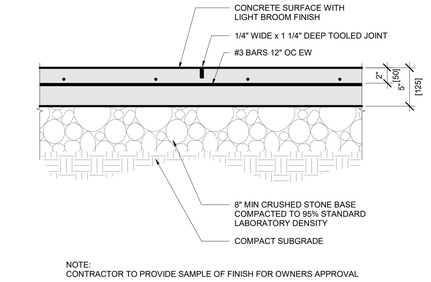
1 SD500 DECK EXPANSION JOINT
PLAN VIEW
1 1/2" = 1'-0"



10 SD500 CHAIN LINK FENCE
PLAN VIEW
1/4" = 1'-0"

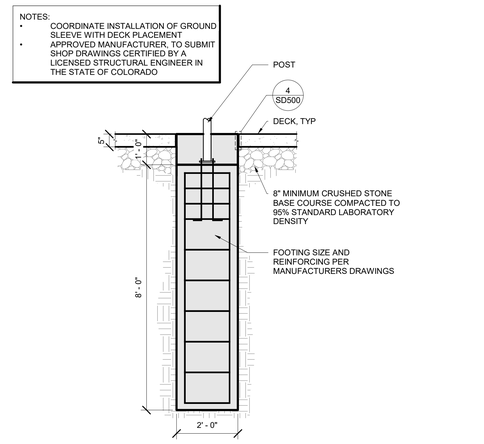


6 SD500 CHANNEL DRAIN DROPOUT
PLAN VIEW
1 1/2" = 1'-0"

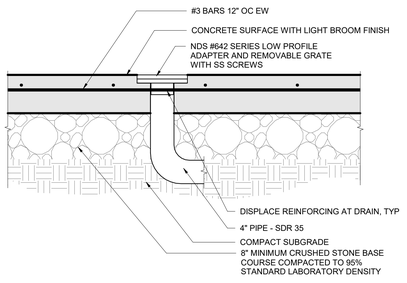


NOTE:
CONTRACTOR TO PROVIDE SAMPLE OF FINISH FOR OWNERS APPROVAL

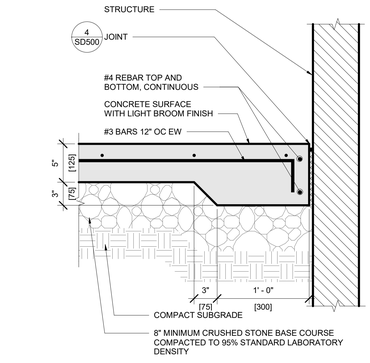
2 SD500 DECK CONTROL JOINT
PLAN VIEW
1 1/2" = 1'-0"



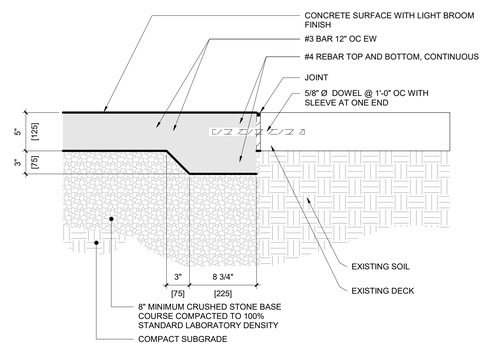
11 SD500 FLUSH MOUNT SHADE FOOTING 8FT
PLAN VIEW
1/2" = 1'-0"



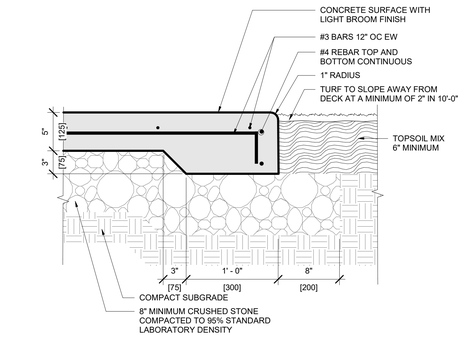
7 SD500 AREA DRAIN IN DECK
PLAN VIEW
1 1/2" = 1'-0"



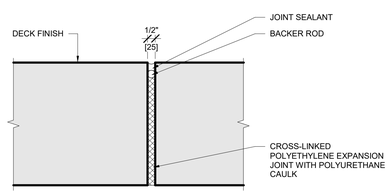
3 SD500 DECK AT STRUCTURE
PLAN VIEW
1 1/2" = 1'-0"



12 SD500 NEW DECK AT EXISTING DECK
PLAN VIEW
1 1/2" = 1'-0"



8 SD500 DECK AT TURF EDGE
PLAN VIEW
1 1/2" = 1'-0"



4 SD500 DECK AT JOINT
PLAN VIEW
3" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920 887 7235

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

COLORADO LICENSED
BRIAN W. FRIES
42920
PROFESSIONAL ENGINEER
01/27/2023

CONSULTANTS

REVISION SCHEDULE

Number	Description	Date
	PERMIT SET	01/27/23

ISSUE DATE: 01/11/23
PROJECT NUMBER: 22232
DRAWN BY: Author
CHECKED BY: Checker

SITE DETAILS

SD500

MECHANICAL BUILDING DEMOLITION NOTES:

1. CLEAN AND PREPARE ALL CONCRETE AND MASONRY SURFACES TO RECEIVE ANY CONCRETE SURFACE REPAIRS AND NEW PAINT FINISHES.
2. REMOVE EXISTING STAIR RAILING. CUT OFF ALL ANCHOR BOLTS AND GRIND FLUSH TO A SMOOTH SURFACE.
3. REMOVE EXISTING MAN DOOR AND FRAME IN EXISTING MASONRY WALL. CLEAN AND REPAIR EXISTING MASONRY OPENING TO RECEIVE NEW MASONRY BLOCK. REMOVE EXISTING DOOR THRESHOLD AS REQUIRED TO INSTALL NEW CMU TO MATCH EXISTING COURSING.
4. REMOVE EXISTING MAN DOOR AND FRAME IN EXISTING MASONRY WALL. SAW CUT EXISTING MASONRY WALL TO RECEIVE NEW DOOR LINTEL AND DOUBLE DOOR FRAME.
5. REMOVE EXISTING STEEL PLATFORM AND STUD WALLS INTERIOR ENCLOSURE. CLEAN AND PREPARE EXISTING CONCRETE AND MASONRY SURFACES TO RECEIVE ANY SURFACE REPAIRS AND NEW PAINT.
6. REMOVE AND SALVAGE EXISTING WINDOW, CLEAN AND PREPARE UNIT FOR REINSTALLATION.
7. CLEAN AND PREPARE ALL INTERIOR AND EXTERIOR FINISHES TO RECEIVE NEW SEALANT OR PAINT.
8. REMOVE ALL MECHANICAL DUCTS IN EXISTING PRECAST ROOF PLANKS. CLEAN A PREPARE OPENINGS TO RECEIVE NEW MECHANICAL INTAKE AND EXHAUST UNITS.
9. SAW CUT EXISTING MASONRY FOR NEW OPENINGS AT MECHANICAL UNITS LOCATIONS. COORDINATE WITH ALL TRADES FINAL OPENING LOCATIONS.
10. SAW CUT EXISTING CONCRETE SIDEWALK FOR BELOW GRADE CONSTRUCTION OF NEW STORAGE ROOM FOUNDATION.

LIST OF ABBREVIATIONS

AC	- ACOUSTIC	HM	- HOLLOW METAL
ACT	- ACOUSTICAL TILE CEILING	MP	- METAL PANEL
AFF	- ABOVE FINISHED FLOOR	MTL	- METAL
ALUM	- ALUMINUM	NP	- NAPKIN DISPOSAL
BO	- BOTTOM OF	OC	- ON CENTER
BRG	- BEARING	PT	- PAINT
CARP	- CARPET	PF	- PREFINISHED
CMU	- CONCRETE MASONRY UNIT	RD	- ROOF DRAIN
CONC	- CONCRETE	RTU	- ROOF TOP UNIT
CJ	- CONTROL JOINT	S&V	- STAIN AND VARNISH
CO	- CLEAN OUT	SCHD	- SCHEDULE
CT	- CERAMIC TILE	SD	- SOAP DISPENSER
EPX	- EPOXY	STL	- STEEL
EQ	- EQUAL	TD	- TOWEL DISPENSER
ES	- EXPOSED STRUCTURE	TO	- TOP OF
EXIST	- EXISTING	TOE	- TOP OF EXISTING
FD	- FLOOR DRAIN	TP	- TOILET PAPER
FE	- FIRE EXTINGUISHER	V	- VARNISH
FEC	- FIRE EXTINGUISHER CABINET	VB	- VINYL BASE
FV	- FIELD VERIFY	VCT	- VINYL COMPOSITE TILE
GA	- GAUGE	VFGT	- VINYL FACED GYPSUM TILE
GB	- GYPSUM BOARD	WD	- WOOD
GL	- GLASS	WND	- WINDOW
		WR	- WASTE RECEPTACLE

SYMBOLS LEGEND

LINE

- BEYOND
- BATT INSULATION
- CENTER, GRID
- DEMOLITION
- EXISTING (HALFTONE)
- HIDDEN
- MATCHLINE
- NEW (CUT)
- NEW (PROJECTION)
- OVERHEAD

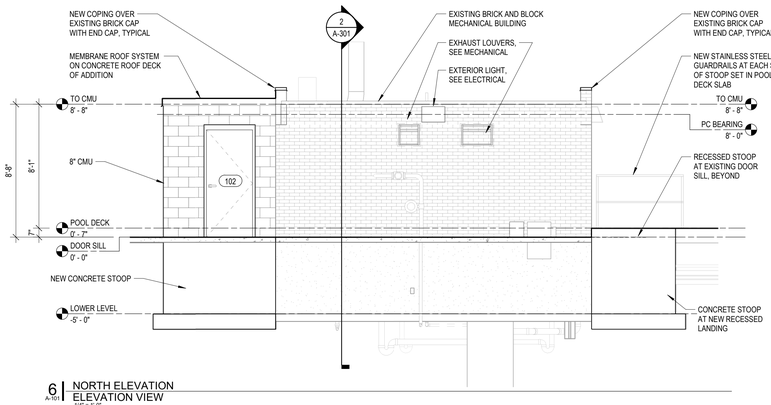
MATERIAL

- ALUMINUM
- BRICK
- CONCRETE
- CONCRETE MASONRY BLOCK
- EARTH
- GRAVEL
- DRY WALL, GROUT
- WOOD
- STEEL

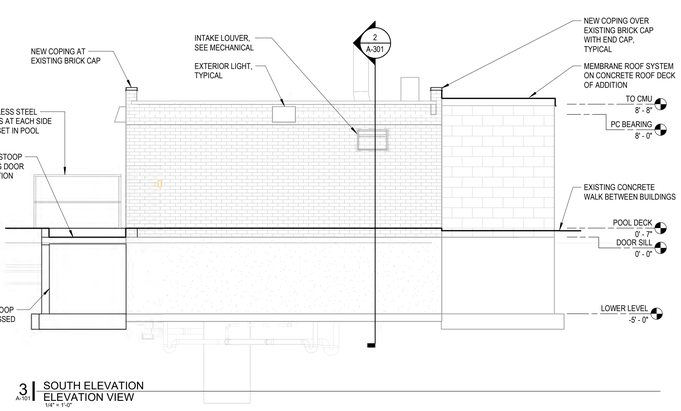
REFERENCE

- NORTH INDICATOR
- DETAIL VIEW INDICATOR (A3 / A-501)
- ELEVATION VIEW INDICATOR (A1, B1, C1, D1 / A-301)
- SECTION VIEW INDICATOR (1 / A-101)
- VIEW INDICATOR (7/A-101)
- GRID INDICATOR
- EXISTING GRID INDICATOR

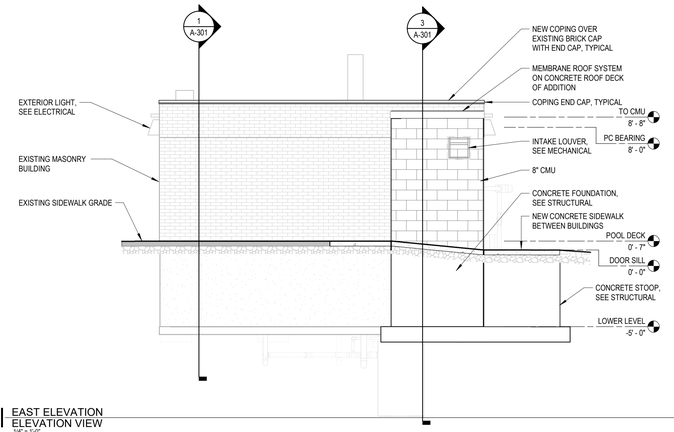
- BREAK LINE
- SPAN DIRECTION INDICATOR
- OPENING (FLOOR, ROOF OR WALL)
- ELEVATION INDICATOR (TOC 100'-0")
- KEYED NOTE INDICATOR
- KEYED NOTE INDICATOR
- WALL TYPE INDICATOR
- REVISION CLOUD
- REVISION INDICATOR



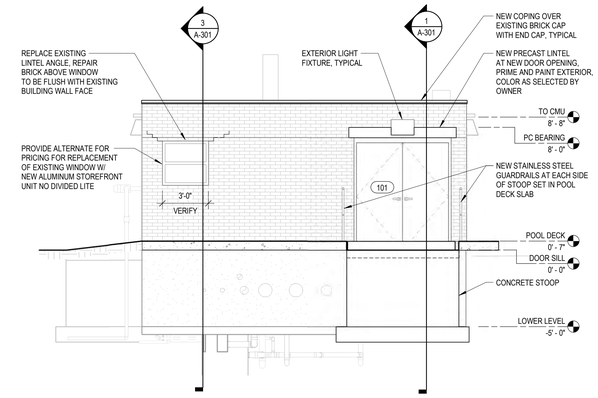
6 | NORTH ELEVATION
A-101 | ELEVATION VIEW
1/4" = 1'-0"



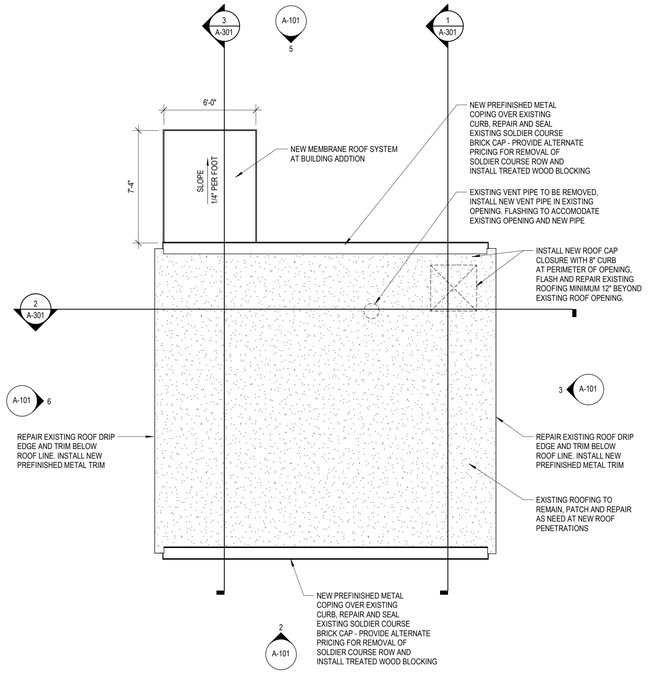
3 | SOUTH ELEVATION
A-101 | ELEVATION VIEW
1/4" = 1'-0"



5 | EAST ELEVATION
A-101 | ELEVATION VIEW
1/4" = 1'-0"

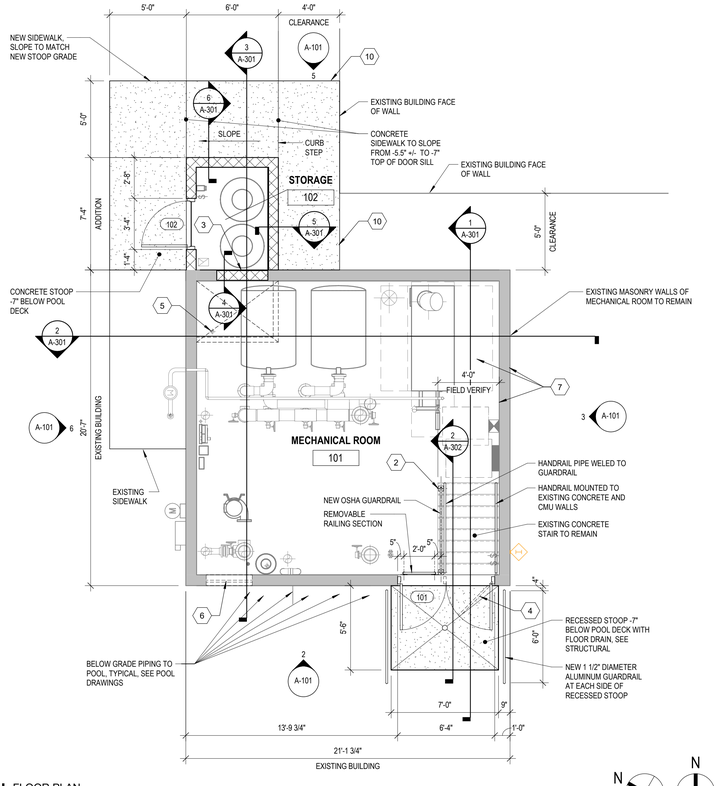


2 | WEST ELEVATION
A-101 | ELEVATION VIEW
1/4" = 1'-0"



4 | ROOF PLAN
A-101 | PLAN VIEW
1/4" = 1'-0"

TRUE NORTH PLAN NORTH



1 | FLOOR PLAN
A-101 | PLAN VIEW
1/4" = 1'-0"

TRUE NORTH PLAN NORTH

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

STATE OF COLORADO
TIM EINWALTER
00403437
LICENSED ARCHITECT
1/27/2023

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JJ
CHECKED BY: JR

PLANS AND ELEVATIONS

A-101

DOOR / FRAME & HARDWARE SCHEDULE

DOOR NO	ASSOCIATED ROOM	DOOR: PANEL DIMENSIONS: PRIMARY	SECONDARY	HEIGHT	THICKNESS	DOOR: SPECIFICATION: TYPE	GLAZING	MATL	FINISH	FRAME: SPECIFICATION: TYPE	MATL	FINISH	FRAME: DETAIL: HEAD	JAMB	SILL	FIRE RATING LABEL	HARDWARE: SET	HINGES	CLOSER	STOP	BOLTS: AUTOMATIC	FOOT	HEAD	PLATES: ARMOR	KICK	PULL	PUSH	MISCELLANEOUS: ACOUSTIC SEAL	ASTRAGAL	RAIN DRIP	SMOKE SEAL	SWEEP	THRESHOLD	WEATHER STRIP	NOTES
101	MECHANICAL ROOM	3' - 0"	3' - 0"	7' - 0"	1 3/4"	F	---	HM	P	02	HM	P	6/A-302	5/A-302	---	45 MIN	S6	H4	X	X		X	X		X					X	X	X	X	X	X	INSULATED DOORS
102	STORAGE	3' - 0"		7' - 0"	1 3/4"	F	---	HM	P	01	HM	P	8/A-302	7/A-302	---	45 MIN	S6	H2	X	X					X						X	X	X	X	X	X	INSULATED DOOR

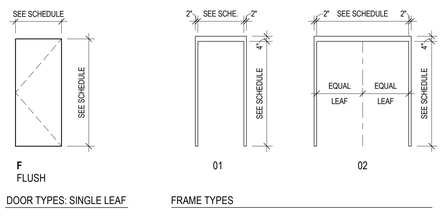
HINGES:		SETS:	
H-1	1 1/2 PR, BB, NRP	S-1	ELECTRIFIED LOCKSET
H-2	1 1/2 PR, BB	S-2	PASSAGE SET
H-3	1 1/2 PR	S-3	PRIVACY SET
H-4	3 PR, BB	S-4	CLASSROOM SET
		S-5	OFFICE SET
		S-6	STOREROOM SET

ROOM FINISH SCHEDULE

ROOM NO	ROOM NAME	FLOOR	BASE	WALLS: NORTH: MATL	NORTH: FINISH	EAST: MATL	EAST: FINISH	SOUTH: MATL	SOUTH: FINISH	WEST: MATL	WEST: FINISH	CEILING: MATL	CEILING: HEIGHT	NOTES
101	MECHANICAL ROOM	CONCRETE	---	CMU	P	CMU	P	CMU	P	CMU	P	PRECAST CONCRETE		EXISTING ROOM
102	STORAGE	CONCRETE	---	CMU	P	CMU	P	CMU	P	CMU	P	CONCRETE		

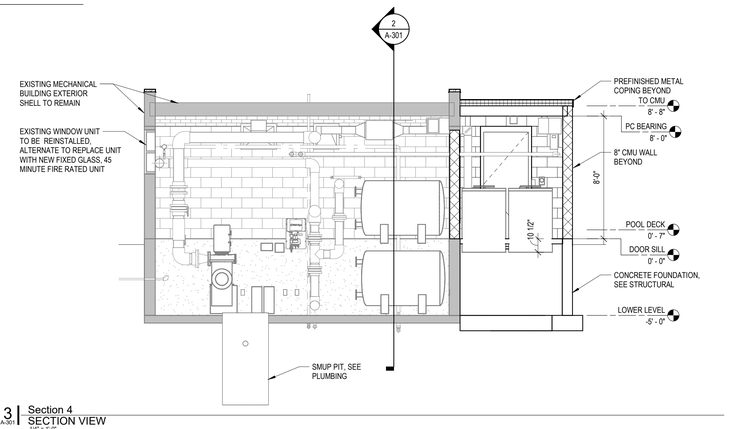
WINDOW SCHEDULE

WINDOW NO	WINDOW: ROUGH OPENING: WIDTH	HEIGHT	SPECIFICATIONS: TYPE	GLAZING	FRAME: SPECIFICATION: MATL	FINISH	DETAIL: HEAD	JAMB	SILL	ASSOCIATED LEVEL	HEAD HEIGHT ABOVE LEVEL	NOTES
W101	3' - 0"	2' - 10 1/2"	W6A	1-INCH	ALUM	ANODIZED	5/A-302	4/A-302		DOOR SILL	7' - 1 1/4"	ALTERNATE - LOW-E INSULATED GLASS - 45 MINUTE FIRE RATED

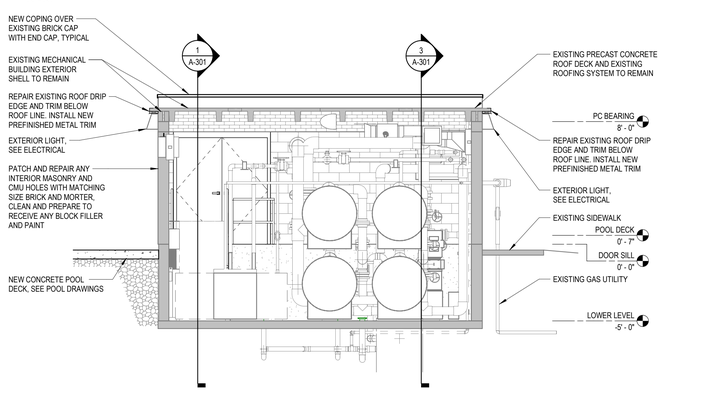


DOOR TYPES: SINGLE LEAF

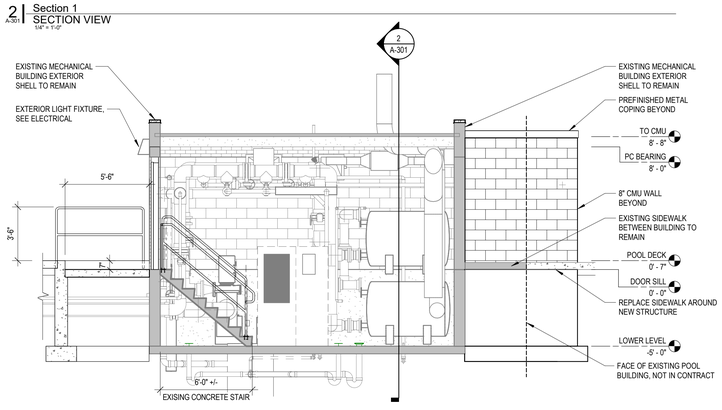
FRAME TYPES



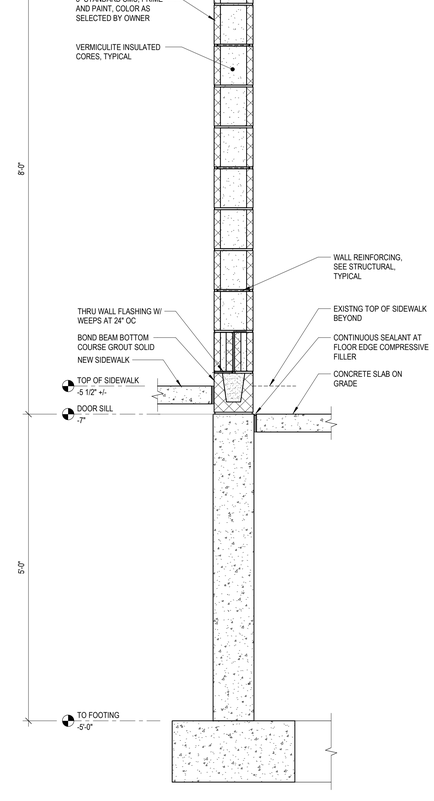
3 | A-301 Section 4
SECTION VIEW
1/4" = 1'-0"



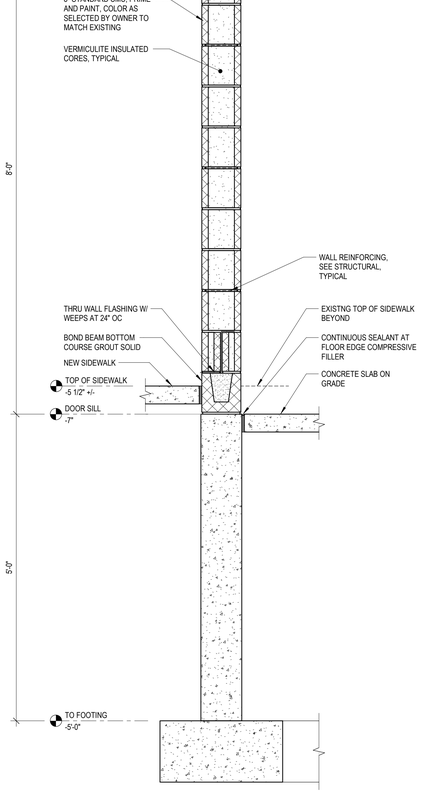
2 | A-301 Section 1
SECTION VIEW
1/4" = 1'-0"



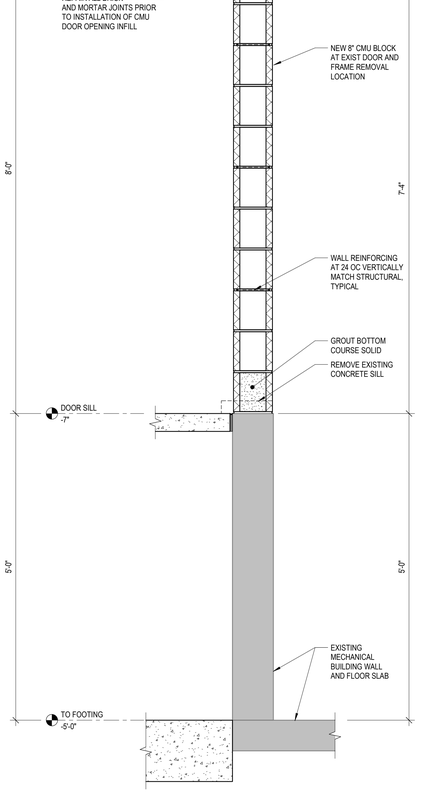
1 | A-301 Section 2
SECTION VIEW
1/4" = 1'-0"



6 | A-301 WALL SECTION 3
SECTION VIEW
1" = 1'-0"



5 | A-301 WALL SECTION 2
SECTION VIEW
1" = 1'-0"



4 | A-301 WALL SECTION 1
SECTION VIEW
1" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

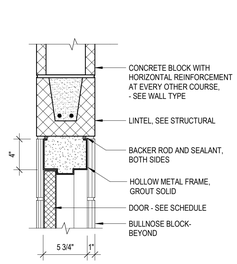
STATE OF COLORADO
TIM EINWALTER
00403437
LICENSED ARCHITECT
1/27/2023

REVISION SCHEDULE		
Number	Description	Date

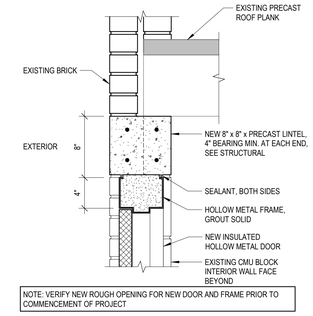
ISSUE DATE: 01/27/2023
DRAWN BY: JJ
CHECKED BY: JR

SECTIONS AND DETAILS

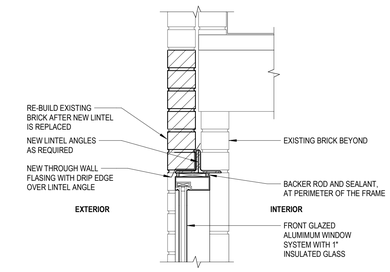
A-301



8 | DOOR HEAD DETAIL
A-302 | DETAIL VIEW
1 1/2" = 1'-0"

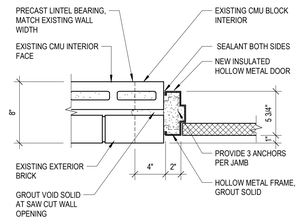


6 | DOOR HEAD DETAIL
A-302 | DETAIL VIEW
1 1/2" = 1'-0"

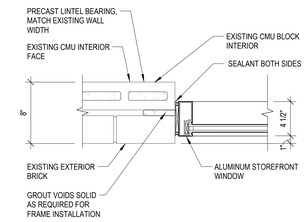


4 | WINDOW HEAD DETAIL - ALTERNATE
A-302 | DETAIL VIEW
1 1/2" = 1'-0"

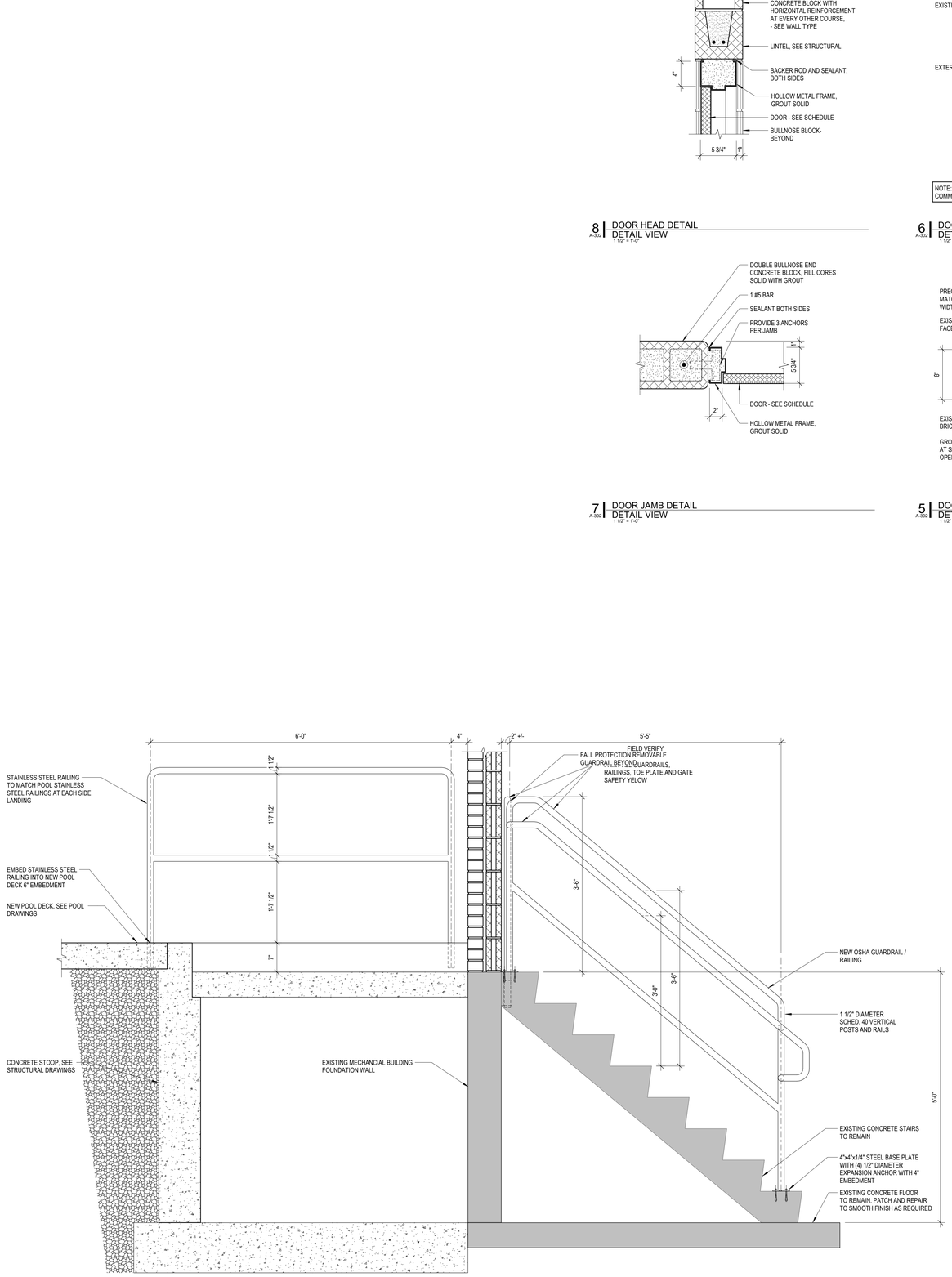
7 | DOOR JAMB DETAIL
A-302 | DETAIL VIEW
1 1/2" = 1'-0"



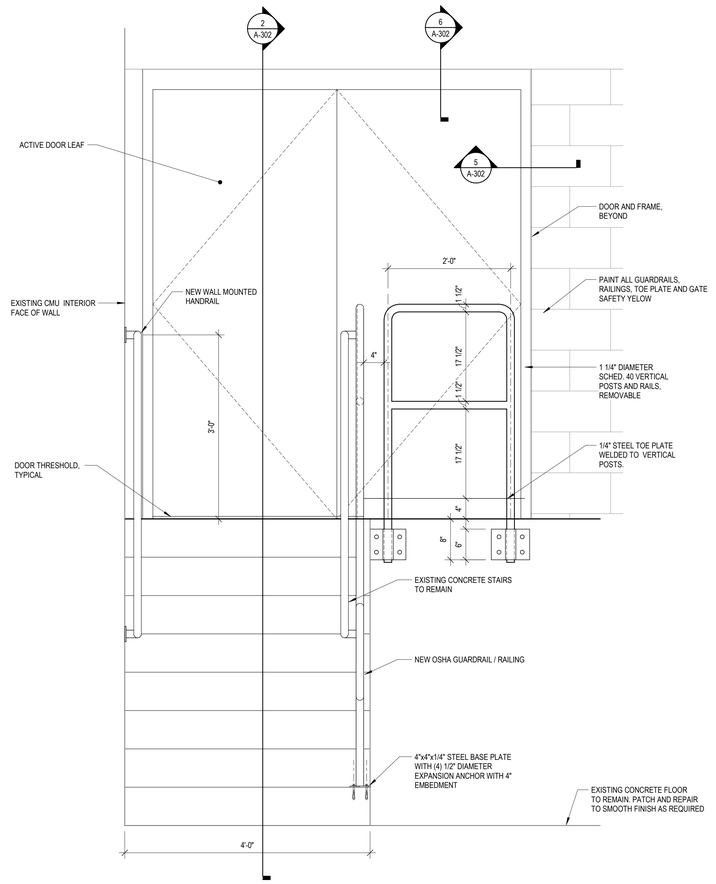
5 | DOOR JAMB DETAIL
A-302 | DETAIL VIEW
1 1/2" = 1'-0"



3 | WINDOW JAMB DETAIL - ALTERNATE
A-302 | DETAIL VIEW
1 1/2" = 1'-0"



2 | STAIR AND RAILING SECTION
A-302 | SECTION VIEW
1" = 1'-0"



1 | GATE ELEVATION
A-302 | ELEVATION VIEW
1" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

STATE OF COLORADO
TIM EINWALTER
00403437
LICENSED ARCHITECT
1/27/2023

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JJ
CHECKED BY: TE

SECTIONS AND DETAILS

A-302

DESIGN SPECIFICATIONS

1. DESIGN IS IN ACCORDANCE WITH THE STATE OF COLORADO AND THE 2018 INTERNATIONAL BUILDING CODE.

2. MINIMUM 28 DAY CONCRETE CYLINDER STRENGTH SHALL BE:

FOOTINGS	4000 PSI
FOUNDATION WALLS	4000 PSI
SLABS ON GRADE	4000 PSI
STRUCTURAL SLAB SYSTEMS	4000 PSI
PRECAST LINTEL	4000 PSI

3. REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60.

4. CONCRETE MASONRY UNITS NET AREA COMPRESSIVE STRENGTH OF 2000 PSI.

5. NET AREA COMPRESSIVE STRENGTH OF CONCRETE MASONRY WALLS (f'm) IS EQUAL TO 2000 PSI BASED ON THE CMU STRENGH SHOWN ABOVE AND MORTAR SHOWN BELOW.

6. MORTAR SHALL CONFORM TO ASTM C270 TYPE S.

7. MASONRY GROUT SHALL CONFORM TO ASTM C476. MINIMUM COMPRESSIVE STRENGTH SHALL BE f'_g = 3000 PSI.

8. STRUCTURAL STEEL PLATES SHALL CONFORM TO THE FOLLOWING:

THICKNESS <= 1/8"	ASTM A1011 CS TYPE B (OR APPROVED EQUAL)
3/16" <= THICKNESS <= 4"	ASTM A572 GRADE 50

9. STRUCTURAL STEEL W-SHAPES AND WT-SHAPES SHALL CONFORM TO ASTM A992 GRADE 50.

10. STRUCTURAL STEEL ANGLES AND OTHER ROLLED MEMBERS SHALL CONFORM TO ASTM A572 GRADE 50.

11. ASSUMED BEARING CAPACITY FOR SPREAD FOOTINGS IS 1500 PSF.

12. DESIGN LOADS:

FLOOR LIVE LOAD	
MECHANICAL ROOMS	150 PSF
ROOF LIVE LOAD	
MINIMUM ROOF LIVE LOAD	20 PSF
ROOF SNOW LOAD	
RISK CATEGORY	II
IMPORTANCE FACTOR	I_s = 1.0
GROUND SNOW LOAD	P_g = 35 PSF
FLAT ROOF SNOW LOAD	P_f = 30 PSF
EXPOSURE FACTOR	C_e = 1.0
THERMAL FACTOR	C_t = 1.2
WIND LOAD	
RISK CATEGORY	II
ULTIMATE WIND SPEED	V_{ult} = 107 MPH
NOMINAL WIND SPEED	V_{asd} = 82.9 MPH
EXPOSURE	C
INTERNAL PRESSURE COEFFICIENT	GC_{pi} = +/- 0.18
SEISMIC LOAD	
RISK CATEGORY	II
IMPORTANCE FACTOR	I_e = 1.0
MAPPED SPECTRAL RESPONSE ACCELERATION PARAMETERS	S_S = 0.19 g S_1 = 0.043 g
DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETERS	S_{DS} = 0.160 g S_{D1} = 0.065 g
SEISMIC RESPONSE COEFFICIENT	C_s = 0.068
RESPONSE MODIFICATION FACTOR	R = 3
SITE CLASS	D (ASSUMED)
SEISMIC DESIGN CATEGORY	B
SEISMIC FORCE-RESISTING SYSTEM	ORDINARY REINFORCED MASONRY SHEAR WALLS
ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE PROCEDURE

13. RESISTANCE TO LATERAL LOADS ON STRUCTURE IS PROVIDED BY ROOF DIAPHRAGMS. CONTRACTOR SHALL PROVIDE SUFFICIENT TEMPORARY BRACING UNTIL ALL LATERAL SUPPORT SYSTEMS ARE IN PLACE AND FUNCTIONAL.

14. ALL STRUCTURAL FRAMING AND CONNECTIONS HAVE BEEN DESIGNED FOR THE FINAL COMPLETED CONDITION AND HAVE NOT BEEN INVESTIGATED FOR POTENTIAL LOADINGS ENCOUNTERED DURING ERECTION AND CONSTRUCTION. ANY INVESTIGATION OF THE STRUCTURAL FRAMING AND CONNECTIONS FOR ADEQUACY DURING THE ERECTION AND CONSTRUCTION PROCESS IS THE RESPONSIBILITY OF THE CONTRACTOR.

15. CONTRACTOR IS RESPONSIBLE FOR MEANS AND METHODS OF CONSTRUCTION AND JOB SITE SAFETY.

GENERAL NOTES

EARTHWORK

1. FOOTINGS SHALL BE CAST ON UNDISTURBED SUBSOIL. IF DESIGN CAPACITY IS NOT ENCOUNTERED AT THE ELEVATIONS SHOWN, FOOTINGS MUST BE LOWERED. CONSULT ENGINEER BEFORE PROCEEDING.

2. NO HOLES, TRENCHES OR DISTURBANCES OF THE SOIL SHALL BE ALLOWED WITHIN THE VOLUME DESCRIBED BY 45 DEGREE LINES SLOPING FROM THE BOTTOM EDGE OF THE FOOTING. IF SUCH ARE REQUIRED, FOOTINGS MUST BE LOWERED.

3. BACKFILL EVENLY ON EACH SIDE OF FOUNDATION WALLS AND RETAINING WALLS.

4. DO NOT BACKFILL AGAINST BASEMENT WALLS UNTIL FLOOR SYSTEM IS IN PLACE AND FASTENED OR UNTIL WALLS ARE ADEQUATELY BRACED. BRACING SHALL BE DESIGNED BY THE CONTRACTOR.

5. TOPSOIL AND FILL BELOW SLABS ON GROUND SHALL BE REMOVED. AGGREGATE BASE COURSE UNDER SLABS ON GROUND SHALL BE GRAVEL COMPACTED TO 6-INCH LAYERS (EXCEPT WHERE LOOSE FILL IS INDICATED ON DRAWINGS), AS SPECIFIED.

6. BACKFILL AGAINST INTERIOR FOUNDATION WALLS SHALL BE GRAVEL COMPACTED TO MAXIMUM 6-INCH LAYERS, AS SPECIFIED.

7. BACKFILL AGAINST EXTERIOR FOUNDATION WALLS SHALL BE GRAVEL COMPACTED TO MAXIMUM 6-INCH LAYERS, AS SPECIFIED.

8. PROVIDE MINIMUM 24 INCHES OF FREE DRAINING AGGREGATE AS SPECIFIED OVER ALL DRAIN TILES AND 4 INCHES BELOW.

CONCRETE

1. FORMWORK SHALL BE DESIGNED IN ACCORDANCE WITH THE ACI "MANUAL OF CONCRETE PRACTICE", LATEST EDITION.

2. REINFORCING STEEL SHALL BE DETAILED AND PLACED IN ACCORDANCE WITH THE ACI "MANUAL OF CONCRETE PRACTICE", LATEST EDITION, UNLESS OTHERWISE NOTED.

3. LAP ALL WALL BARS 30 DIAMETERS 36 DIAMETERS UNLESS OTHERWISE DETAILED. LAP WELDED WIRE MESH 6 INCHES.

4. PROVIDE COLUMN AND WALL DOWELS OF THE SAME SIZE AND NUMBER AS THE RESPECTIVE COLUMN AND WALL REINFORCING UNLESS OTHERWISE DETAILED.

5. PROVIDE TWO #4 BARS AS STIRRUP CARRY BARS WHERE NO TOP STEEL IS AVAILABLE TO HOLD STIRRUPS.

6. WHEREVER AN APPROVED PIPE OR CONDUIT EXTENDS THROUGH A BEAM, PROVIDE ONE ADDITIONAL STIRRUP ON EACH SIDE OF THE OPENING.

7. CONCRETE PROTECTION FOR REINFORCING BARS SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", ACI 318-14.

8. SLABS ON GRADE SHALL BE CAST ALLOWING A SUFFICIENT NUMBER OF JOINTS TO ADEQUATELY CONTROL SHRINKAGE CRACKING. SAWCUTTING SHALL BE DONE AS SOON AS SAWCUT WILL NOT RAVEL CONCRETE OR WITHIN 24 HOURS MAXIMUM OF INITAL POURING OPERATION. MAXIMUM SIZE OF PANELS SHALL BE 15 FEET BY 15 FEET. GENERALLY, JOINTS SHALL OCCUR ON COLUMN CENTERLINES.

9. INTERIOR SLABS ON GRADE SHALL BE AS SHOWN ON THE DRAWINGS.

10. EXTERIOR SLABS ON GRADE SHALL BE AS SHOWN ON THE DRAWINGS.

11. ALLOW AT LEAST 24 HOURS BEFORE POURING ADJACENT WALL SECTIONS BETWEEN CONSTRUCTION JOINTS. MAXIMUM LENGTH OF POUR TO BE 40 FEET, UNLESS CRACK INDUCERS ARE USED AS DETAILED ON THE DRAWINGS.

12. CONTRACTOR SHALL NOTIFY THE ENGINEER AT LEAST 24 HOURS PRIOR TO PLACING CONCRETE.

13. DO NOT PLACE OR CUT HOLES IN CONCRETE SLABS, BEAMS, WALLS OR COLUMNS WITHOUT PRIOR APPROVAL OF THE ENGINEER.

14. EXTERIOR EXPOSED CONCRETE SHALL BE AIR-ENTRAINED. AIR CONTENT SHALL BE 6 PERCENT (+/-1 1/2 PERCENT).

15. CAMBER CONCRETE MEMBERS FOR DEAD LOAD DEFLECTION BY ADJUSTING FORMS.

16. PIPES AND CONDUITS EMBEDDED IN OR PASSING THROUGH STRUCTURAL MEMBERS MUST BE APPROVED BY THE STRUCTURAL ENGINEER. PIPE AND CONDUITS EMBEDDED IN CONCRETE SHALL NOT BE LARGER THAN 2 INCHES IN OUTSIDE DIAMETER AT THEIR WIDEST POINT OR FITTING OR 1/3 OF THE THICKNESS OF THE SLAB, BEAM OR WALL.

17. ELECTRICAL CONDUIT OR PIPES EMBEDDED IN OR PASSING THROUGH SLABS, BEAMS OR WALLS SHALL BE LOCATED AND PLACED SO THAT:

    1. THEY ARE NOT CLOSER THAN THREE DIAMETERS ON CENTER.
    2. THE CONCRETE COVER IS NOT LESS THAN 1-INCH.
    3. THEY RUN BETWEEN REINFORCING AND DO NOT DISPLACE IT IN ANY MANNER.

18. ALUMINUM CONDUITS SHALL NOT BE PLACED IN CONCRETE.

19. CHAMFER ALL EXPOSED CONCRETE CORNERS. SEE ARCHITECTURAL/STRUCTURAL DRAWINGS FOR REQUIREMENTS.

20. CONCRETE SHALL BE TESTED BY THE OWNER'S TESTING LAB. REFER TO SPECIFICATIONS FOR REQUIREMENTS.

21. PROPER CURING PROCEDURES SHALL BE USED FOR SLAB ON GRADE TO PREVENT CURLING.

22. CALCIUM CHLORIDE SHALL NOT BE USED IN CONCRETE MIXES.

23. PROVIDE WATERSTOPS AT ALL CONSTRUCTION JOINTS BELOW THE WATER TABLE AND AS SHOWN ON DRAWINGS. SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION.

CONCRETE MASONRY

1. PRODUCTION AND CONSTRUCTION OF CONCRETE MASONRY SHALL BE IN ACCORDANCE WITH THE "BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES", ACI 530-13, AND THE NCMA "TEK MANUAL FOR CONCRETE MASONRY DESIGN AND CONSTRUCTION", LATEST EDITION.

2. HOT AND COLD WEATHER CONSTRUCTION SHALL BE IN COMPLIANCE WITH THE IMIAC (INTERNATIONAL MASONRY INDUSTRY ALL-WEATHER COUNCIL) "RECOMMENDED PRACTICES AND GUIDE SPECIFICATIONS FOR HOT AND COLD WEATHER MASONRY AND CONSTRUCTION".

3. CALCIUM CHLORIDE OR ADMIXTURES CONTAINING CALCIUM CHLORIDE SHALL NOT BE USED.

4. MASONRY WALLS SHALL BE ADEQUATELY BRACED TO RESIST WIND FORCES UNTIL PERMANENT DESIGN SUPPORTS ARE IN PLACE AND FUNCTIONAL. BRACING SHALL BE DESIGNED BY THE CONTRACTOR.

5. PROVIDE DOWELS INTO FOUNDATION THE SAME SIZE AND NUMBER AS WALL REINFORCING.

6. LAP REINFORCING BARS 48 DIAMETERS.

7. CONCRETE MASONRY WALLS SHALL BE REINFORCED AT EVERY OTHER BED JOINT WITH 9 GAGE LADDER TYPE JOINT REINFORCEMENT.

8. VERTICAL BARS SHOWN ON THE DESIGN DRAWINGS SHALL BE PLACED IN A CONTINUOUS UNOBSTRUCTED CELL OF NOT LESS THAN 3 INCHES BY 4 INCHES.

9. ALL BOND BEAMS AND PILASTERS SHALL BE REINFORCED AS SHOWN ON THE DESIGN DRAWINGS AND FILLED WITH GROUT.

10. ALL DOOR AND WINDOW JAMBS SHALL BE GROUTED SOLID 8 INCHES WIDE UNLESS SHOWN OTHERWISE.

11. WHERE NOT SHOWN OTHERWISE, MINIMUM SOLID GROUTED MASONRY BELOW BEAM REACTIONS SHALL BE 16 INCHES DEEP BY 32 INCHES LONG.

12. WHERE NOT SHOWN OTHERWISE, MINIMUM SOLID GROUTED MASONRY BELOW LINTEL REACTIONS SHALL BE 16 INCHES DEEP BY 16 INCHES LONG.

MISCELLANEOUS

1. DIMENSIONS OF EXISTING CONSTRUCTION OR CONSTRUCTION IN PROGRESS SHALL BE VERIFIED AND COORDINATED PRIOR TO FABRICATION OF STRUCTURAL COMPONENTS.

2. VERIFY AND COORDINATE, WITH ALL CONTRACTORS, THE LOCATION OF ALL ARCHITECTURAL AND MECHANICAL APPURTENANCES AND OPENINGS.

3. REFER TO PLUMBING DRAWINGS FOR ROOF DRAIN LOCATIONS.

4. EXPANSION ANCHORS SHALL BE HILTI KWIK BOLT TZ.

5. ADHESIVE ANCHORS SHALL BE HILTI HIT-HY 200.

6. SLEEVE ANCHORS SHALL BE HILTI HLC.

7. SCREW ANCHORS SHALL BE HILTI KWIK HUS.

8. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS FOR THE FOLLOWING ITEMS PRIOR TO FABRICATION: REINFORCING STEEL.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTH GLENN, CO 80234

COLORADO LICENSED
MICHAEL KRATSCHMER
36170
01/27/2023
PROFESSIONAL ENGINEER

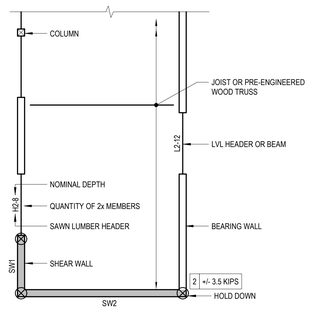
REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
PROJECT NUMBER: 22232
DRAWN BY: AMZ
CHECKED BY: SAC

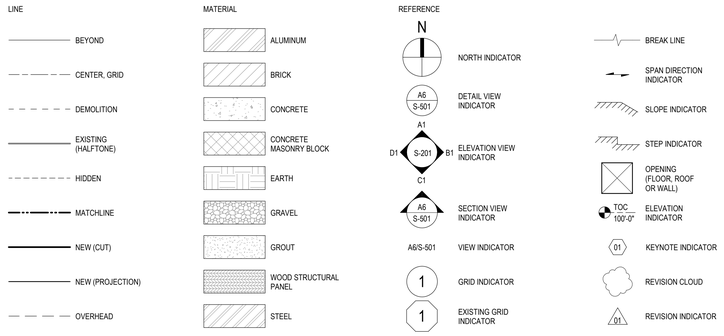
GENERAL NOTES

S-001

WOOD FRAMING PLAN LEGEND



SYMBOL LEGEND

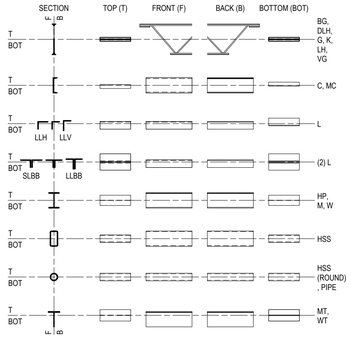


VIEW LOCATION LEGEND

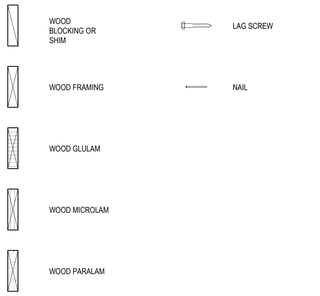
D1	D2	D3	D4	D5	D6
C1	C2	C3	C4	C5	C6
B1	B2	B3	B4	B5	B6
A1	A2	A3	A4	A5	A6

SHEET INDEX

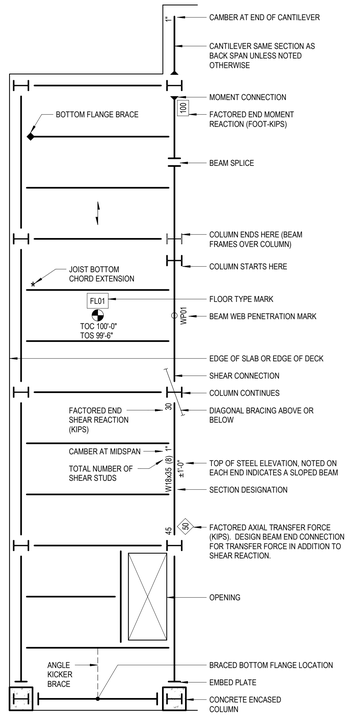
STEEL SHAPES LEGEND



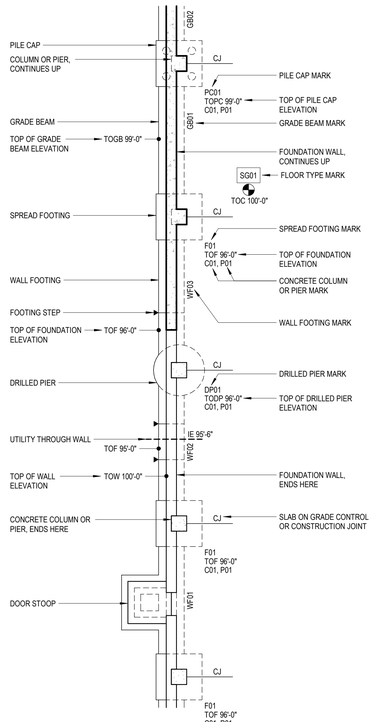
WOOD LEGEND



STEEL FRAMING PLAN LEGEND



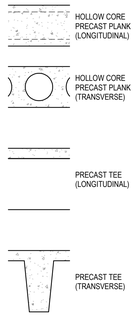
FOUNDATION PLAN LEGEND



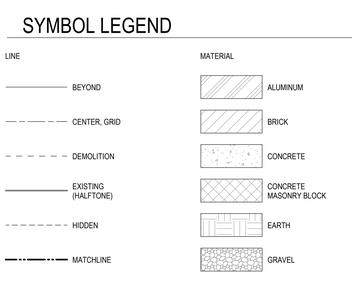
ABBREVIATIONS

1WAY	ONE-WAY
AB	ANCHOR BOLT
ADDL	ADDITIONAL
ADDM	ADDENDUM
AHU	AIR HANDLING UNIT
ALT	ALTERNATE
APPROX	APPROXIMATE
AR	AS REQUIRED
ARCH	ARCHITECT
B PL	BASE PLATE
B/B	BACK TO BACK
BC	BOTTOM CHORD
BF	BOTH FACES
BF	BOTTOM FACE
BLDG	BUILDING
BM	BEAM
BO	BOTTOM OF __ (REFER TO TOP OF __)
BOT	BOTTOM
BRDG	BRIDGING
BRG	BEARING
BRG PL	BEARING PLATE
BS	BOTH SIDES
BSMT	BASEMENT
BW	BOTH WAYS
C	CHANNEL
C TO C	CENTER TO CENTER
CANTIL	CANTILEVER
CGS	CENTER OF GRAVITY OF STRAND
CIP	CAST-IN-PLACE
CJ	CONSTRUCTION JOINT
CJ	CONTROL JOINT
CL	CENTER LINE
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CONN	CONNECT
CONSTR	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
CPRS	COMPRESSIBLE
CTRL	CONTROL
CU	CUBIC
CU FT	CUBIC FEET
CU IN	CUBIC INCH
CU YD	CUBIC YARD
D	DEEP
D	DEPTH
DBE	DECK BEARING ELEVATION
DBL	DOUBLE
DEG	DEGREE
DET	DETAIL
DEMO	DEMOLITION
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DIR	DIRECTION
DL	DEAD LOAD
DWG	DRAWING
E	EAST
EA	EACH
EE	EACH END
EF	EACH FACE
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRIC
ELEV	ELEVATOR
ENGR	ENGINEER
EOD	EDGE OF DECK
EOG	EDGE OF GRATING
EOS	EDGE OF SLAB
EQ	EQUAL
EQL SP	EQUALLY SPACED
EQUIP	EQUIPMENT
EQUIV	EQUIVALENT
EW	EACH WAY
EXC	EXCAVATE
EXIST., (E)	EXISTING
EXP	EXPANSION
EXP BT	EXPANSION BOLT
EXT	EXTERIOR
FD	FLOOR DRAIN
FDTN	FOUNDATION
FF	FAR FACE
FLR	FLOOR
FR	FRAME
FS	FAR SIDE
FSTNR	FASTENER
FT	FEET
FTG	FOOTING
FUT	FUTURE
GA	GAGE
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GLU LAM	GLUE LAMINATED WOOD
GR BM	GRADE BEAM
GRTG	GRATING
H	HIGH
HDR	HEADER
HGR	HANGER
HORIZ, H	HORIZONTAL
HS	HIGH STRENGTH
HSKPG	HOUSEKEEPING
HT	HEIGHT
I	MOMENT OF INERTIA
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
INFO	INFORMATION
INT	INTERIOR
JST	JOIST
JST BRG	JOIST BEARING
K	KIP (ONE THOUSAND POUNDS)
KB	KNEE BRACE
KLF	KIPS PER LINEAR FOOT
KOP	KNOCK OUT PANEL
KSF	KIPS PER SQUARE FOOT
KSI	KIPS PER SQUARE INCH
KWY	KEYWAY
L	ANGLE
LATL	LATERAL
LB	POUND
LD BRG	LOAD-BEARING
LDH	LONG DIMENSION HORIZONTAL
LDV	LONG DIMENSION VERTICAL
LL	LIVE LOAD
LLBB	LONG LEG BACK TO BACK
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LVL	LAMINATED VENEER LUMBER
LVR	LOUVER
M	MOMENT
MAX	MAXIMUM
MBR	MEMBER
MC	MOMENT CONNECTION
MD	METAL DECK
MECH	MECHANICAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MFR REC	MANUFACTURER'S RECOMMENDATION
MID	MIDDLE
MIN	MINIMUM
MISC	MISCELLANEOUS
ML	MONOLITHIC
MO	MASONRY OPENING
MTL	METAL
MULT	MULTIPLE
N	NORTH
NF	NEAR FACE
NIC	NOT IN CONTRACT
NLB	NON LOAD-BEARING
NO	NUMBER
NOM	NOMINAL
NS	NEAR SIDE
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OPNG	OPENING
OPH	OPPOSITE HAND
OPP	OPPOSITE
OPT	OPTIONAL
O/O	OUT TO OUT
PCC	PRECAST CONCRETE
PCF	POUNDS PER CUBIC FOOT
PL	PLATE
PLF	POUNDS PER LINEAR FOOT
PLYWD	PLYWOOD
PRCST	PRECAST
PRELIM	PRELIMINARY
PS CONC	PRESTRESSED CONCRETE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POST-TENSIONED
PT	PRESSURE TREATED
PT CONC	POST-TENSIONED CONCRETE
QTY	QUANTITY
R	RADIUS
RD	ROOF DRAIN
REF	REFERENCE
REINF	REINFORCE
REQD	REQUIRED
REV	REVISION
RS	ROUGH SAWN
RTU	ROOF TOP UNIT
S	SOUTH
SCHED	SCHEDULE
SCHEM	SCHEMATIC
SE	STRUCTURAL ENGINEER
SECT	SECTION
SF	SQUARE FOOT (FEET)
SHT	SHEET
SIM	SIMILAR
SL	SLAB
SLBB	SHORT LEG BACK TO BACK
SP	SUMP PIT
SPCL	SPECIAL
SPEC	SPECIFICATION
SQ	SQUARE
SQ IN	SQUARE INCH
SQ YD	SQUARE YARD
STD	STANDARD
STIF	STIFFENER
STL JST	STEEL JOIST
STRUC	STRUCTURAL
SYMM	SYMMETRICAL
T&B	TOP AND BOTTOM
TB	THROUGH BOLT
TC	TOP CHORD
TEMJ	TOP ELEVATION MATCHES JOIST
TEMP	TEMPORARY
THK	THICKNESS
THRU	THROUGH
TOB	TOP OF BEAM
TOC	TOP OF CONCRETE
TOCF	TOP OF COLD-FORMED
TOD	TOP OF DECK
TODP	TOP OF DRILLED PIER
TOF	TOP OF FOUNDATION
TOG	TOP OF GRATING
TOGB	TOP OF GRADE BEAM
TOP	TOP OF PIER
TOPC	TOP OF PILE CAP
TOS	TOP OF STEEL
TOW	TOP OF WALL
TS	TUBE STEEL
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VAR	VARIES
VERT, V	VERTICAL
VIF	VERIFY IN FIELD
W	WEST
W	WIDE
W/	WITH
W/O	WITHOUT
WBL	WOOD BLOCKING
WD	WOOD
WF	WIDE FLANGE
WP	WORK POINT
WT	WEIGHT
WWF	WELDED WIRE FABRIC
WWM	WELDED WIRE MESH
YD	YARD

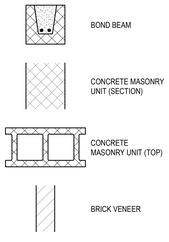
PRECAST CONCRETE SHAPES LEGEND



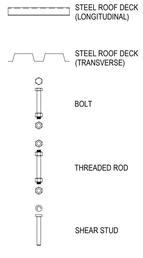
CONCRETE MASONRY PLAN LEGEND



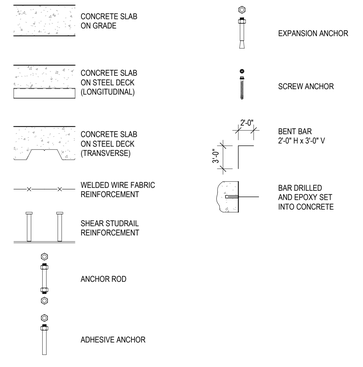
CONCRETE MASONRY LEGEND



STEEL LEGEND



CONCRETE LEGEND



WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTH GLENN, CO 80234

COLORADO LICENSED
SHAWN L. KRATOCHVIL
36170
01/27/2023
PROFESSIONAL ENGINEER

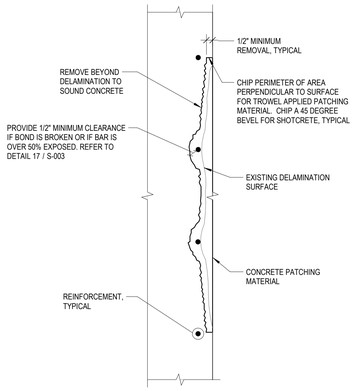
REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/2023
PROJECT NUMBER: 22232
DRAWN BY: AMZ
CHECKED BY: SAC

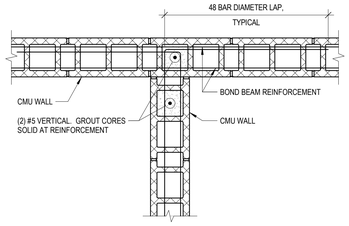
GENERAL INFORMATION

S-002

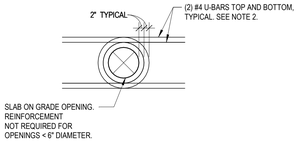


16 | S-003 TYPICAL WALL SPALL REPAIR DETAIL VIEW
1 1/2" = 1'-0"

17 | S-003 TYPICAL REBAR CLEARANCE DETAIL VIEW
3" = 1'-0"



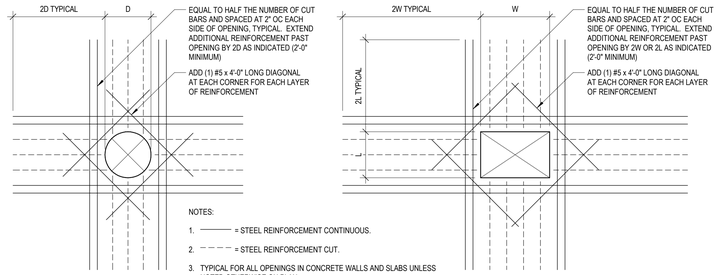
12 | S-003 BOND BEAM INTERSECTION DETAIL VIEW
1" = 1'-0"



NOTES:

1. TYPICAL OF ALL OPENINGS IN CONCRETE SLABS ON GRADE UNLESS NOTED OTHERWISE ON PLAN.
2. DO NOT WELD REINFORCEMENT TO PIPES SLEEVES OR INSERTS.
3. COVER FOR TOP BARS = 1". COVER FOR BOTTOM BARS = 2".
4. OMIT BOTTOM BARS WHEN SLAB ON GRADE IS LESS THAN 6" THICK.

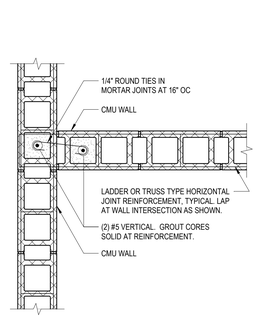
8 | S-003 SLAB ON GRADE OPENING DETAIL VIEW
1/2" = 1'-0"



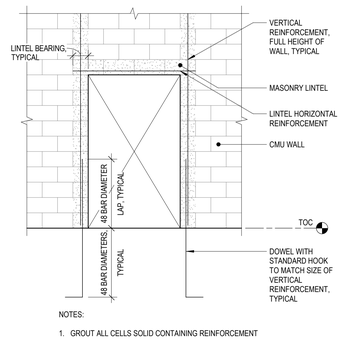
NOTES:

1. ——— = STEEL REINFORCEMENT CONTINUOUS.
2. - - - - = STEEL REINFORCEMENT CUT.
3. TYPICAL FOR ALL OPENINGS IN CONCRETE WALLS AND SLABS UNLESS NOTED OTHERWISE ON PLAN.
4. DO NOT WELD REINFORCEMENT TO PIPE SLEEVES OR INSERTS.
5. FOR OPENINGS 1'-0" ROUND/SQUARE OR LESS THE WALL STEEL CAN BE REPLACED WITHOUT ADDITIONAL REINFORCEMENT.

1 | S-003 OPENING REINFORCEMENT DETAIL VIEW
1/2" = 1'-0"



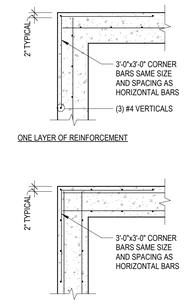
13 | S-003 CMU WALL INTERSECTION DETAIL VIEW
1" = 1'-0"



NOTES:

1. GROUT ALL CELLS SOLID CONTAINING REINFORCEMENT

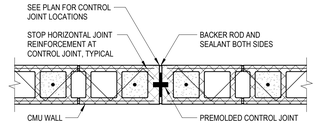
9 | S-003 CMU WALL DOOR OPENING DETAIL VIEW
3/8" = 1'-0"



ONE LAYER OF REINFORCEMENT

TWO LAYERS OF REINFORCEMENT

5 | S-003 WALL CORNER DETAIL VIEW
1/2" = 1'-0"

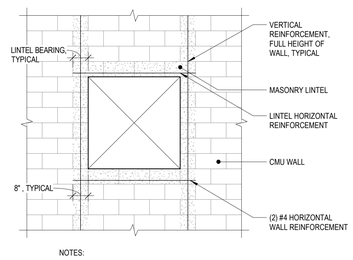


NOTES:

1. STOP BOND BEAM REINFORCEMENT (NOT SHOWN) AT CONTROL JOINT.

2 | S-003 CMU WALL VERTICAL CONTROL JOINT DETAIL VIEW
1" = 1'-0"

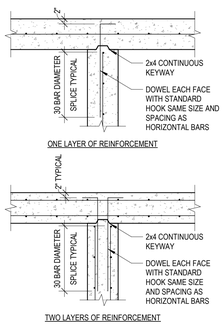
14 | S-003 CMU WALL CORNER DETAIL VIEW
1" = 1'-0"



NOTES:

1. GROUT ALL CELLS SOLID CONTAINING REINFORCEMENT.

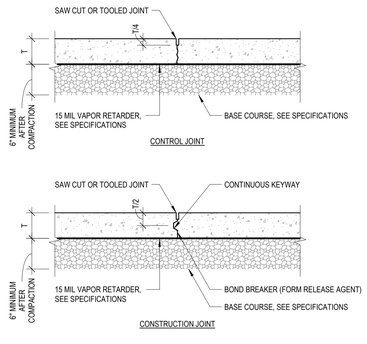
10 | S-003 CMU WALL PUNCHED OPENING DETAIL VIEW
3/8" = 1'-0"



ONE LAYER OF REINFORCEMENT

TWO LAYERS OF REINFORCEMENT

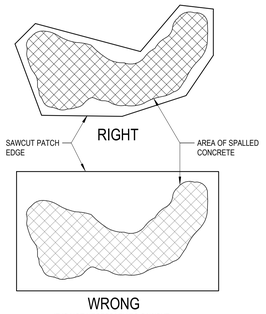
6 | S-003 WALL INTERSECTION DETAIL VIEW
1/2" = 1'-0"



CONTROL JOINT

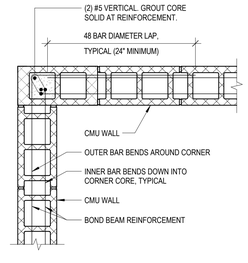
CONSTRUCTION JOINT

3 | S-003 SLAB ON GRADE CONTROL AND CONSTRUCTION JOINT DETAIL VIEW
1" = 1'-0"

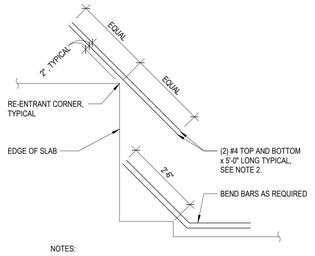


NOTE: IF MULTIPLE SPALLS ARE CLOSE TOGETHER, INCORPORATE INTO ONE LARGER PATCHED AREA.

15 | S-003 TYPICAL SPALL AREA DETAIL VIEW
1/2" = 1'-0"



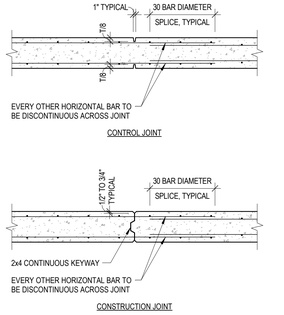
11 | S-003 BOND BEAM CORNER DETAIL VIEW
1" = 1'-0"



NOTES:

1. COVER FOR TOP BARS = 1". COVER FOR BOTTOM BARS = 2".
2. OMIT BOTTOM BARS WHEN SLAB ON GRADE IS LESS THAN 6" THICK.

7 | S-003 SLAB ON GRADE RE-ENTRANT CORNER DETAIL VIEW
1/2" = 1'-0"



CONTROL JOINT

CONSTRUCTION JOINT

4 | S-003 WALL CONTROL AND CONSTRUCTION JOINT DETAIL VIEW
1/2" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTH GLENN, CO 80234

COLORADO LICENSED
MICHAEL KRATSCHMER
36170
01/27/2023
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/2023
PROJECT NUMBER: 22232
DRAWN BY: AMZ
CHECKED BY: SAC

GENERAL STRUCTURAL DETAILS

S-003

FLOOR / ROOF SCHEDULE

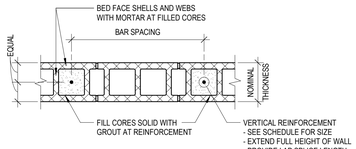
MARK	DESCRIPTION	REMARKS
RF08	8" CAST IN PLACE CONCRETE	#4@12" OC EW
SG06	6" SLAB ON GRADE	6x6-W2.9xW2.9 WWM
SG08	8" SLAB ON GRADE	#4@12" OC EW

MASONRY WALL SCHEDULE

MARK	NOMINAL THICKNESS	TYPE	VERTICAL REINFORCEMENT	REMARKS
MW08	8"	A	#5@24" OC	

MASONRY WALL SCHEDULE NOTES:

1. PROVIDE TYPICAL VERTICAL REINFORCEMENT AT WALL ENDS AND EACH SIDE OF CONTROL JOINTS. REINFORCE FIRST TWO CELLS EACH SIDE OF OPENINGS FULL HEIGHT OF WALL. WHERE THE USE OF STEEL OR PRECAST LINTELS INTERRUPTS VERTICAL CONTINUITY OF WALL REINFORCEMENT, SHIFT REINFORCED CELLS PAST LINTEL BEARING AND GROUT WALL SOLID BELOW ENDS OF LINTELS.
2. PROVIDE DOWELS FOR VERTICAL REINFORCEMENT INTO FOUNDATION WALLS AND FOOTINGS BELOW PER DETAILS.
3. SEE GENERAL NOTES AND DETAILS FOR HORIZONTAL JOINT REINFORCEMENT AND BOND BEAM REQUIREMENTS.
4. UNLESS DETAILED OR OTHERWISE CALLED OUT, PROVIDE CMU LINTELS PER LINTEL SCHEDULE OVER OPENINGS IN MASONRY WALLS.
5. PROVIDE CONTINUOUS HORIZONTAL JOINT REINFORCEMENT IN ALL WALLS AS PER SPECIFICATIONS.
6. OPENINGS IN WALLS PROVIDED FOR MECHANICAL DUCTWORK SHALL BE CENTERED IN BETWEEN BEAM BEARING LOCATIONS OR POSITIONED WITH THE NEAREST EDGE NO CLOSER THAN 24" EITHER SIDE OF BEAM BEARING LOCATIONS.
7. SEE PLAN AND DETAILS FOR ADDITIONAL WALL REINFORCEMENT AND GROUTING REQUIREMENTS NOT COVERED IN THIS SCHEDULE.



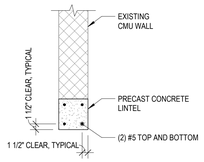
TYPE A

LINTEL SCHEDULE

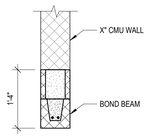
MARK	TYPE	SIZE	BEARING LENGTH	REMARKS
L1	IV	16" BOND BEAM WITH (2) #5 BOTTOM	8"	SEE DETAIL B
L2	III	11" HIGH PRECAST CONCRETE LINTEL	8"	SEE DETAIL A
L3	V	BRICK ANGLE TO MATCH EXISTING	8"	LOOSE ANGLE, FIELD VERIFY EXISTING.
L4	V	(2) L3x3x1/4 - BACK TO BACK	8"	LOOSE ANGLE

LINTEL SCHEDULE NOTES:

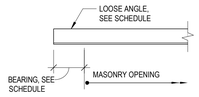
1. SEE ARCHITECTURAL DRAWINGS FOR SIZE AND LOCATION OF ALL OPENINGS.
2. COORDINATE BOTTOM OF LINTEL ELEVATION WITH ARCHITECTURAL DRAWINGS.
3. ALL DIMENSIONS ARE NOMINAL MASONRY DIMENSIONS UNLESS NOTED OTHERWISE.
4. PROVIDE MINIMUM 6" BEARING EACH END UNLESS NOTED OTHERWISE.
5. FOR CMU LINTELS, CONTRACTOR TO PROVIDE TEMPORARY SHORING UNTIL MASONRY HAS PROPERLY SET (3 DAYS MINIMUM).
6. FOR PRECAST CONCRETE LINTELS, WIDTH OF LINTEL TO MATCH EXISTING WALL CONSTRUCTION THICKNESS.



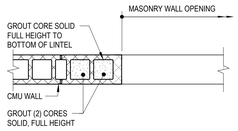
TYPE III



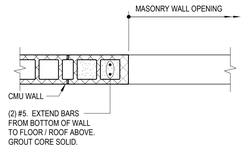
TYPE IV



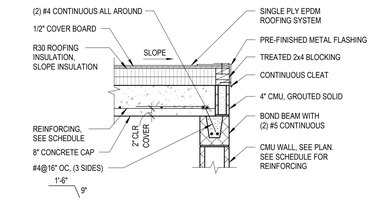
TYPE V



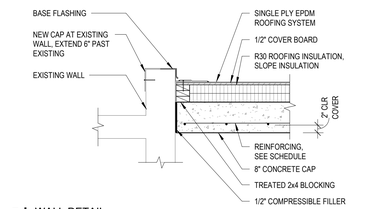
DETAIL A



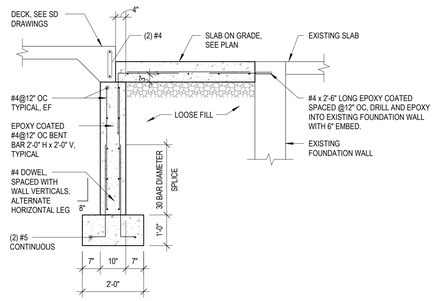
DETAIL B



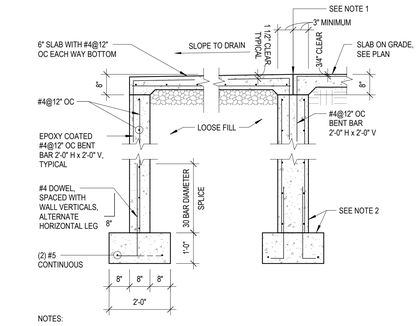
4 | S-101 WALL DETAIL
DETAIL VIEW
3/4" = 1'-0"



5 | S-101 WALL DETAIL
DETAIL VIEW
3/4" = 1'-0"



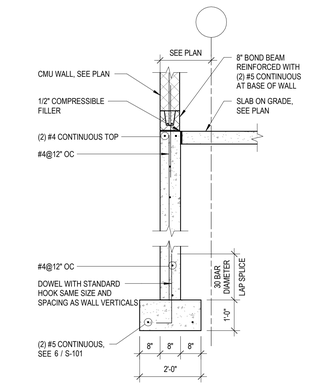
6 | S-101 DETAIL
DETAIL VIEW
1/2" = 1'-0"



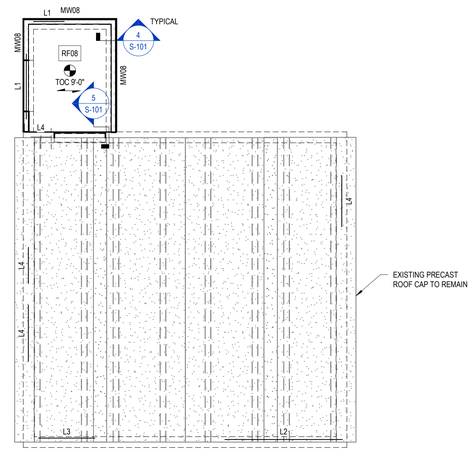
NOTES:

1. LOCATE SLAB BREAK UNDER DOOR THRESHOLD. COORDINATE LOCATION WITH ARCHITECTURAL DRAWINGS.
2. SEE ADJACENT WALL SECTION, DETAIL 6 / S-101, ON PLAN FOR SIZE AND REINFORCEMENT OF WALL AND FOOTING.

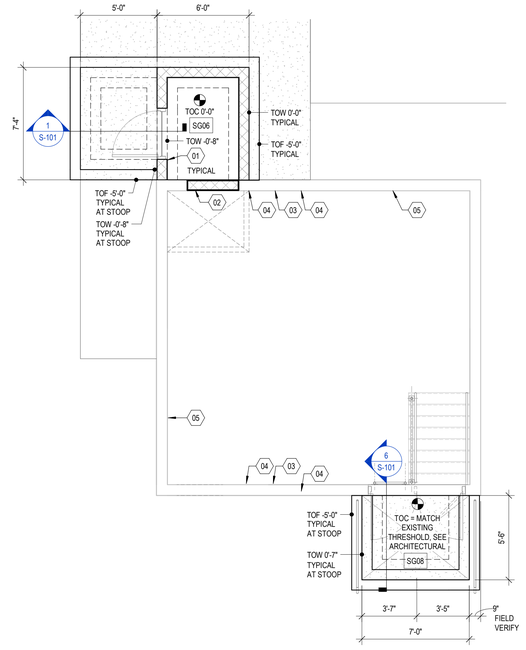
1 | S-101 DETAIL
DETAIL VIEW
1/2" = 1'-0"



2 | S-101 DETAIL
DETAIL VIEW
1/2" = 1'-0"



7 | S-101 ROOF FRAMING
PLAN VIEW
1/4" = 1'-0"



3 | S-101 FOUNDATION
PLAN VIEW
1/4" = 1'-0"

GENERAL SHEET NOTES

- SEE "GENERAL DETAILS" SHEET(S) FOR THE FOLLOWING DETAILS:
  - OPENING REINFORCEMENT
  - SLAB ON GRADE CONTROL AND CONSTRUCTION JOINT
  - WALL CONTROL AND CONSTRUCTION JOINT
  - WALL CORNER
  - WALL INTERSECTION
  - SLAB ON GRADE RE-ENTRANT CORNER
  - SLAB ON GRADE OPENING

SHEET KEYNOTES

01 (2) #4 x 5'-0" LONG LOCATED 1" BELOW TOP OF SLAB ON GRADE. PROVIDE AT ALL SLAB ON GRADE RE-ENTRANT CORNERS. ALL LOCATIONS NOT SHOWN ON PLAN.
02 CMU INFILL.
03 SPALL REPAIR. SEE DETAILS 15/S-003, 16/S-003 AND 17/S-003.
04 CRACK REPAIR. CLEAN AND EPOXY INJECT.
05 CMU REPAIR. SEE ARCHITECTURAL DRAWINGS FOR DETAILS.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTH GLENN, CO 80234

COLORADO LICENSED
MATTHEW R. STEPHENS
36170
01/27/2023
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/2023
PROJECT NUMBER: 22232
DRAWN BY: AMZ
CHECKED BY: SAC

FOUNDATION AND FRAMING PLANS, DETAILS, SCHEDULES

S-101

N TRUE NORTH
N PLAN NORTH

PLUMBING SYMBOLS, ABBREVIATIONS, SCHEDULES & SHEET INDEX

NOTE: NOT ALL SYMBOLS AND ABBREVIATIONS INDICATED HERE ARE USED IN THE DRAWINGS AND MAY NOT APPLY TO THIS PROJECT. ADDITIONAL SYMBOLS MAY BE INDICATED IN THE DRAWINGS.

PLUMBING ABBREVIATIONS

AP - ACCESS PANEL
AD - AREA DRAIN
AFF - ABOVE FINISHED FLOOR
AFG - ABOVE FINISHED GRADE
ANB - ACID NEUTRALIZING BASIN
ARCH - ARCHITECTURAL

B/S - BELOW SLAB
BFP - BACKFLOW PREVENTER
BLDG - BUILDING
BOP - BOTTOM OF PIPE
BOT - BOTTOM
BV - BALL VALVE
BWV - BACKWATER VALVE

CLG - CEILING
CO - CLEANOUT
COL - COLUMN
CONC - CONCRETE
CONN - CONNECTION
CTR - CENTER
CU - COPPER
CV - CHECK VALVE
CW - COLD WATER
CWFU - COLD WATER FIXTURE UNITS
CPVC - CHLORINATED POLYVINYL CHLORIDE

DCV - DOUBLE CHECK VALVE
DCW - DOMESTIC COLD WATER
DD - DEOK DRAIN
DET - DETAIL
DF - DRINKING FOUNTAIN
DFU - DRAINAGE FIXTURE UNITS
DHW - DOMESTIC HOT WATER
DHWR - DOMESTIC HOT WATER RETURN
DI - DEIONIZED WATER
DIA - DIAMETER
DN - DOWN
DS - DOWNSPOUT
DT - DRAIN TILE
DTW - DOMESTIC TEMPERED WATER
DV - DRAIN VALVE
DW - DISHWASHER
DWG - DRAWING
DWH - DOMESTIC WATER HEATER

E/EX - EXISTING
EEW - EMERGENCY EYE WASH
ESEW - EMERGENCY SHOWER / EYE WASH STATION
ELEV - ELEVATION
EOD - EMERGENCY OVERFLOW DRAIN PIPING
EQUIP - EQUIPMENT
EXT - EXPANSION TANK
EWC - ELECTRIC WATER COOLER
EWH - ELECTRIC WATER HEATER

F - FAHRENHEIT
FCO - FLOOR CLEANOUT
FD - FLOOR DRAIN
FDC - FIRE DEPARTMENT CONNECTION
FH - FUME HOOD
FS - FLOOR SINK
FT - FEET
FU - FIXTURE UNITS
FV - FLUSH VALVE

GAL - GALLON
GCO - GRADE OR GROUND CLEANOUT
GI - GREASE INTERCEPTOR
GPH - GALLONS PER HOUR
GPM - GALLONS PER MINUTE
GV - GATE VALVE

HB - HOSE BIBB
HD - HUB DRAIN
HR - HOUR
HS - HOSE STATION
HW - HOT WATER
HWFU - HOT WATER FIXTURE UNITS
HWR - HOT WATER RETURN
HYD - HYDRAULIC
HX - HEAT EXCHANGER

ID - INSIDE DIAMETER
IE - INVERT ELEVATION
IM - ICE MACHINE
IN - INCHES
INSUL - INSULATION
IW - INDIRECT WASTE

KW - KITCHEN WASTE

L - LAVATORY
LPM - LITERS PER MINUTE
LS - LAB SINK
LT - LAUNDRY TUB
LW - LAUNDRY WASTE OR LAB WASTE

M - METER
MAX - MAXIMUM
MB - MOP BASIN
MECH - MECHANICAL
MEP - MECHANICAL, ELECTRICAL, AND PIPING
MEZZ - MEZZANINE
MFR - MANUFACTURER
MH - MANHOLE
MIN - MINIMUM OR MINUTES
MISC - MISCELLANEOUS
MS - MOP SINK

NA - NOT APPLICABLE
N.C. - NORMALLY CLOSED
NIC - NOT IN CONTRACT
NO - NUMBER
N.O. - NORMALLY OPEN
NPCW - NON POTABLE COLD WATER
NPHW - NON POTABLE HOT WATER
NPHWR - NON POTABLE HOT WATER RETURN
NPS - NOMINAL PIPE SIZE
NTS - NOT TO SCALE

OBV - OIL BASIN VENT
OC - ON CENTER
OD - OUTSIDE DIAMETER
OHD - OPEN HUB DRAIN
OS&Y - OUTSIDE SCREW AND YOKE
OI - OIL INTERCEPTOR
ORD - EMERGENCY OVERFLOW ROOF DRAIN

PBV - PRESSURE BALANCING VALVE
PC - PLUMBING CONTRACTOR
PG - PRESSURE GAUGE
PH - PHASE
PITCH - PITCHES UP OR DOWN
PIV - POST INDICATOR VALVE
PLBG - PLUMBING
POC - POINT OF CONNECTION
PRESS - PRESSURE
PRV - PRESSURE RELIEF VALVE
PSF - POUNDS PER SQUARE FOOT
PSI - POUNDS PER SQUARE INCH
PSIA - POUNDS PER SQUARE INCH ABSOLUTE
PSIG - POUNDS PER SQUARE INCH GAUGE
PVC - POLYVINYL CHLORIDE

QTY - QUANTITY

RD - ROOF DRAIN
RI - ROUGH-IN
RO - REVERSE OSMOSES
RCP - RECIRCULATION PUMP
RPM - REVOLUTIONS PER MINUTE
RPZ - REDUCED PRESSURE ZONE VALVE
RV - RELIEF VALVE
RH - ROOF HYDRANT

S - SINK
SAN - SANITARY PIPING
SCH - SCHEDULE
SD - SITE DRAIN
SE - SEWAGE EJECTOR
SF - SQUARE FOOT
SH - SHOWNER
SL - SLOPE
SP - SUMP PUMP
SP - STANDPIPE
SPEC - SPECIFICATION
SS - SERVICE SINK
STD - STANDARD
STM - STORM PIPING

T&P - TEMPERATURE AND PRESSURE
TD - TRENCH DRAIN
TEMP - TEMPERATURE
TH - THERMOMETER
TMV - THERMOSTATIC MIXING VALVE
TOF - TOP OF FOOTING
TOP - TOP OF PIPE
TOS - TOP OF SLAB
TYP - TYPICAL

U / UR - URINAL

V - VENT
VIF - VERIFY IN FIELD
VTR - VENT THROUGH ROOF

WTR - WATER
W - WASTE
WHA - WATER HAMMER ARRESTOR
WH - WALL HYDRANT
WCO - WALL CLEANOUT
WC - WATER CLOSET
WF - WASH FOUNTAIN
WM - WASHING MACHINE
WOB - WALL OUTLET BOX
WSFU - WATER SUPPLY FIXTURE UNITS

YH - YARD HYDRANT

PLUMBING SYMBOLS

	ANGLE VALVE (AV)		FLOOR DRAIN		RISER UP (ELBOW)
	AQUASTAT		FLOOR SINK		ROOF DRAIN
	BACKFLOW PREVENTER (BFP or RPZ)		FLOW DIRECTION ARROW		SANITARY TEE
	BALANCING VALVE (BV)		FLOW SWITCH (FS)		SOLENOID VALVE (SV)
	BALL VALVE		GATE VALVE (GV)		STRAINER
	BRANCH, BOTTOM CONNECTION		GLOBE VALVE (GLV)		TEE BRANCH
	BRANCH, TOP CONNECTION		HOSE BIBB OR WALL HYDRANT	T	TEMPERATURE TRANSMITTER
	BUTTERFLY VALVE (BFV)		HUB DRAIN		THERMOMETER
	CAP ON END OF PIPE		PRESSURE GAUGE WITH VALVE (PG)		THERMOSTATIC MIXING VALVE
	CHECK VALVE (CV)	### PSI	PRESSURE-REDUCING VALVE (PRV)		UNION (SCREWED)
CO	CLEANOUT PLUG (CO)	PS	PRESSURE SWITCH (PS)	X" WCO	WALL CLEANOUT WITH SIZE (WCO)
	DOUBLE SANITARY TEE	P	PRESSURE TRANSMITTER	"A"	WATER HAMMER ARRESTER (WHA) WITH PDI SIZING
	DRAIN WITH P-TRAP		RECIRCULATION PUMP	M	WATER METER (WM)
	FLOOR/GRADE CLEANOUT (FCO/GCO)		RISER DOWN (ELBOW)		WYE & 1/8TH BEND

DESIGN CRITERIA

APPLICABLE CODES	1. 2018 INTERNATIONAL PLUMBING CODE 2. 2018 INTERNATIONAL BUILDING CODE

VIEW LOCATION LEGEND

D1	D2	D3	D4	D5	D6
C1	C2	C3	C4	C5	C6
B1	B2	B3	B4	B5	B6
A1	A2	A3	A4	A5	A6

GENERAL SYMBOLS

#	REVISION CLOUD WITH TAG	S 123.00'	INVERT ELEVATION
# ####'	VIEW CALLOUT (ENLARGED PLANS)		ELEVATION MARKER
# ####'	SECTION VIEW		POINT OF CONNECTION (POC)
- ---	STACK REFERENCE		POINT OF DISCONNECTION
# ####'	VIEW REFERENCE (DETAIL TAGS)	#	PLAN KEYED NOTE
	ISOMETRIC TAG	TAG TAG	PIPE TAG
	PIPING, EQUIPMENT, DEVICES, ETC. TO BE DEMOLISHED		
	EXISTING PIPING OR EQUIPMENT TO REMAIN		
	NEW PIPING OR EQUIPMENT		

PLUMBING SYSTEM ABBREVIATIONS

DCW	DOMESTIC COLD WATER	V	SANITARY VENT
		SAN	SANITARY SEWER

PLUMBING SHEET INDEX

PLUMBING GENERAL NOTES

1. REFERENCE THE SPECIFICATIONS FOR MATERIAL AND EQUIPMENT INSTALLATION STANDARDS.
2. VERIFY ALL MEASUREMENTS, PIPE SIZES, PIPE LOCATIONS, ELEVATIONS, ETC. AT SITES.
3. THE PLUMBING INSTALLATION SHALL COMPLY WITH ALL STATE AND LOCAL CODES.
4. UTILITIES AND SERVICES INDICATED ARE TAKEN FROM VARIOUS OLD AND NEW SURVEYS, AS-BUILT RECORDS AND FIELD INVESTIGATIONS. UNFORESEEN CONDITIONS MAY EXIST AND NEW WORK MAY NOT BE FIELD LOCATED EXACTLY AS SHOWN ON DRAWINGS. COOPERATION WITH OTHER TRADES IN ROUTING AND BURIAL DEPTHS, AS DETERMINED DURING CONSTRUCTION, WILL BE NECESSARY.
5. DRAWINGS OF ALL OTHER TRADES SHALL BE REVIEWED. COORDINATE THE INSTALLATION AND SCHEDULING OF THE WORK WITH OTHER TRADES TO PREVENT INTERFERENCE WITH THEIR RESPECTIVE INSTALLATION.
6. FIELD VERIFY EXISTING INSTALLATIONS. MODIFY EXISTING PLUMBING SYSTEMS, WHICH ARE TO REMAIN ACTIVE, TO FACILITATE RECONNECTION AND EXTENSION OF THE NEW WORK.
7. NOTIFY OWNER AT LEAST 24 HOURS PRIOR TO INTERRUPTING EXISTING SERVICE. SCHEDULE DISCONNECTION AND TIE-INS TO MINIMIZE DISRUPTION OF SERVICES. SERVICES ARE NOT TO BE LEFT DISRUPTED DURING NON-NORMAL CONTRACTOR WORKING HOURS.
8. PIPE ROUTING SHOWN IS DIAGRAMMATIC AND IS NOT INTENDED TO INDICATE EXACT ROUTING. CONTRACTOR SHALL PROVIDE ANY ADDITIONAL OFFSETS AND FITTINGS REQUIRED FOR PROPER INSTALLATION AND TO MAINTAIN CLEARANCES. VERIFY STRUCTURAL, MECHANICAL AND ELECTRICAL INSTALLATIONS AND OTHER POTENTIAL OBSTRUCTIONS AND ROUTE PIPING TO AVOID INTERFERENCES.
9. PROVIDE ALL OFFSETS AND FITTINGS AND MAKE CONNECTION TO SITE UTILITIES.
10. CONFLICT BETWEEN DRAWINGS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO BID OPENING. THE ENGINEER RESERVES THE RIGHT TO FINAL DECISION.
11. CONCEAL PIPING ABOVE CEILINGS, WITHIN WALLS OR CHASES EXCEPT IN MECHANICAL ROOMS OR AS SPECIFICALLY NOTED.
12. PROVIDE ACCESS PANELS FOR ALL VALVES CONCEALED IN WALLS OR ABOVE NON-ACCESSIBLE CEILINGS.
13. SLEEVE AND/OR FIRESTOP ALL PENETRATIONS THROUGH RATED WALLS, CEILINGS, AND FLOORS WITH U/L LISTED ASSEMBLIES. FIRESTOP ASSEMBLIES SHALL BE EQUAL TO OR EXCEED THE RATING OF THE WALL, CEILING OR FLOOR. SEE ARCHITECTURAL DRAWINGS FOR FINAL FINISHES.
14. FLASH AND COUNTER-FLASH ROOF PENETRATIONS.
15. PROVIDE FOUNDATION PAD PENETRATION SLEEVES. ALLOW 1" MINIMUM CLEARANCE BETWEEN SLEEVE INSIDE SURFACE AND PIPE EXTERIOR.
16. SEE ARCHITECTURAL DRAWINGS FOR FIXTURE LOCATIONS AND MOUNTING HEIGHTS.
17. PROVIDE AN AIR GAP, WHEN REQUIRED BY CODE, SERVING INDIVIDUAL FIXTURES, DEVICES, APPLIANCES AND APPARATUS.
18. PROVIDE CLEANOUTS IN ACCORDANCE WITH ALL STATE AND LOCAL CODES. INSTALL CLEANOUTS WITH COVER FLUSH TO FINISH SURFACE.
19. COORDINATE EXACT FLOOR DRAIN LOCATIONS WITH ARCHITECTURAL DRAWINGS. SET FLOOR DRAINS BELOW FINISHED FLOOR TO ALLOW FOR FLOOR SLOPING TO THE DRAIN.
20. IT IS THE INTENT OF THESE DRAWINGS THAT A COMPLETE WORKING SYSTEM PROPERLY TESTED, WILL BE OPERATIONAL UPON COMPLETION OF INSTALLATION.
21. COORDINATE PIPING WITH ALL ELECTRICAL EQUIPMENT (PANELS, TRANSFORMERS, ETC.) PRIOR TO ANY INSTALLATION. DO NOT ROUTE ANY PIPING OVER ANY ELECTRICAL PANELS UNDER ANY CIRCUMSTANCES. ANY PIPING RUN OVER PANELS SHALL BE RE-ROUTED AT NO ADDITIONAL COST.
22. PROVIDE SANITARY WASTE, VENT, DOMESTIC WATER, ETC. ROUGH-IN AND MAKE FINAL CONNECTIONS (TO INCLUDE PROVIDING ALL NECESSARY RELATED STOPS, VALVES, TRAPS, ETC. AND MAKE READY FOR USE) TO ALL EQUIPMENT, WHETHER FURNISHED BY THIS CONTRACTOR OR FURNISHED BY OTHERS.
23. UNLESS NOTED OTHERWISE, ALL PIPING 3" AND LARGER SHALL BE INSTALLED AT A SLOPE OF 1/8" PER FOOT AND PIPING 2" AND SMALLER AT 1/4" PER FOOT.
24. PLUMBING CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CUTTING AND PATCHING OF HOLES AND OPENINGS IN EXISTING WALLS AND FLOORS.

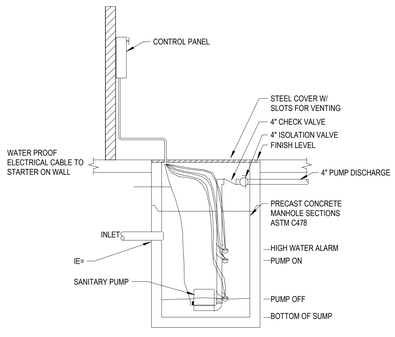
DRAIN AND CLEANOUT SCHEDULE

NOTES:
1. 6"HUB DRAIN RIM TO BE A MINIMUM OF 6" ABOVE FINISHED FLOOR.

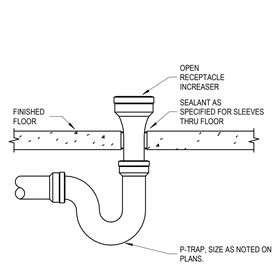
TAG	MANUFACTURER	MODEL NO.	BODY MATERIAL	STRAINER		OUTLET SIZE (IN)	DESCRIPTION	NOTES
				SIZE (IN)	FINISH			
FD-1	ZURN	Z415-B	CAST IRON	5	NICKEL BRONZE	3"	ROUND FLOOR DRAIN	
HD-1	ZURN	Z1870	STAINLESS STEEL	N/A	---	4"	ROUND HUB DRAIN	1

SUMP PUMP SCHEDULE

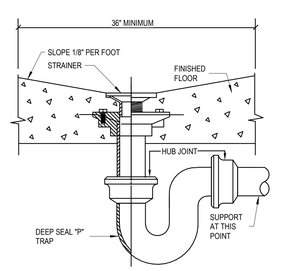
TAG	MANUFACTURER	MODEL	BASIN SIZE	TYPE	GPM	HP	HEAD (FEET)	ELECTRICAL REQUIREMENTS				COMMENTS
								AMPS	VOLTAGE	PHASE	HERTZ	
SP-1	ZOELLER	M161	36" X 36" X 72"	SIMPLEX SUMP PUMP	94	1/2	10	15	120	1	60	



A4 SANITARY SUMP PUMP (INDOOR-CONCRETE)



A5 HUB DRAIN DETAIL



A6 FLOOR DRAIN DETAIL

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II
550 GARLAND DR, NORTHGLENN, CO

3/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

PLUMBING SYMBOLS, SCHEDULES, DETAILS, & ABBREVIATIONS

P-001

SHEET KEYNOTES

01 SANITARY PIPE TO CONNECT TO EXISTING SANITARY SERVICE INSIDE OF BUILDING. LOCATION OF EXISTING SANITARY PIPE TO BE FIELD VERIFIED.

06 1-1/2" VENT TO RUN UP WALL AND CONNECT VENT INTO EXISTING VENT THROUGH ROOF.

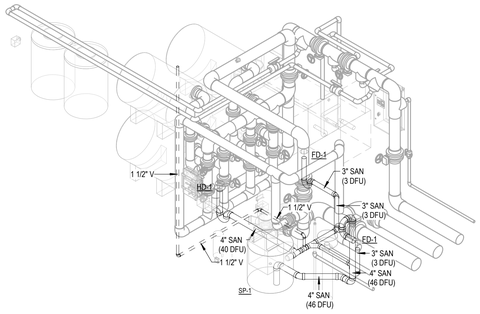
07 EXISTING SUMP PUMP TO BE CUT OUT AND REMOVED. NEW SUMP PUMP TO BE INSTALLED IN SIMILAR LOCATION.

GENERAL SHEET NOTES

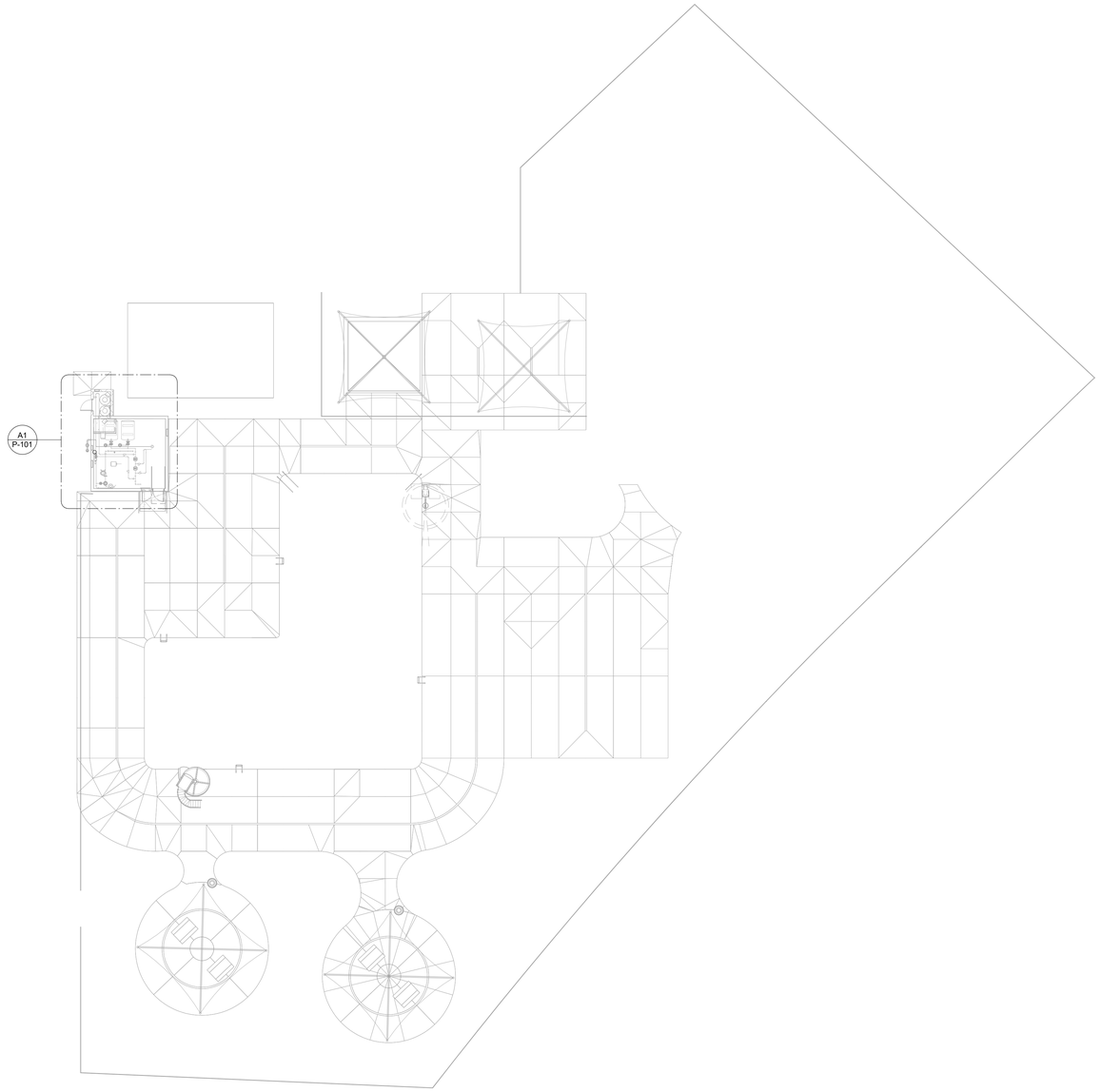
BID ALTERNATE 1:
IN LIEU OF 6" HUB DRAIN HD-1, PROVIDE 12" HUB DRAIN OPENING NEAR POOL FILTERS. TOP OF HUB DRAIN OPENING SHALL BE 1" ABOVE TANK FFE.

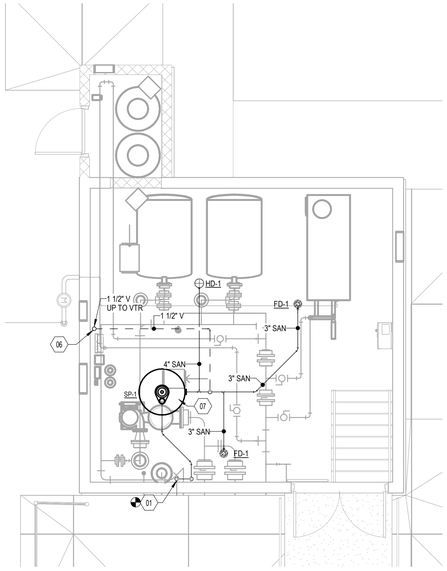
EXISTING PROJECT CONDITIONS

INFORMATION PERTAINING TO EXISTING PROJECT CONDITIONS, SUCH AS LOCATIONS OF ARCHITECTURAL AND STRUCTURAL BUILDING COMPONENTS, MECHANICAL AND ELECTRICAL EQUIPMENT, PIPING, DUCTWORK, ROUGH-INS AND OTHER MISCELLANEOUS CONSTRUCTION, APPEARS ON PROJECT DRAWINGS. THIS INFORMATION IS BASED ON AVAILABLE RECORDS AS WELL AS INFORMATION COLLECTED WITH REASONABLE CARE AT THE PROJECT SITE. CONTRACTORS SHALL BE SOLELY RESPONSIBLE FOR VERIFYING DIMENSIONS AND RELATED INFORMATION AT THE PROJECT SITE PRIOR TO PROCURING ANY MATERIALS, PRODUCTS OR EQUIPMENT TO PERFORM THEIR WORK.



C1 PLUMBING ISOMETRIC - SANITARY & VENT





A1 MECHANICAL BUILDING PLUMBING PLAN - SANITARY & VENT
1/4" = 1'-0"

A3 OVERALL PLUMBING PLAN - SANITARY & VENT
1/16" = 1'-0"

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

PLUMBING PLAN - SANITARY & VENT

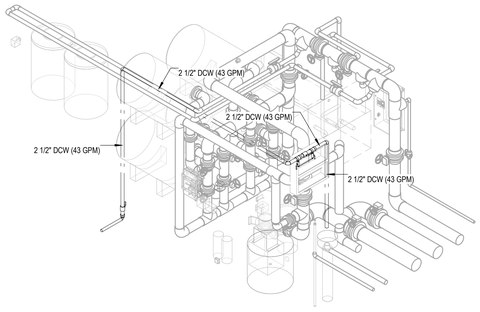
P-101

SHEET KEYNOTES

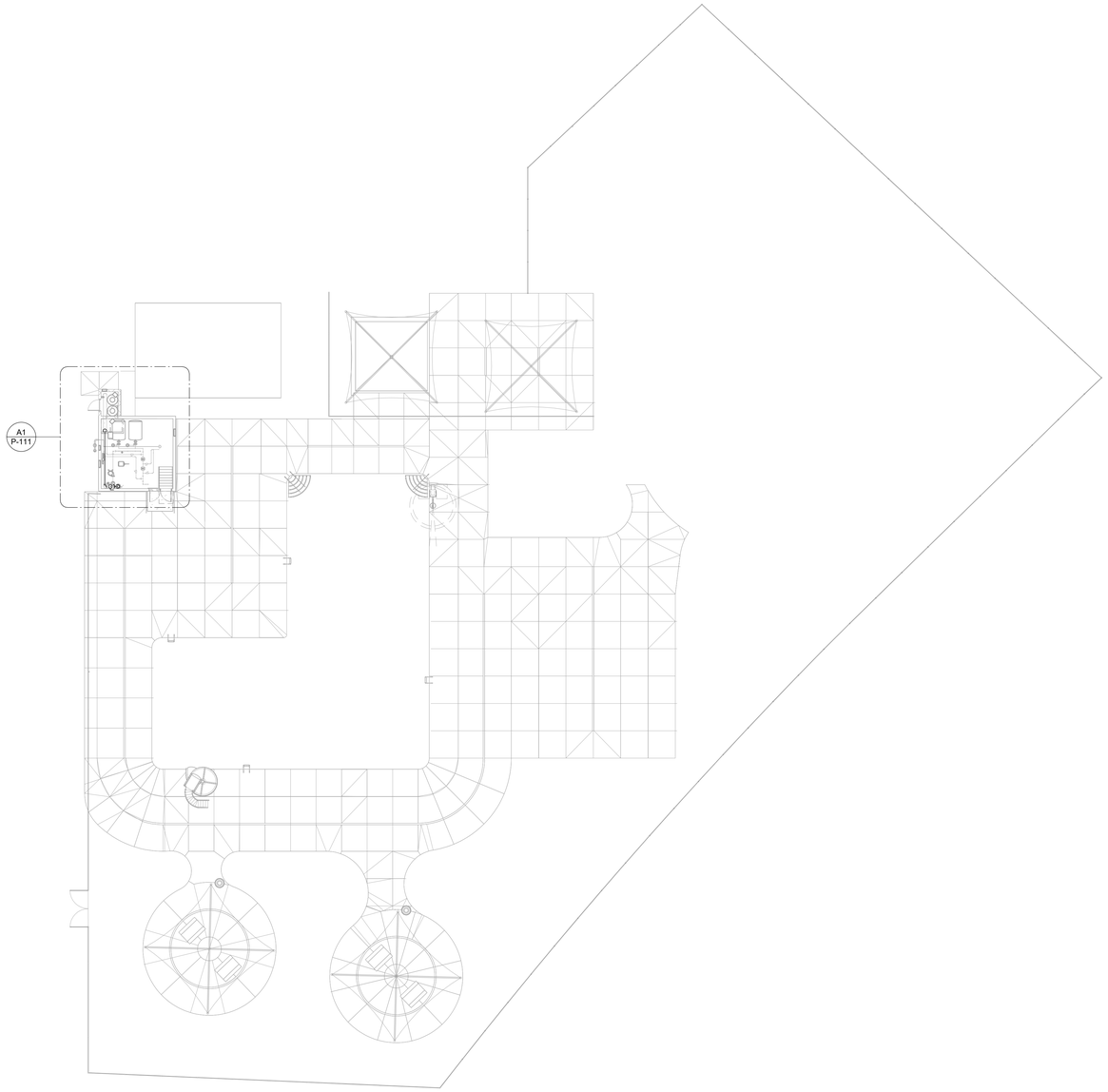
02 DCW PIPE TO CONNECT TO EXISTING 2" DCW SERVICE INSIDE OF BUILDING. PROVIDE ISOLATION VALVE NEAR CONNECTION.
03 DCW TO BE CONNECTED TO AUTOFILL VALVE. PROVIDE WATER HAMMER ARRESTOR.
04 DCW DROP TO TERMINATE ABOVE STANDPIPIE AND PROVIDE 6" AIR GAP.
05 PROVIDE AUTOFILL VALVING. SEE AUTOFILL/WATER LEVEL CONTROL DETAIL ON PL PLANS.

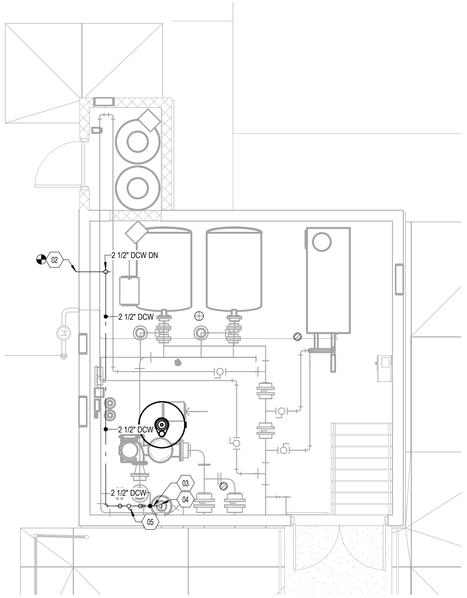
EXISTING PROJECT CONDITIONS

INFORMATION PERTAINING TO EXISTING PROJECT CONDITIONS, SUCH AS LOCATIONS OF ARCHITECTURAL AND ISTRUCTURAL BUILDING COMPONENTS, MECHANICAL AND ELECTRICAL EQUIPMENT, PIPING, DUCTWORK, ROUGH-INS AND OTHER MISCELLANEOUS CONSTRUCTION, APPEARS ON PROJECT DRAWINGS. THIS INFORMATION IS BASED ON AVAILABLE RECORDS AS WELL AS INFORMATION COLLECTED WITH REASONABLE CARE AT THE PROJECT SITE. CONTRACTORS SHALL BE SOLELY RESPONSIBLE FOR VERIFYING DIMENSIONS AND RELATED INFORMATION AT THE PROJECT SITE PRIOR TO PROCURING ANY MATERIALS, PRODUCTS OR EQUIPMENT TO PERFORM THEIR WORK.



C1 PLUMBING ISOMETRIC - DOMESTIC WATER





A1 MECHANICAL BUILDING PLUMBING PLAN - DOMESTIC WATER

N

A3 OVERALL PLUMBING PLAN - DOMESTIC WATER
1/16" = 1'-0"

N

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO

3/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

PLUMBING PLAN - DOMESTIC WATER

P-111

MECHANICAL SYMBOLS AND ABBREVIATIONS

NOTE: NOT ALL SYMBOLS AND ABBREVIATIONS INDICATED HERE ARE USED IN THE DRAWINGS AND MAY NOT APPLY TO THIS PROJECT. ADDITIONAL SYMBOLS MAY BE INDICATED IN THE DRAWINGS.

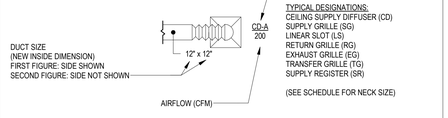
MECHANICAL ABBREVIATIONS

AC	-	AIR CONDITIONING UNIT/AIR COMPRESSOR	LAT	-	LEAVING AIR TEMPERATURE
ACC	-	AIR COOLED CONDENSER	LB/HR	-	POUNDS PER HOUR
ACCU	-	AIR COOLED CONDENSING UNIT	LF	-	LINEAR FEET
ACU	-	AIR CONDITIONING UNIT	LP	-	LOUVERED PENTHOUSE
AD	-	ACCESS DOOR	LTG	-	LIGHTING
ADJ	-	ADJUSTABLE	LWT	-	LEAVING WATER TEMPERATURE
AFF	-	ABOVE FINISHED FLOOR			
AHU	-	AIR HANDLING UNIT	MAU	-	MAKE-UP AIR UNIT
AL	-	ALUMINUM	MAX	-	MAXIMUM
ALT	-	ALTERNATE	MBH	-	THOUSANDS OF BTU PER HOUR
AMD	-	AIR MIXING DEVICE	MC	-	MECHANICAL CONTRACTOR
AP	-	ACCESS PANEL	MCA	-	MINIMUM CIRCUIT AMPACITY
APD	-	AIR PRESSURE DROP	MCC	-	MOTOR CONTROL CENTER
APPROX	-	APPROXIMATE	MCC	-	MOTOR CONTROL CENTER
ARCH	-	ARCHITECTURAL	MEP	-	MECHANICAL, ELECTRICAL AND PLUMBING
ARU	-	AIR ROTATION UNIT	MER	-	MECHANICAL EQUIPMENT ROOM
AS	-	AIR SEPARATOR	MEZZ	-	MEZZANINE
AT	-	AIR TERMINAL DEVICE	MFR	-	MANUFACTURER
AVG	-	AVERAGE	MIN.	-	MINIMUM
			MISC.	-	MISCELLANEOUS
			MOD	-	MOTOR OPERATED DAMPER
B	-	BOILER			
BAS	-	BUILDING AUTOMATION SYSTEM			
BBS	-	BOILER BLOWDOWN SEPARATOR	NA	-	NOT APPLICABLE
BC	-	BOOSTER COIL	NC	-	NORMALLY CLOSED
BFS	-	BOILER FEEDWATER SYSTEM	NIC	-	NOT IN CONTRACT
BOB	-	BOTTOM OF BEAM	NO	-	NORMALLY OPEN
BOD	-	BOTTOM OF DUCT	NPS	-	NOMINAL PIPE SIZE
BOP	-	BOTTOM OF PIPE	NPSH	-	NET POSITIVE SUCTION HEAD
BTU	-	BRITISH THERMAL UNITS	NPT	-	NATIONAL PIPE THREAD
BTUH	-	BRITISH THERMAL UNITS PER HOUR	NR	-	NEAR
			NTS	-	NOT TO SCALE
C	-	CONVECTOR			
CAV	-	CONSTANT AIR VOLUME	OC	-	ON CENTER
CC	-	COOLING COIL	OED	-	OPEN END DUCT
CFH	-	CUBIC FEET PER HOUR	OLP	-	OVERLOAD PROTECTION
CFM	-	CUBIC FEET PER MINUTE	OV	-	OUTLET VELOCITY
CH	-	CHILLER			
CL	-	CENTERLINE	P	-	PUMP
CLG	-	CEILING	PC	-	PLUMBING CONTRACTOR
COND	-	CONDENSATE	PCF	-	POUNDS PER CUBIC FOOT
CONTR	-	CONTRACTOR	PD	-	PRESSURE DROP
COP	-	COEFFICIENT OF PERFORMANCE	PH	-	PHASE
CP	-	CONDENSATE PUMP	PLBG	-	PLUMBING
CRU	-	CONDENSATE RETURN UNIT	POC	-	POINT OF CONNECTION
CT	-	COOLING TOWER	PPH	-	POUNDS PER HOUR
CU	-	COPPER	PRV	-	PRESSURE RELIEF VALVE
CUH	-	CABINET UNIT HEATER	PSF	-	POUNDS PER SQUARE FOOT
			PSI	-	POUNDS PER SQUARE INCH
DAP	-	DUCT ACCESS PANEL	PSIA	-	POUNDS PER SQUARE INCH ABSOLUTE
DB	-	DRY BULB	PSIG	-	POUNDS PER SQUARE INCH GAUGE
DC	-	DUST COLLECTOR	PVC	-	POLYVINYL CHLORIDE
DDC	-	DIRECT DIGITAL CONTROL			
DEG	-	DEGREES	RAHU	-	ROOFTOP AIR HANDLING UNIT
DH	-	DEHUMIDIFIER	RCP	-	RADIANT CEILING PANEL
DIA	-	DIAMETER	REF	-	ROOF EXHAUST FAN
DIM	-	DIMENSION	REQD	-	REQUIRED
DN	-	DOWN	RF	-	ROOF
DWG	-	DRAWING	RF	-	RELIEF FAN
DX	-	DIRECT EXPANSION	RH	-	RELIEF HOOD
			RH	-	RELATIVE HUMIDITY
EAT	-	ENTERING AIR TEMPERATURE	RPM	-	REVOLUTIONS PER MINUTE
EBB	-	ELECTRIC BASEBOARD	RTU	-	ROOFTOP UNIT
EC	-	ELECTRICAL CONTRACTOR	RV	-	ROOF VENTILATOR
EDR	-	EQUIVALENT DIRECT RADIATION			
EF	-	EXHAUST FAN			
EFF	-	EFFICIENCY	S/S	-	STAINLESS STEEL
EH	-	EXHAUST HOOD	SA	-	SOUND ATTENUATOR
EJ	-	EXPANSION JOINT	SCH	-	SCHEDULE
ELEC	-	ELECTRICAL	SF	-	SUPPLY FAN
ELEV	-	ELEVATOR	SHT	-	SHEET
EM	-	EMERGENCY	SMD	-	SMOKE MOTORIZED DAMPER
ESP	-	EXTERNAL STATIC PRESSURE	SP	-	STATIC PRESSURE
ET	-	EXPANSION TANK	SPEC	-	SPECIFICATION
ETR	-	EXISTING TO REMAIN	SQ	-	SQUARE
EUH	-	ELECTRIC UNIT HEATER	STD	-	STANDARD
EWT	-	ENTERING WATER TEMPERATURE	STRUCT	-	STRUCTURAL
EXH	-	EXHAUST			
EXIST	-	EXISTING	T	-	TANK
EXP	-	EXPANSION	T STAT	-	THERMOSTAT
			T&P	-	TEMPERATURE AND PRESSURE
			TBR	-	TO BE REMOVED
F	-	FAHRENHEIT	TC	-	TEMPERATURE CONTROL
F	-	FILTER	TEMP	-	TEMPERATURE
F&T	-	FLOAT AND THERMOSTATIC	TOB	-	TOP OF BEAM
FC	-	FORWARD CURVED	TOD	-	TOP OF DUCT
FCU	-	FAN COIL UNIT	TOP	-	TOP OF PIPE
FD	-	FLOOR DRAIN	TOS	-	TOP OF SLAB
FLA	-	FULL LOAD AMPS	TSP	-	TOTAL STATIC PRESSURE
FLR	-	FLOOR	TXV	-	THERMAL EXPANSION VALVE
FM	-	FACTORY MUTUAL	TYP	-	TYPICAL
FOP	-	FUEL OIL PUMP			
FOT	-	FUEL OIL TANK			
FPD	-	FLUID PRESSURE DROP	UC	-	UNDERCUT DOOR
FPI	-	FINS PER INCH	UH	-	UNIT HEATER
FPM	-	FEET PER MINUTE	UNO	-	UNLESS OTHERWISE NOTED
FPS	-	FEET PER SECOND	UST	-	UNDERGROUND STORAGE TANK
FT	-	FEET	UV	-	UNIT VENTILATOR
FTG	-	FOOTING			
FTR	-	FIN TUBE RADIATION	V	-	VOLTS
			V	-	VALVE
GA	-	GAUGE	VA	-	VALVE
GAL	-	GALLON	VAV	-	VARIABLE AIR VOLUME
GALV	-	GALVANIZED	VEL	-	VELOCITY
GBD	-	GRAVITY BACKDRAFT DAMPER	VF	-	VENTILATION FAN
GC	-	GENERAL CONTRACTOR	VFD	-	VARIABLE FREQUENCY DRIVE
GF	-	GAS FURNACE	VP	-	VELOCITY PRESSURE
GPH	-	GALLONS PER HOUR	VP	-	VACUUM PUMP
GPM	-	GALLONS PER MINUTE	VTR	-	VENT THRU ROOF
GV	-	GRAVITY VENTILATOR			
H	-	HUMIDIFIER	W/	-	WITH
HC	-	HEATING COIL	W/O	-	WITHOUT
HP	-	HEAT PUMP	WB	-	WET BULB
HP	-	HORSEPOWER	WC	-	WATER COLUMN
HRC	-	HEAT RECOVERY COIL	WG	-	WATER GAUGE
HRD	-	HEAT RECLAIM DEVICE			
HX	-	HEAT EXCHANGER	X	-	EXISTING
IAH	-	INTAKE AIR HOOD			
ID	-	INSIDE DIAMETER			
IE	-	INVERT ELEVATION			
IF	-	INLINE FAN			
IFH	-	INFRARED HEATER			
IN	-	INCHES			

MECHANICAL SYSTEM ABBREVIATIONS

PIPING SYSTEMS			DUCT SYSTEMS		
CA	-	COMPRESSED AIR	EA	-	EXHAUST AIR
CWS	-	CONDENSER WATER SUPPLY	OA	-	OUTSIDE AIR
CWR	-	CONDENSER WATER RETURN	RA	-	RETURN AIR
CHWS	-	CHILLED WATER SUPPLY	SA	-	SUPPLY AIR
CHWR	-	CHILLED WATER RETURN	TA	-	TRANSFER AIR
D	-	DRAIN LINE			
PW	-	POTABLE WATER			
FOF	-	FUEL OIL FILL			
FOS	-	FUEL OIL SUPPLY			
FOR	-	FUEL OIL RETURN			
FOV	-	FUEL OIL VENT			
HPS	-	HEAT PUMP WATER SUPPLY			
HPR	-	HEAT PUMP WATER RETURN			
HWS	-	HOT WATER SUPPLY			
HWR	-	HOT WATER RETURN			
HPS	-	HIGH PRESSURE STEAM			
HPC	-	HIGH PRESSURE STEAM CONDENSATE			
HS	-	HYDRONIC SUPPLY (DUAL TEMPERATURE SYSTEM)			
HR	-	HYDRONIC RETURN (DUAL TEMPERATURE SYSTEM)			
LPS	-	LOW PRESSURE STEAM			
LPC	-	LOW PRESSURE STEAM CONDENSATE			
NG	-	NATURAL GAS			
NPW	-	NON-POTABLE WATER			
PC	-	PUMPED CONDENSATE			
RHG	-	REFRIGERANT HOT GAS			
RL	-	REFRIGERANT LIQUID			
RS	-	REFRIGERANT SUCTION			
V	-	VENT LINE			
(X) ABBV	-	EXISTING SYSTEM			

GRILLE, REGISTER, AND DIFFUSER NOTATION



	- RECTANGULAR SUPPLY GRILLE, REGISTER, OR DIFFUSER (HORIZONTAL MOUNT)		- SUPPLY GRILLE, REGISTER, OR DIFFUSER (VERTICAL MOUNT)
	- ROUND SUPPLY GRILLE, REGISTER, OR DIFFUSER (HORIZONTAL MOUNT)		- RETURN OR EXHAUST GRILLE OR REGISTER (VERTICAL MOUNT)
	- RECTANGULAR RETURN GRILLE OR REGISTER (HORIZONTAL MOUNT)	DG	- DOOR TRANSFER GRILLE
	- RECTANGULAR EXHAUST GRILLE OR REGISTER (HORIZONTAL MOUNT)	UC	- UNDERCUT DOOR

MECHANICAL DUCTWORK SPECIALTIES

	- MANUAL VOLUME DAMPER	F/S	- COMBINATION FIRE/SMOKE DAMPER
M	- MOTORIZED DAMPER		- DUCT ACCESS DOOR
B	- BACKDRAFT DAMPER		- FLEX DUCT (DOUBLE & SINGLE LINE)
FD	- FIRE DAMPER		- IN-DUCT HEATING / COOLING COIL
	- SMOKE DAMPER		- LINED DUCTWORK

GENERAL SYMBOLS

4	- REVISION CLOUND WITH TAG
# ###	- VIEW CALLOUT
# ###	- SECTION VIEW
DETAIL / PAGE #	- VIEW REFERENCE
	- ELEVATION MARKER
	- POINT OF CONNECTION
	- POINT OF DISCONNECTION
# #	- KEYED NOTE - HEXAGON = NEW CONSTRUCTION - CIRCLE = DEMOLITION
VAV-1	- MECHANICAL EQUIPMENT TAG
TAG TAG	- PIPE OR DUCT TAG
	- PIPING, DUCTWORK, EQUIPMENT, DEVICES, ETC. TO BE DEMOLISHED - EXISTING PIPING, DUCTWORK, OR EQUIPMENT TO REMAIN - NEW PIPING, DUCTWORK, OR EQUIPMENT
	- BREAK LINE
	- AIRFLOW DIRECTION ARROW
	- FLOW DIRECTION ARROW

DUCTWORK FITTINGS & SYMBOLS

	RECTANGULAR / ROUND BRANCH TAKEOFF	
	TEE (FOR LOW PRESSURE SUPPLY AIR DUCTWORK ONLY)	
	ECCENTRIC TRANSITION	
	CONCENTRIC TRANSITION	
	SUPPLY AIR OR OUTSIDE AIR RISE	
	SUPPLY AIR OR OUTSIDE AIR DROP	
	RETURN AIR RISE	
	RETURN AIR DROP	
	EXHAUST AIR RISE	
	EXHAUST AIR DROP	
	RADIUS ELBOW	
	SQUARE ELBOW	
	DUCT CROSSING	
	DUCT SLOPE IN DIRECTION OF RISE	

MECHANICAL PIPING FITTINGS, VALVES, AND SPECIALTIES

	- BALANCING VALVE		- PIPE ELBOW DOWN
	- BALL VALVE		- PIPE ELBOW UP
	- BUTTERFLY VALVE		- PIPE TEE DOWN
	- BUTTERFLY VALVE WITH ACTUATOR		- PIPE TEE UP
	- CHECK VALVE		- PIPE UNION
	- DRAIN VALVE WITH CAPPED END	AV	- AUTOMATIC AIR VENT
	- GATE VALVE	HAV	- MANUAL AIR VENT
	- GLOBE VALVE		- BALL JOINT
	- ISOLATION (SHUTOFF) VALVE	EJ	- EXPANSION JOINT
	- PIPE STRAINER		- FLEX CONNECTION
### PSI	- PRESSURE REDUCING VALVE	FM	- FLOW METER
### PSI	- PRESSURE RELIEF VALVE	FS	- FLOW SWITCH
	- PUMP		- PETES PLUG
	- TRIPLE DUTY VALVE		- PRESSURE GAUGE
	- 2-WAY CONTROL VALVE	PS	- PRESSURE SWITCH
	- 3-WAY CONTROL VALVE	XX	- STEAM TRAP (XX) IB = INVERTED BUCKET T = THERMOSTATIC T&B = FLOAT AND THERMOSTATIC
	- CAPPED PIPE		- THERMOMETER
F	- FLOW SENSOR	T	- TEMPERATURE SENSOR

MECHANICAL CONTROLS

T ##-###	- SPACE THERMOSTAT/TEMPERATURE SENSOR WITH ASSOCIATED EQUIPMENT TAG	CO	- CARBON MONOXIDE SENSOR
H	- SPACE HUMIDISTAT	CO_2	- CARBON DIOXIDE SENSOR
P	- PRESSURE SENSOR	NO_2	- NITROGEN DIOXIDE SENSOR
SD	- DUCT SMOKE DETECTOR		
S	- SPEED SWITCH		
S	- STARTER		

VIEW ORGANIZATION

D1	D2	D3	D4	D5	D6
C1	C2	C3	C4	C5	C6
B1	B2	B3	B4	B5	B6
A1	A2	A3	A4	A5	A6

MECHANICAL SHEET INDEX

GENERAL PROJECT NOTES

1. ALL WORK SHALL COMPLY WITH THE INTERNATIONAL BUILDING CODE 2018, INTERNATIONAL MECHANICAL CODE 2018 AND ALL APPLICABLE STANDARDS.
2. DIMENSIONS SHALL BE FIELD-VERIFIED AND COORDINATED PRIOR TO PROCUREMENT OR FABRICATION. COORDINATE THE WORK WITH OTHER TRADES INVOLVED. FIELD MODIFICATIONS SUCH AS OFFSETS IN PIPING OR DUCTWORK (INCLUDING DIVIDED DUCTWORK) NEEDED DUE TO OBSTRUCTIONS OR INTERFERENCES SHALL BE PROVIDED AT NO ADDITIONAL COST. FOR PROJECTS INVOLVING RENOVATION, COORDINATE NEW WORK WITH EXISTING ELEMENTS SUCH AS THE BUILDING STRUCTURE AND ARCHITECTURAL FEATURES, SPRINKLER PIPING, LIGHTS, PLUMBING, AND ELECTRICAL CONDUIT.
3. DRAWINGS ARE DIAGRAMMATIC IN NATURE. COORDINATE EXACT LOCATION OF ALL CEILING MOUNTED EQUIPMENT SO ALL SERVICEABLE COMPONENTS CAN BE EASILY ACCESSED BY REMOVING CEILING TILES ONLY. REMOVAL OR RELOCATION OF LIGHTING FIXTURES FOR SERVICE ACCESS IS NOT ACCEPTABLE. THE CONTRACTOR SHALL RE-INSTALL EQUIPMENT THAT HAS INADEQUATE OR UNSAFE ACCESSIBILITY. PROVIDE ALL TRANSITIONS, TURNING VANES, ELBOWS, FITTINGS, ETC., TO ALLOW SMOOTH FLOWS. ALL SPLIT DUCT FITTINGS SHALL TRANSITION TO FULL SIZE OF THE SUM OF BOTH BRANCHES, UPSTREAM OF SPLIT. REFER TO TYPICAL DETAILS FOR PIPING AND INSTALLATION OF EQUIPMENT.
4. PRIOR TO BID, COORDINATE ALL MECHANICAL WORK WITH ELECTRICAL WORK AND OTHER TRADES. SEE SPECIFICATIONS FOR REQUIREMENTS.
5. GENERAL CONTRACTOR IS RESPONSIBLE TO HAVE QUALIFIED SUBCONTRACTORS PERFORMING ALL WORK. CONTRACTORS AND FOREMEN PERFORMING WORK UNDER THIS DIVISION SHALL MEET THE SPECIFIED MINIMUM QUALIFICATIONS AND LICENSE REQUIREMENTS. QUALIFICATIONS SHALL BE SUBMITTED FOR REVIEW BY A/E PRIOR TO SHOP DRAWING PHASE AND PRIOR TO ANY WORK BEING PERFORMED BY CONTRACTOR. NO PAYMENTS WILL BE AUTHORIZED BY ENGINEER FOR WORK PERFORMED BY SUBCONTRACTING FIRMS OR FOREMEN THAT DO NOT MEET THE MINIMUM QUALIFICATIONS.
6. WHERE CROWDED LOCATIONS EXIST OR WHERE THERE IS A POSSIBILITY OF CONFLICT BETWEEN TRADES, CONTRACTOR SHALL PREPARE COMPOSITE DRAWINGS SHOWING THE EXACT LOCATION OF PIPES, DUCTS, CONDUIT AND EQUIPMENT. DRAWINGS SHALL BE BASED ON FIELD MEASUREMENTS AND, AFTER CONSULTATION AND AGREEMENT BETWEEN THE TRADES, SHALL BE APPROVED BY THE ARCHITECT/ENGINEER BEFORE INSTALLATION OF THE WORK.
7. MECHANICAL CONTRACTOR SHALL COORDINATE WITH ENGINEER AND GENERAL CONTRACTOR ON REQUIREMENTS FOR STRUCTURAL SUPPORT AND FRAMING FOR ALL MECHANICAL EQUIPMENT AND SYSTEMS. GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND VERIFYING STRUCTURAL SUPPORT AND FRAMING.
8. MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF EXISTING CONDITIONS AND COORDINATION WITH ALL OTHER TRADES, INCLUDING BUT NOT LIMITED TO STRUCTURAL, LIGHTING, ELECTRICAL, PLUMBING, AND OTHER EXISTING AND NEW WORK. VERIFY ALL EXISTING CONDITIONS IN FIELD PRIOR TO PURCHASING EQUIPMENT. ALL DISCREPANCIES OR POTENTIAL PROBLEMS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO BIDDING. PROVIDE ADDITIONAL MATERIALS AND LABOR TO RELOCATE OR REPLACE MECHANICAL WORK AS REQUIRED TO ALLOW SPACE FOR THE WORK OF ALL TRADES.
9. THE DRAWINGS INDICATE APPROXIMATE LOCATIONS BASED UPON INFORMATION OBTAINED WITHOUT REMOVING CEILING TILES OR WALLS. THEREFORE, THE CONTRACTOR SHALL INCLUDE IN THEIR BID CONTINGENCY COSTS TO ADDRESS CONFLICTS BETWEEN DESIGN AND EXISTING CONDITIONS.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL COSTS INCURRED BY OTHER TRADES DUE TO SUBSTITUTION OF OTHER THAN SCHEDULED EQUIPMENT. WHEN EQUIPMENT FURNISHED IS DIFFERENT THAN INDICATED, THE COST OF ADDITIONAL ELECTRICAL SERVICE, STRUCTURAL RELATED WORK SHALL BE PAID BY THIS CONTRACTOR.
11. ALL SERVICES TO EXISTING BUILDINGS SHALL BE MAINTAINED DURING CONSTRUCTION UNLESS OTHERWISE INDICATED. IF NECESSARY, INTERRUPTIONS TO EXISTING SERVICES SHALL BE SCHEDULED FOR TIMES OTHER THAN NORMAL OPERATING HOURS (SUCH AS NIGHTS AND WEEKENDS). SUCH INTERRUPTIONS TO SERVICES SHALL NOT BE MADE WITHOUT THE PRIOR WRITTEN CONSENT OF THE OWNER'S REPRESENTATIVE AND PROPER COORDINATION WITH OTHER TRADES. PRE-WORK SHALL BE PERFORMED TO MAKE THE SHUTDOWN PERIOD AS BRIEF AS POSSIBLE.
12. ALL CHANGES MADE IN THE FIELD SHALL BE RECORDED ON AS-BUILT DRAWINGS, SHOP DRAWINGS, AND MAINTENANCE MANUALS. NOTIFY ENGINEER OF ANY CONFLICTS PRIOR TO PURCHASING EQUIPMENT AND PRIOR TO CUTTING OPENINGS.
13. SHOP DRAWINGS SHALL BE SUBMITTED AND REVIEWED FOR ALL MECHANICAL WORK INCLUDING, BUT NOT LIMITED TO, DUCTWORK, PIPING, EQUIPMENT, AND AIR DISTRIBUTION DEVICES PRIOR TO ANY FABRICATION OR INSTALLATION. ALL SHOP DRAWINGS SHALL BE SUBMITTED IN A FORMAT THAT IS IN STRICT ACCORDANCE WITH SPECIFICATIONS.
14. LOCATE EQUIPMENT TO ACHIEVE MANUFACTURER'S RECOMMENDED ACCESS AND CLEARANCE FOR OPERATION AND MAINTENANCE. COORDINATE EQUIPMENT LOCATIONS WITH WORK OF OTHER TRADES. DO NOT INFRINGE ON THE OPERATION AND MAINTENANCE SPACES OF EQUIPMENT INSTALLED BY OTHER TRADES. WHERE CONFLICT OCCURS, COORDINATE WITH OTHER TRADES TO LOCATE OR RELOCATE EQUIPMENT TO RESOLVE CONFLICT AND MAINTAIN REQUIRED ACCESS.
15. ALL CONNECTIONS TO EQUIPMENT SHALL BE VERIFIED WITH MANUFACTURER'S CERTIFIED DRAWINGS. TRANSITIONS TO ALL EQUIPMENT SHALL BE VERIFIED AND PROVIDED FOR EQUIPMENT FURNISHED.
16. ALL EQUIPMENT, PIPING AND VALVES SHALL HAVE SPECIFIED IDENTIFICATION LABELS AND AS INDICATED.
17. DUCT OPENING TYPES THROUGH BUILDING CONSTRUCTION SHALL BE SUITED TO PRESERVE FLOOR, WALL, OR DUCT/PIPE SYSTEM RATINGS.
18. DUCT CONSTRUCTION SHALL BE SHEET METAL AND IN ACCORDANCE WITH THE LATEST EDITION OF THE SMACNA HVAC DUCT CONSTRUCTION STANDARD. DUCT SIZES SHOWN ARE MINIMUM INSIDE CLEAR DIMENSIONS.
19. ALL SUPPLY AIR DUCT BENDS FROM THE VERTICAL TO THE HORIZONTAL AND ANGLED TURNS OF DUCTWORK SHALL BE RADIUS ELBOWS. WHERE A RADIUS ELBOW WILL NOT FIT, ELBOW SHALL HAVE TURNING VANES INSTALLED.
20. BEVELED TAKE-OFFS AND DAMPERS SHALL BE INSTALLED IN ALL BRANCH DUCTWORK LEADING FROM MAIN TRUNK LINES.
21. PROVIDE AIR TURNING VANES IN ALL 90-DEGREE RECTANGULAR DUCT ELBOWS.
22. SEE SPECIFICATIONS FOR GAUGES, THICKNESS, BRACING, REQUIREMENTS, ETC., OF DUCTWORK.
23. LOCATE THERMOSTATS, TEMPERATURE SENSORS, HUMIDISTATS, AND HUMIDITY SENSORS AT 48" ABOVE FINISHED FLOOR UNLESS NOTED OTHERWISE. COORDINATE LOCATIONS WITH OTHER EQUIPMENT, FURNITURE, AND DOOR SWINGS.
24. ALL EQUIPMENT, DUCTWORK, ETC., SHALL BE SUPPORTED AS DETAILED AND/OR SPECIFIED. PROVIDE ADDITIONAL SUPPORTS AS REQUIRED TO PROVIDE A VIBRATION-FREE, RIGID INSTALLATION.
25. ALL BARE METAL SURFACES SHALL BE PRIMED TO PREVENT ANY RUST, INCLUDING, BUT NOT LIMITED TO, ANGLE FRAMING, UNIT SUPPORTS, MOUNTING HARDWARE, ETC. DAMPERS AND INSIDES OF DUCTS VISIBLE THROUGH GRILLES, REGISTERS AND DIFFUSERS SHALL BE PAINTED FLAT BLACK.
26. ACCESS PANELS IN DUCTWORK AND CEILINGS SHALL BE PROVIDED WHERE REQUIRED FOR OPERATION, BALANCING OR MAINTENANCE OF ALL MECHANICAL EQUIPMENT. PROVIDE ACCESS PANELS AS REQUIRED FOR ALL VALVES, DAMPERS, CONTROLS, OR OTHER EQUIPMENT.
27. PROVIDE FLEXIBLE DUCT CONNECTIONS ON ALL DUCTWORK CONNECTING TO EACH FAN, AIR HANDLING UNITS, AND FAN COIL UNITS.
28. LOCATE ALL OUTSIDE AIR INTAKES A MINIMUM OF 10'-0" CLEAR FROM ALL PLUMBING VENTS AND EXHAUST AIR DISCHARGE LOCATIONS. LOWEST POINT OF EACH OUTSIDE AIR INTAKE ON ROOF SHALL BE A MINIMUM OF 24" ABOVE ROOF.
29. PIPING, DUCTWORK, LEAK PROTECTION APPARATUS, OR OTHER EQUIPMENT FOREIGN TO ELECTRICAL SWITCHBOARDS, PANELBOARDS, DISTRIBUTION BOARDS, OR MOTOR CONTROL CENTERS SHALL NOT BE INSTALLED WITHIN THE REQUIRED SPACE FOR WORKING CLEARANCES OR DEDICATED SPACES OF THE ELECTRICAL EQUIPMENT, EXTENDING IN FRONT OF AND FROM FLOOR TO STRUCTURAL CEILING WITH A WIDTH AND DEPTH OF THE ELECTRICAL EQUIPMENT IN ACCORDANCE WITH NEC-110.26.
30. GENERAL DEMOLITION NOTE: INFORMATION TAKEN FROM AVAILABLE RECORD DRAWINGS AND VISUAL FIELD OBSERVATIONS. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO COMMENCEMENT OF WORK.
31. ALL EQUIPMENT, DUCTWORK, ETC., TO BE REMOVED SHALL REMAIN PROPERTY OF THE OWNER OR DISPOSED OF LEGALLY, AS DIRECTED BY OWNER.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

MECHANICAL SYMBOLS AND ABBREVIATIONS

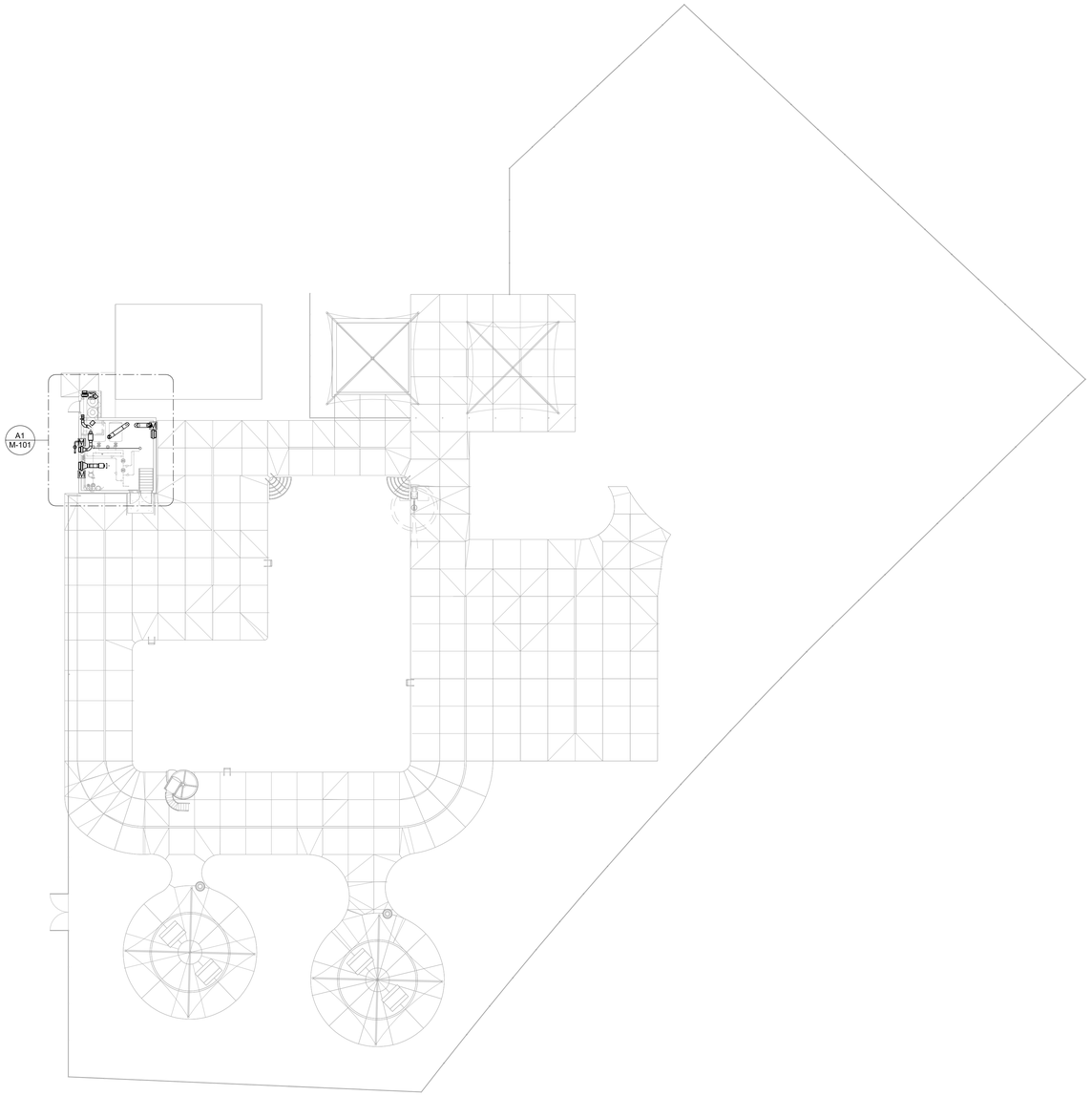
M-001

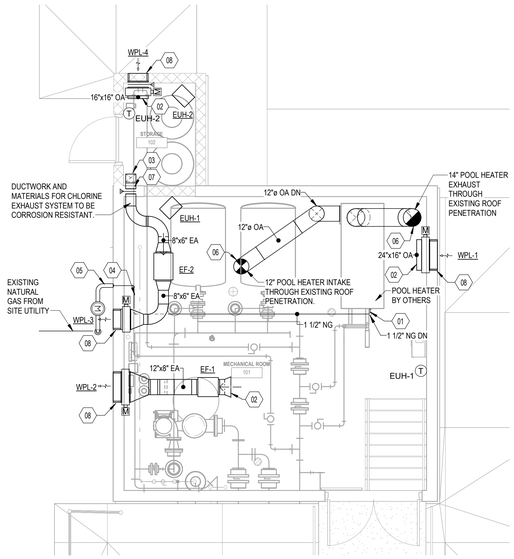
SHEET KEYNOTES

01 1-1/2" NATURAL GAS TO SERVE POOL HEATER H1A. PROVIDE GAS PRESSURE LOCK-UP REGULATOR, SHUT OFF VALVE, UNION, AND DRIP LEG PRIOR TO GAS CONNECTION TO UNIT. INSTALL REGULATOR MINIMUM 6' FROM HEATER INFLUENT, HORIZONTALLY OR VERTICALLY. COORDINATE LOCATION WITH POOL CONTRACTOR.
02 PROVIDE WITH STAINLESS STEELWIRE MESH COVER ON DUCT OPENING.
03 EXHAUST INTAKE 6" AFF. PROVIDE WITH STAINLESS STEEL WIRE MESH COVER ON DUCT OPENING.
04 PROVIDE ISOLATION VALVE INSIDE BUILDING.
05 EXISTING NATURAL GAS METER TO REMAIN. CONNECTION TO EXISTING NATURAL GAS TO BE MADE INSIDE OF MECHANICAL BUILDING.
06 NEW DUCTWORK TO BE ROUTED THROUGH EXISTING ROOF PENETRATION. ROOF TO BE PATCHED AROUND NEW DUCTWORK.
07 TOP OF DUCT PENETRATION AT 7'-4" AFF.
08 MOUNT TOP OF LOUVER AT 7'-4" AFF.

EXISTING PROJECT CONDITIONS

INFORMATION PERTAINING TO EXISTING PROJECT CONDITIONS, SUCH AS LOCATIONS OF ARCHITECTURAL AND STRUCTURAL BUILDING COMPONENTS, MECHANICAL AND ELECTRICAL EQUIPMENT, PIPING, DUCTWORK, ROUGH-INS AND OTHER MISCELLANEOUS CONSTRUCTION, APPEARS ON PROJECT DRAWINGS. THIS INFORMATION IS BASED ON AVAILABLE RECORDS AS WELL AS INFORMATION COLLECTED WITH REASONABLE CARE AT THE PROJECT SITE. CONTRACTORS SHALL BE SOLELY RESPONSIBLE FOR VERIFYING DIMENSIONS AND RELATED INFORMATION AT THE PROJECT SITE PRIOR TO PROCURING ANY MATERIALS, PRODUCTS OR EQUIPMENT TO PERFORM THEIR WORK.





A1 MECHANICAL BUILDING MECHANICAL PLAN
1/4" = 1'-0"

N

A3 OVERALL MECHANICAL PLAN
1/16" = 1'-0"

N

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

MECHANICAL PLANS

M-101

EXHAUST FAN (EF) SCHEDULE

NOTES:
1. PROVIDE WITH HI-PRO POLYESTER COATING ON FAN, MOTOR, AND ACCESSORIES.
2. FAN TO RUN CONTINUOUSLY.

TAG	SERVICE	FAN				ELECTRICAL			MODEL	MANUFACTURER	NOTES
		AIRFLOW (CFM)	EXTERNAL STATIC (in-wg)	DRIVE TYPE	MOUNTING TYPE	HORSEPOWER	VOLTAGE	PHASE			
EF-1	MECHANICAL ROOM	420	0.50	DIRECT	INLINE	0.167	115	1	SQ-95-VG	GREENHECK	
EF-2	CHLORINE STORAGE	140	0.50	DIRECT	INLINE	0.25	120	1	SQ-97-VG	GREENHECK	1,2

LOUVER (WPL) SCHEDULE

NOTES:
1. NONE

TAG	SERVICE	WIDTH	HEIGHT	DEPTH	AIRFLOW (CFM)	FREE AREA (SF)	FREE AREA VELOCITY (FPM)	APD (IN-WG)	MODEL	MANUFACTURER	NOTES
WPL-1	MECHANICAL ROOM INTAKE	24"	16"	6"	420	0.90	459	0.03	ESD-635	GREENHECK	
WPL-2	MECHANICAL ROOM EXHAUST	24"	16"	6"	420	0.90	459	0.03	ESD-635	GREENHECK	
WPL-3	CHLORINE ROOM EXHAUST	16"	16"	6"	140	0.57	247	0.01	ESD-635	GREENHECK	
WPL-4	CHLORINE ROOM INTAKE	16"	16"	6"	140	0.57	247	0.01	ESD-635	GREENHECK	

ELECTRIC HEATER (EUH) SCHEDULE

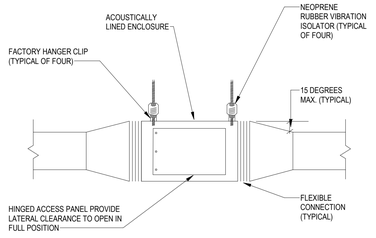
NOTES:
1. MOUNT BOTTOM OF UNIT AT 11' 8 AFF
2. MOUNT BOTTOM OF UNIT AT 6' 10" AFF.

TAG	TOTAL CAPACITY (KW)	AIRFLOW (CFM)	ELECTRICAL			MANUFACTURER	MODEL	NOTES
			VOLTAGE	PHASE	MCA			
EUH-1	3.75	270	208	1	22.5	QMARK	MWUH5004	1
EUH-2	1.875	270	208	1	11.3	QMARK	MWUH5004	2

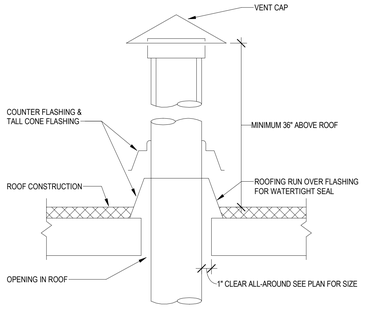
ELECTRICAL COORDINATION INFORMATION

NOTES:
1. NONE

TAG	CIRCUIT 1					STARTER												STARTER UNIT / CONTROL			DISCONNECT				COMMENTS
						TYPE				LOCATION		FURNISHED BY		ACCESSORIES											
	VOLTAGE	PHASE	HORSEPOWER	FULL LOAD AMPS	MIN. CURRENT AMPS	COMBINATION / MAGNETIC	MANUAL	REDUCED VOLTAGE	TWO SPEED	VFD	NEAR UNIT	ON / IN UNIT	REMOTE	ELECTRICAL CONTRACTOR	EQUIPMENT MANUFACTURER	MECHANICAL CONTRACTOR	HAND - OFF - AUTO SWITCH	ON - OFF SWITCH	PILOT LIGHT	PUSHBUTTON SWITCH	BUILDING AUTOMATION SYSTEM	INTEGRAL	MANUAL	INTERLOCK WITH	INTEGRAL BY MANUFACTURER	EXTERNAL BY ELECTRICAL CONTRACTOR	EXTERNAL BY MECHANICAL CONTRACTOR	UNIT ON BACKUP POWER	
EF-1	115	1	0.167	2.8																								
EF-2	120	1	0.25																									
EUH-1	208	1		40.5	22.5																							
EUH-2	208	1		20.3	11.3																							

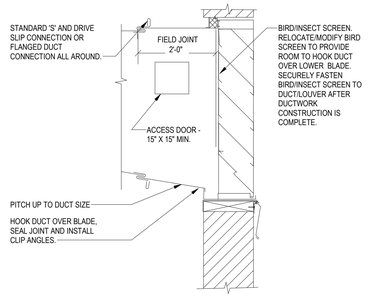


B5 IN-LINE CENTRIFUGAL FAN DETAIL



NOTES:
1. COORDINATE VENT LOCATION AND OPENING SIZE REQUIREMENTS WITH GENERAL CONTRACTOR.

A4 VENT STACK DETAIL



NOTES:
1. SEAL ALL DUCT JOINTS , CORNERS AND SEAMS WATERTIGHT USING SEALANT AND OR SOLDERING. REFER TO SPECIFICATION SECTION 23 31 00 FOR ACCEPTABLE SEALANTS TO BE UTILIZED IN DUCT SYSTEMS

A5 LOUVER DETAIL

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JGB
CHECKED BY: JLC

MECHANICAL SCHEDULES AND DETAILS

M-601

ELECTRICAL SYMBOLS AND ABBREVIATIONS

NOTE: NOT ALL SYMBOLS AND ABBREVIATIONS INDICATED HERE ARE USED IN DRAWINGS AND MAY NOT APPLY TO CURRENT PROJECT. ADDITIONAL SYMBOLS MAY BE INDICATED ON DRAWINGS. ALL LISTED MOUNTING HEIGHTS ARE TO CENTER OF BOX, UNLESS OTHERWISE INDICATED.

ELECTRICAL ABBREVIATIONS

1P	-	ONE POLE	KVA	-	KILOVOLT AMPERE
2P	-	TWO POLE	KVAR	-	KILOVOLT AMPERE REACTIVE
3P	-	THREE POLE	KW	-	KILOWATT
4P	-	FOUR POLE	LP	-	LIGHTING PANEL
1P, 1W	-	ONE POLE, ONE WIRE	LS	-	LIMIT SWITCH
1P, 2W	-	ONE POLE, TWO WIRE	LTG	-	LIGHTING
2P, 2W	-	TWO POLE, TWO WIRE	LV	-	LOW VOLTAGE
2P, 3W	-	TWO POLE, THREE WIRE	MC	-	MECHANICAL CONTRACTOR
3P, 2W	-	THREE POLE, TWO WIRE	MCA	-	MINIMUM CIRCUIT AMPS
3P, 3W	-	THREE POLE, THREE WIRE	MCC	-	MOTOR CONTROL CENTER
3P, 4W	-	THREE POLE, FOUR WIRE	MDP	-	MAIN DISTRIBUTION PANEL
4P, 4W	-	FOUR POLE, FOUR WIRE	MISC	-	MISCELLANEOUS
A	-	AMPERE	MH	-	MANHOLE
AC	-	ALTERNATING CURRENT	MLO	-	MAIN LUGS ONLY
AF	-	AMPERE FRAME	MTD	-	MOUNTED
AFF	-	ABOVE FINISHED FLOOR	MTG	-	MOUNTING
AFG	-	ABOVE FINISHED GRADE	MTS	-	MANUAL TRANSFER SWITCH
AIC	-	AMPERE INTERRUPTING CAPACITY	MW	-	MICROWAVE
ANSI	-	AMERICAN NATIONAL STANDARDS INSTITUTE	MV	-	MEDIUM VOLTAGE
AL	-	ALUMINUM	N / A	-	NOT APPLICABLE
AS	-	AMP SWITCH	NC	-	NORMALLY CLOSED
AT	-	AMP TRIP	NEC	-	NATIONAL ELECTRIC CODE
ARCH	-	ARCHITECT	NIC	-	NOT IN CONTRACT
ATS	-	AUTOMATIC TRANSFER SWITCH	NO	-	NORMALLY OPEN
A / V	-	AUDIO VISUAL	#	-	NUMBER
AWG	-	AMERICAN WIRE GRADE	NTS	-	NOT TO SCALE
B	-	PEDESTAL MOUNTED ON BENCH TOP	OSP	-	OUTSIDE PLANT
BF	-	BELOW FLOOR	P	-	POLE
BFC	-	BELOW FINISHED CEILING	PB	-	PULL BOX
BFF	-	BELOW FINISHED FLOOR	PC	-	PLUMBING SYSTEM CONTRACTOR
BFG	-	BELOW FINISHED GRADE	PH	-	PHASE
BLDG	-	BUILDING	PNL	-	PANEL OR PANELBOARD
C	-	CONDUIT	PP	-	POWER PANEL
CAM	-	CAMERA	PR	-	PAIR
CAT	-	CATALOG	PRI	-	PRIMARY
CATV	-	CABLE TELEVISION	PROJ	-	PROJECTOR
CB	-	CIRCUIT BREAKER	PVC	-	POLYVINYL CHLORIDE
CKT	-	CIRCUIT	REC	-	RECESSED
CLG	-	CEILING MOUNTED	RE / CKT	-	REUSE EXISTING CIRCUIT
CO	-	COPIER	REF	-	REFRIGERATOR
CT	-	CURRENT TRANSFORMER	RSC	-	RIGID STEEL CONDUIT
CU	-	COPPER	SC	-	SECURITY CONTRACTOR
CL	-	CENTERLINE	SEC	-	SECONDARY
DC	-	DIRECT CURRENT	SN	-	SOLID NEUTRAL
DR	-	DRYER	SP	-	SPARE
Δ	-	DELTA	SS	-	STAINLESS STEEL
DISC	-	DISCONNECT	ST	-	SHUNT TRIP
DW	-	DISHWASHER	STP	-	SHIELDED TWISTED PAIR
DWG	-	DRAWING	SUSP	-	SUSPENDED
E	-	EMERGENCY	SW	-	SWITCH
EC	-	ELECTRICAL CONTRACTOR	SWBD	-	SWITCHBOARD
EMT	-	ELECTRIC METALLIC TUBING	T	-	TAMPER RESISTANT SAFETY RECEPTACLE
ETR	-	EXISTING TO REMAIN	TBB	-	TELECOMMUNICATIONS BONDING BACKBONE
ER	-	EQUIPMENT ROOM	TC	-	TELEPHONE CABINET
ERL	-	EXISTING TO BE RELOCATED	TCI	-	TELECOMMUNICATIONS CABLING INSTALLER
ERLD	-	RELOCATED EQUIPMENT'S NEW LOCATION	TELE / DATA	-	TELEPHONE / DATA
EWC	-	ELECTRIC WATER COOLER	TEL	-	TELEPHONE
EX	-	EXISTING	TELECOM	-	TELECOMMUNICATIONS
FA	-	FIRE ALARM	TGP	-	TELECOMMUNICATIONS GROUNDING BUSBAR
FLA	-	FULL LOAD AMPS	TMGB	-	TELECOMMUNICATIONS MAIN GROUNDING BUSBAR
FO	-	FIBER OPTIC	TP	-	TWISTED PAIR
FPC	-	FIRE PROTECTION CONTRACTOR	TYP	-	TYPICAL
GC	-	GENERAL CONTRACTOR	UG	-	UNDERGROUND
GDS	-	GENERATOR DOCKING STATION	UTP	-	UNSHIELDED TWISTED PAIR
GFCI	-	GROUND FAULT CIRCUIT INTERRUPTER	UOI	-	UNLESS OTHERWISE INDICATED
GFPE	-	GROUND FAULT PROTECTION EQUIPMENT	V	-	VOLT
GND	-	GROUND	W	-	WATT
GRC	-	GALVANIZED RIGID CONDUIT	WA	-	WASHER
HH	-	HANDHOLE	WAP	-	WIRELESS ACCESS POINT
HP	-	HORSEPOWER	WP	-	WEATHERPROOF
HVAC	-	HEATING, VENTILATING, AND AIR CONDITIONING	XFMR	-	TRANSFORMER
HZ	-	HERTZ (CYCLE) PER SECOND	XR	-	XRAY
ISP	-	INSIDE PLANT	XV	-	XRAY VIEWER
IT	-	INFORMATION TECHNOLOGY	Y	-	WYE
JB	-	JUNCTION BOX	ZAM	-	ZONE ADAPTER MODULE

EQUIPMENT AND PANELBOARDS

- TRANSFORMER - (X) INDICATES DESIGNATION
- DISTRIBUTION CIRCUIT PANELBOARD - SURFACE MOUNTED - (X) INDICATES DESIGNATION
- BRANCH CIRCUIT PANELBOARD - RECESSED MOUNTED - (X) INDICATES DESIGNATION
- BRANCH CIRCUIT PANELBOARD - SURFACE MOUNTED - (X) INDICATES DESIGNATION
- CT - CURRENT TRANSFORMER CABINET
- M - METER
- MGB - MAIN GROUND BAR

GENERAL SYMBOLS

- DETAIL REFERENCE - TOP DESIGNATES DETAIL NUMBER - BOTTOM DESIGNATES SHEET NUMBER
- PICTURE LOCATION REFERENCE - TOP DESIGNATES DETAIL NUMBER - BOTTOM DESIGNATES SHEET NUMBER
- 1 / E-XXX MATCHLINE REFERENCE

RACEWAYS AND BOXES

- WIREWAY - RATING AND TYPE AS INDICATED ON DRAWINGS
- MULTI-OUTLET RACEWAY ASSEMBLY - WALL MOUNTED 1'-6" AFF, UOI
- MANHOLE
- HH HANDHOLE
- PB PULL BOX
- JUNCTION BOX
- CTB CABLE TAP BOX
- F FLOOR BOX - FLUSH - OUTLET TYPES REQUIRED AT EACH BOX AS INDICATED ON DRAWINGS
- P POKE THRU - FLOOR MOUNTED - OUTLET TYPES REQUIRED AT EACH BOX AS INDICATED ON DRAWINGS
- PP POWER POLE - OUTLET TYPES REQUIRED AT EACH BOX AS INDICATED ON DRAWINGS

MOTOR STARTERS AND DISCONNECTS

- M MANUAL MOTOR STARTER
- MAGNETIC MOTOR STARTER
- MAGNETIC MOTOR STARTER AND DISCONNECT COMBINATION
- X DISCONNECT SWITCH SIZE AS INDICATED ON DRAWINGS - (X) INDICATES TYPE: (CB) CIRCUIT BREAKER (F) FUSED (NF) NON-FUSED
- VFD VARIABLE FREQUENCY DRIVE MOTOR CONTROLLER

WIRING DEVICES

TYPE ABBREVIATIONS:
(AF) ARC-FAULT CIRCUIT INTERRUPTER
(GF) GROUND FAULT CIRCUIT INTERRUPTING
(TR) TAMPER RESISTANT
(USB) RECEPTACLE WITH ONE TYPE A AND ONE TYPE C USB CHARGING PORTS. 2 AMP CHARGING MINIMUM.
(WP-D) DAMP LOCATION WITH WEATHERPROOF COVER
(WP-W) WET LOCATION WITH WEATHERPROOF IN-USE COVER
(WR) WEATHER RESISTANT

- DUPLEX RECEPTACLE - MOUNTED 1'-6" AFF UOI - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE - (H) INDICATES HORIZONTAL MOUNT
- QUADPLEX RECEPTACLE - MOUNTED 1'-6" AFF UOI - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- DUPLEX RECEPTACLE MOUNTED HORIZONTALLY 6" ABOVE COUNTER BACKSPLASH, UOI - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- QUADPLEX RECEPTACLE MOUNTED 6" ABOVE COUNTER BACKSPLASH, UOI - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- DUPLEX RECEPTACLE - TOP HALF SWITCHED - MOUNTED 1'-6" AFF UOI - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- DUPLEX RECEPTACLE - MOUNTED FLUSH IN COUNTERTOP - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- DUPLEX RECEPTACLE - MOUNTED FLUSH IN CEILING - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- QUADPLEX RECEPTACLE - MOUNTED FLUSH IN CEILING - (X) INDICATES CIRCUIT NUMBER (PANEL BOUNDARY AS INDICATED ON DRAWINGS) - (Y) INDICATES TYPE
- SIMPLEX OUTLET - MOUNT 1'-6" AFF UOI - (Y) INDICATES TYPE
- SPECIAL PURPOSE OUTLET (SPO) - (X) INDICATES SPO DESIGNATION
- MOTOR CONNECTION - (X) INDICATES MOTOR DESIGNATION
- TV / POWER OUTLET BOX 6'-8" AFF UOI.
- PUSHBUTTON - MOUNTED 3'-8" AFF UOI

SECURITY AND ACCESS CONTROL

- SECURITY OR ACCESS CONTROL PANEL - SURFACE MOUNTED - (X) INDICATES DESIGNATION (DACP) DOOR ACCESS CONTROL PANEL (SAP) SECURITY ANNUNCIATOR PANEL (SACP) SECURITY ACCESS CONTROL PANEL
- AA AUDIBLE ALARM
- CCTV CAMERA - CEILING OR WALL MOUNTED - PROVIDE (1) CATEGORY 6 CABLE - (X) INDICATES TYPE: (WP) WEATHER PROOF (VP) VANDAL PROOF
- CCTV CAMERA - CEILING OR WALL MOUNTED - (X) INDICATES TYPE: (WP) WEATHER PROOF (VP) VANDAL PROOF
- CR CARD READER - WALL MOUNTED 3'-8" AFF UOI - (X) INDICATES TYPE: (M) MULLION MOUNT (WP) WEATHER PROOF (VP) VANDAL PROOF
- DE DELAYED EGRESS
- DC DOOR CONTACT
- DHG DOOR HARDWARE GROUP (DHG) - (X) INDICATES: DHG DESIGNATION
- DPS DOOR POSITION SWITCH
- DR DOOR RELEASE PUSH BUTTON - WALL MOUNTED 3'-8" AFF UOI
- DRS DOOR RELEASE SWITCH
- DB DURESS BUTTON
- EFED ELECTRIC FIRE EXIT DEVICE
- EL ELECTRIC LOCKING DEVICE
- EPD ELECTRIC PANIC DEVICE
- EPT ELECTRIC POWER TRANSFER
- ES ELECTRIC STRIKE
- ETW ELECTRIC THROUGH WIRE HINGE
- GB GLASS BREAK DETECTOR
- IR INFARRED MOTION SENSOR
- KP KEY PAD
- KS KEY SWITCH
- ML MAGNETIC LOCK
- M MONITOR
- MD MOTION DETECTOR
- PB PANIC BUTTON
- PS POWER SUPPLY
- PTH POWER TRANSFER HINGE
- RSD REMOTE STATUS DISPLAY
- REX REQUEST TO EXIT SENSOR
- SD SOUND DETECTOR

ELECTRICAL SHEET INDEX 30X42

LIGHTING FIXTURES

- SURFACE OR PENDANT MOUNTED
- RECESS MOUNTED
- WALL SURFACE MOUNTED
- WALL RECESS MOUNTED
- STRIP LIGHT OR UNDER CABINET LIGHT
- LIGHTING TRACK - LENGTH AS INDICATED ON DRAWINGS - NUMBER AND DIRECTION OF FIXTURES AS INDICATED ON DRAWINGS AND / OR SCHEDULE
- SURFACE MOUNTED ACCENT - ARROW INDICATES DIRECTION OF ILLUMINATION
- RECESS MOUNTED ACCENT - ARROW INDICATES DIRECTION OF ILLUMINATION
- POLE MOUNTED WITH ARM
- POST TOP POLE
- BOLLARD
- FLOOD LIGHT
- EMERGENCY BATTERY UNIT - WALL MOUNT AT 8'-0" AFF UOI
- EMERGENCY BATTERY UNIT CEILING
- EMERGENCY BATTERY SINGLE REMOTE HEAD - WALL MOUNT AT 8'-0" AFF UOI
- EMERGENCY BATTERY DUAL REMOTE HEAD - WALL MOUNT AT 8'-0" AFF UOI
- WALL MOUNTED EXIT LIGHT FIXTURE WITH EMERGENCY HEADS - MOUNT AT 8'-0" AFF UOI - SHADING INDICATES FACE(S) - ARROW(S) AND FACE(S) AS INDICATED ON DRAWINGS
- CEILING MOUNTED EXIT LIGHT FIXTURE WITH EMERGENCY HEADS - SHADING INDICATES FACE(S) - ARROW(S) AND FACE(S) AS INDICATED ON DRAWINGS
- CEILING MOUNTED EXIT LIGHT FIXTURE - SHADING INDICATES FACE(S) - ARROW(S) AND FACE(S) AS INDICATED ON DRAWINGS
- WALL MOUNTED EXIT LIGHT FIXTURE - MOUNT AT 8'-0" AFF UOI - SHADING INDICATES FACE(S) - ARROW(S) AND FACE(S) AS INDICATED ON DRAWINGS

LIGHTING FIXTURE DESIGNATIONS

- SHADING INDICATES FIXTURE WIRED TO EMERGENCY OR UNSWITCHED NIGHT LIGHTING CIRCUIT
- AA-1b LIGHT FIXTURE DESIGNATION - (AA) INDICATES FIXTURE TYPE - (1) INDICATES CIRCUIT NUMBER (PANEL BOUNDS AS INDICATED ON DRAWINGS) - (b) INDICATES CONTROL DESIGNATION (IF NOT INDICATED, CONTROLLED VIA SWITCH AT ROOM ENTRY) - (NL) INDICATES UNSWITCHED NIGHT LIGHTING

TYPICAL AT EACH FIXTURE LOCATION:
- ca CONTACTOR DESIGNATION / CONTROLLED VIA CONTACTOR
- dai DIMMER CHANNEL CABINET DESIGNATION / CONTROLLED VIA ELECTRONIC DIMMING SYSTEM
- oa SPECIFIC DEVICE DESIGNATION CONTROLLING CIRCUIT OR PORTION OF CIRCUIT / OCCUPANCY SENSOR CONTROLLED
- ra RELAY DESIGNATION CONTROLLING CIRCUIT OR PORTION OF CIRCUIT / LOW VOLTAGE RELAY CONTROLLED VIA RELAY CABINET
- ta TIME CLOCK DESIGNATION / TIME CLOCK CONTROLLED

LIGHTING CONTROL

SWITCH / SENSOR TYPE ABBREVIATIONS:
(2) TWO POLE
(3) THREE WAY
(4) FOUR WAY
(A) ADDED TO ANY CEILING SENSOR IS FOR AUXILIARY RELAY FOR HVAC CONNECTION.
(50) OCCUPANCY SENSOR (AUTO OFF / 50% ON)
(D) DAYLIGHT SENSOR
(D50) DAYLIGHT / OCCUPANCY SENSOR (AUTO OFF / 50% ON)
(DLS) DUAL LEVEL SWITCH
(DO) DAYLIGHT / OCCUPANCY'S SENSOR
(DV) DAYLIGHT / VACANCY SENSOR
(K) KEY OPERATED
(O) OCCUPANCY SENSOR (AUTO OFF / AUTO FULL ON)
(P) WITH PILOT LIGHT
(T) TIMER
(V) VACANCY SENSOR (AUTO OFF / MANUAL ON)

- MANUAL WALL SWITCH - MOUNTED 3'-8" AFF UOI - SINGLE POLE UON - ON / OFF - (a) INDICATES SWITCH DESIGNATION - (X) INDICATES SWITCH TYPE
- MANUAL WALL DIMMER - MOUNT AT 3'-8" AFF UOI - (a) INDICATES SWITCH DESIGNATION - (X) INDICATES SWITCH TYPE
- MOMENTARY CONTACT SWITCH - MOUNTED 3'-8" AFF UOI - (Y) INDICATES MOMENTARY CONTACT SWITCH DESIGNATION (SEE FACEPLATE DETAIL AND SCHEDULE)
- CONTROL STATION - MOUNTED 3'-8" AFF UOI - ASSOCIATED WITH A PACKAGED DIMMING SYSTEM ***EDIT EXAMPLES FOR YOUR PROJECT*** - DIGITAL SWITCH STATION - LUTRON GRAFIK EYE OR ACUITY NLIGHT SCENE CONTROLER - DIGITAL TOUCH SCREEN CONTROL - ACUITY FRESCO OR NLIGHT UNITOUCH - (Y) INDICATES CONTROL STATION DESIGNATION (SEE FACEPLATE DETAIL AND SCHEDULE)
- L LOW VOLTAGE SWITCH STATION - MOUNTED 3'-8" AFF UOI - ASSOCIATED WITH A PACKAGED DIMMING SYSTEM ***EDIT EXAMPLES FOR YOUR PROJECT*** - SWITCHES AND DIMMER SWITCHES WITH OR WITHOUT SENSORS AND PUSH BUTTON SCENE CONTROLLERS WITH OUR WITHOUT DIMMING - (X) INDICATES LOW VOLTAGE SWITCH STATION DESIGNATION (SEE FACEPLATE DETAIL AND SCHEDULE)
- WALL SENSOR - MOUNTED 1'-0" BFC UOI - (X) INDICATES SENSOR TYPE
- S CEILING SENSOR - (X) INDICATES SENSOR TYPE
- PC PHOTOCELL
- C CONTACTOR - (X) INDICATES CONTACTOR DESIGNATION (SEE SCHEDULE)
- T TIME CLOCK - (X) INDICATES TIME CLOCK DESIGNATION (SEE SCHEDULE)
- CABINET - TOP (X) INDICATES TYPE: BB - BACKBONE LCP - LIGHTING CONTROL PANEL RP - RELAY PANEL - BOTTOM (X) INDICATES DESIGNATION (SEE SCHEDULE)

FIRE ALARM

- FIRE ALARM PANEL - SEMI-FLUSH MOUNTED - (X) INDICATES DESIGNATION (FAAP) ANNUNCIATOR PANEL (FACU) CONTROL UNIT (NAC) NAC PANEL (FSS) FIRE SUPPRESSION CONTROL PANEL
- FIRE ALARM PANEL - SURFACE MOUNTED - (X) INDICATES DESIGNATION (FAAP) ANNUNCIATOR PANEL (FACU) CONTROL UNIT (NAC) NAC PANEL (FSS) FIRE SUPPRESSION CONTROL PANEL
- FIRE FIGHTER'S TELEPHONE JACK - MOUNTED 3'-8" AFF UOI
- FIRE FIGHTER'S HAND SET - MOUNTED 3'-8" AFF UOI
- PULL STATION - MOUNTED 3'-8" AFF UOI
- H HEAT DETECTOR
- B BEAM SMOKE DETECTOR - CEILING MOUNTED - (X) INDICATES TYPE: (PR) PRISM REFLECTOR (RE) RECEIVER (TR) TRANSMITTER (TR/RE) TRANSMITTER / RECEIVER IN ONE
- B BEAM SMOKE DETECTOR - WALL MOUNTED - (X) INDICATES TYPE: (CTL) CONTROLLER (PR) PRISM REFLECTOR (RE) RECEIVER (TR) TRANSMITTER (TR/RE) TRANSMITTER / RECEIVER IN ONE
- PHOTO - ELECTRIC SMOKE DETECTOR - CEILING MOUNTED - (X) INDICATES TYPE: (NONE) STANDARD (CO) CARBON MONOXIDE (ER) ELEVATOR RECALL (MS) MULTIPLE STATION (SB) SOUNDER BASE (SS) SINGLE STATION
- PHOTO - ELECTRIC SMOKE DETECTOR - WALL MOUNTED 1'-0" BFC UOI - (X) INDICATES TYPE: (NONE) STANDARD (MS) MULTIPLE STATION (SB) SOUNDER BASE (SS) SINGLE STATION
- CO CARBON MONOXIDE DETECTOR - CEILING MOUNTED - (X) INDICATES TYPE: (NONE) STANDARD (MS) MULTIPLE STATION (SB) SOUNDER BASE (SS) SINGLE STATION
- CO CARBON MONOXIDE DETECTOR - WALL MOUNTED 1'-0" BFC UOI - (X) INDICATES TYPE: (NONE) STANDARD (MS) MULTIPLE STATION (SB) SOUNDER BASE (SS) SINGLE STATION
- DS DUCT SMOKE DETECTOR
- RTS/I REMOTE TEST SWITCH AND / OR INDICATOR
- R FAN SHUTDOWN RELAY
- SD SMOKE DAMPER
- DH MAGNETIC DOOR HOLDER
- CM CONTROL MODULE
- MM MONITOR MODULE
- FS FLOW SWITCH
- TS TAMPER SWITCH
- PE PRESSURE SWITCH
- EOL END OF LINE RESISTOR
- FIRE ALARM STROBE NOTIFICATION APPLIANCE - WALL MOUNTED 6'-8" AFF OR 6" BFC, WHICHEVER IS LOWER
- FIRE ALARM STROBE NOTIFICATION APPLIANCE - CEILING MOUNTED - (X) INDICATES STROBE CANDELA RATING
- FIRE ALARM HORN / STROBE NOTIFICATION APPLIANCE - WALL MOUNTED 6'-8" AFF OR 6" BFC, WHICHEVER IS LOWER - (X) INDICATES STROBE CANDELA RATING
- FIRE ALARM HORN / STROBE NOTIFICATION APPLIANCE - CEILING MOUNTED - (X) INDICATES STROBE CANDELA RATING
- H FIRE ALARM HORN NOTIFICATION APPLIANCE - WALL MOUNTED 6'-8" AFF OR 6" BFC, WHICHEVER IS LOWER
- H FIRE ALARM HORN NOTIFICATION APPLIANCE - CEILING
- M FIRE ALARM MINI HORN NOTIFICATION APPLIANCE - WALL MOUNTED 6'-8" AFF OR 6" BFC, WHICHEVER IS LOWER
- F FIRE ALARM BELL - WALL MOUNTED 6'-8" AFG UOI

AREA OF RESCUE ASSISTANCE

- ARA AREA OF RESCUE ASSISTANCE - (X) INDICATES TYPE: (CP) CONTROL PANEL MOUNT TOP OF PANEL AT 6'-0" AFF UOI (PF) PUSH FOR HELP MOUNT AT 3'-8" AFF UOI (PS) POWER SUPPLY MOUNT TOP OF POWER SUPPLY AT 6'-0" AFF UOI

CLOCKS

- CLOCK - WALL MOUNTED 1'-6" BFC UOI
- CS CLOCK WITH SPEAKER - WALL MOUNTED

INTERCOM

- I INTERCOM UNIT - WALL MOUNT 3'-8" AFF - (X) INDICATES TYPE: (C) CALL IN SWITCH (DB) DOOR STATION WITH DOOR BELL (DBC) DOOR STATION WITH DOOR BELL AND CAMERA (ES) EMERGENCY STATION (M) MASTER INTERCOM AND DIRECTORY (MTT) MULTI-TENANT TELEPHONE

AUDIO / VISUAL

- AMP AMP
- AV AUDIO / VISUAL CONNECTION (SEE SCHEDULE AND AUDIO / VISUAL DRAWINGS)
- CSC CONTROL SOUND CONSOLE
- M MICROPHONE OUTLET - WALL MOUNTED 1'-6" AFF UOI
- VC VOLUME CONTROL - MOUNT 3'-8" AFF UOI
- SPEAKER - CEILING MOUNTED - (X) INDICATES TYPE: (NONE) FLUSH (S) SURFACE
- SPEAKER - WALL MOUNTED 1'-6" BFC UOI - (X) INDICATES TYPE: (NONE) FLUSH (S) SURFACE

TELECOMMUNICATIONS EQUIPMENT ROOM

- TGB GROUND BAR
- LADDER TRAY - (X) INDICATES WIDTH - (Y) INDICATES DEPTH
- BASKET TRAY - (X) INDICATES WIDTH - (Y) INDICATES DEPTH
- WIRE MESH TRAY - (X) INDICATES WIDTH - (Y) INDICATES DEPTH
- IT CABINET - (X) INDICATES DESIGNATION
- 3/4" PLYWOOD BACKBOARD - (X) INDICATES DESIGNATION
- FLOOR MOUNTED TWO POST IT RACK - (X) INDICATES DESIGNATION
- FLOOR MOUNTED FOUR POST IT RACK - (X) INDICATES DESIGNATION

VOICE / DATA

- VOICE / DATA OUTLET - WALL MOUNTED 1'-6" AFF UOI - (C) INDICATES MOUNTED ABOVE COUNTER - (X) INDICATES QUANTITY AND TYPE (A) AUXILIARY (D) DATA (H) HDMI (R) RCA (U) USB (V) VOICE (VG) VGA (W) WALL PHONE MOUNTED AT 44" AFF (X) COAX
- WAP WIRELESS ACCESS POINT - WALL MOUNTED - SUPPLY 10' - 0" SERVICE COIL - PROVIDE (2) CATEGORY 6A CABLES
- VOICE / DATA FURNITURE FEED - WALL MOUNTED 1'-0" AFF UOI - (X) INDICATES QUANTITY AND TYPE (D) DATA (V) VOICE
- VOICE / DATA OUTLET - CEILING MOUNTED - (X) INDICATES TYPE (A) AUXILIARY (D) DATA (H) HDMI (R) RCA (VG) VGA (X) COAX
- WAP WIRELESS ACCESS POINT - CEILING MOUNTED - SUPPLY 10' - 0" SERVICE COIL - PROVIDE (2) CATEGORY 6A CABLES
- PTWP PASS THRU WALL PLATE

VOICE / DATA - ROUGH-IN ONLY

- VOICE / DATA OUTLET - WALL MOUNTED 1'-6" AFF UOI - (C) INDICATES MOUNTED ABOVE COUNTER
- WAP WIRELESS ACCESS POINT - WALL MOUNTED
- VOICE / DATA FURNITURE FEED - WALL MOUNTED 1'-0" AFF UOI
- VOICE / DATA OUTLET - CEILING MOUNTED
- WAP WIRELESS ACCESS POINT - CEILING MOUNTED
- PTWP PASS THRU WALL PLATE

VIEW LOCATION LEGEND

D1	D2	D3	D4	D5	D6
C1	C2	C3	C4	C5	C6
B1	B2	B3	B4	B5	B6
A1	A2	A3	A4	A5	A6

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/2023
DRAWN BY: JTO
CHECKED BY: RJJ

ELECTRICAL SYMBOLS, ABBREVIATIONS & SHEET INDEX

E-001

GENERAL SHEET NOTES

A. ALL ELECTRICAL EQUIPMENT SHOWN ON THE DEMOLITION PLAN IS "EXISTING TO BE REMOVED" UNLESS NOTED OTHERWISE. IN ADDITION TO REMOVING DEVICES, REMOVE ALL ABANDONED ELECTRICAL CIRCUITS BACK TO THEIR SOURCE. REFER TO THE SPECIFICATIONS FOR ADDITIONAL ELECTRICAL DEMOLITION REQUIREMENTS.
B. IN GENERAL, DASHED WALLS ON THIS PLAN INDICATE EXISTING WALLS BEING DEMOLISHED. DO NOT RELY SOLELY ON ELECTRICAL DRAWINGS TO DETERMINE EXTENT OF GENERAL CONSTRUCTION DEMOLITION. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR THE EXACT EXTENT OF GENERAL CONSTRUCTION DEMOLITION REQUIRED BY THIS CONTRACT.
C. REFER TO DEMOLITION DRAWINGS OF OTHER TRADES. WHERE MOTORS, CONTROL PANELS, AND OTHER LOADS THAT HAVE AN ELECTRICAL CONNECTION ARE BEING REMOVED, INCLUDE THE DISCONNECTION AND REMOVAL OF ASSOCIATED ELECTRICAL FEEDS, CIRCUITS, AND LOOSE CONTROL EQUIPMENT IN THIS CONTRACT.
D. ROOMS IDENTIFIED WITH 'ETR', (EXISTING TO REMAIN) ARE ESSENTIALLY TO REMAIN UNCHANGED. ALTHOUGH THIS DESIGNATION IN A GIVEN ROOM REFERS TO THE STATUS OF BASIC ELECTRICAL DEVICES, THERE MAY BE SOME DEMOLITION WORK REQUIRED INVOLVING BACK-FEEDING EXISTING CIRCUITS, REMOVING CIRCUITS THAT ARE DE-ENERGIZED DUE TO DEMOLITION IN OTHER ROOMS, OR OTHER NECESSARY MODIFICATIONS. SEE ALL DOCUMENTS THAT MAKE UP THIS CONTRACT FOR THE TOTAL EXTENT OF WORK REQUIRED IN ALL SPACES.

SHEET KEYNOTES

D01 EXISTING POOL LIGHT TO BE REPLACED. SEE SHEET E-111 FOR NEW LIGHT FIXTURE. REMOVE EXISTING CONDUIT AND WIRE BACK TO LIGHT FIXTURE JUNCTION BOX.
D02 EXISTING LIGHT POLE TO REMAIN
D03 REMOVE AND REPLACE EXISTING EQUIPOTENTIAL BONDING CONDUCTOR AROUND PERIMETER OF POOL. DISCONNECT ANY BONDING CONNECTIONS TO CONDUCTOR. SEE SHEET E-111 FOR NEW BONDING CONDUCTOR AND ADDITIONAL INFORMATION.
D04 EXISTING POOL LIGHTING JUNCTION BOX TO BE REMOVED.

A1 ELECTRICAL DEMOLITION SITE PLAN
1" = 10'-0"

WTI WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

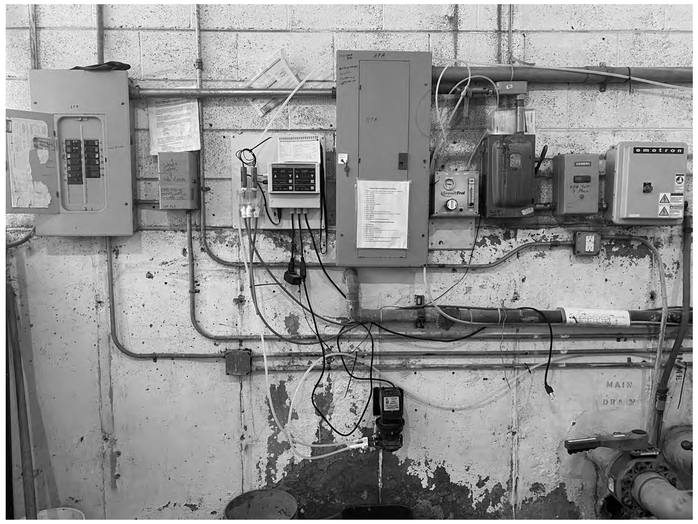
REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

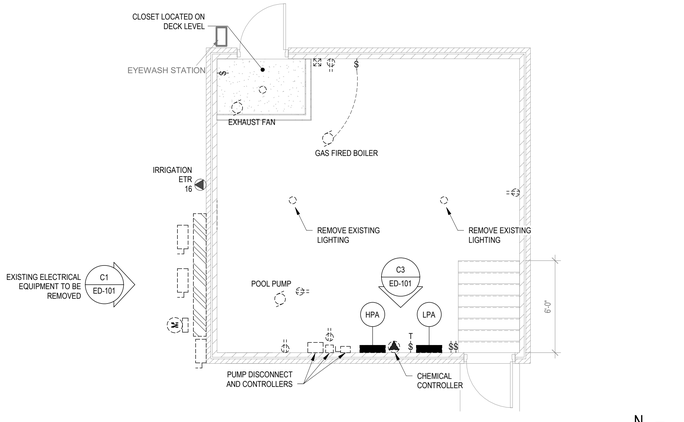
SITE DEMOLITION PLAN - ELECTRICAL

ED-100

C1 EXISTING EXTERIOR ELECTRICAL EQUIPMENT
NTS



C3 EXISTING INTERIOR ELECTRICAL EQUIPMENT
NTS



A1 MECHANICAL BUILDING - ELECTRICAL DEMOLITION PLAN
1/4" = 1'-0"

GENERAL SHEET NOTES

A. ALL ELECTRICAL EQUIPMENT SHOWN ON THE DEMOLITION PLAN IS "EXISTING TO BE REMOVED" UNLESS NOTED OTHERWISE. IN ADDITION TO REMOVING DEVICES, REMOVE ALL ABANDONED ELECTRICAL CIRCUITS BACK TO THEIR SOURCE. REFER TO THE SPECIFICATIONS FOR ADDITIONAL ELECTRICAL DEMOLITION REQUIREMENTS.
B. IN GENERAL, DASHED WALLS ON THIS PLAN INDICATE EXISTING WALLS BEING DEMOLISHED. DO NOT RELY SOLELY ON ELECTRICAL DRAWINGS TO DETERMINE EXTENT OF GENERAL CONSTRUCTION DEMOLITION. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR THE EXACT EXTENT OF GENERAL CONSTRUCTION DEMOLITION REQUIRED BY THIS CONTRACT.
C. REFER TO DEMOLITION DRAWINGS OF OTHER TRADES. WHERE MOTORS, CONTROL PANELS, AND OTHER LOADS THAT HAVE AN ELECTRICAL CONNECTION ARE BEING REMOVED, INCLUDE THE DISCONNECTION AND REMOVAL OF ASSOCIATED ELECTRICAL FEEDS, CIRCUITS, AND LOOSE CONTROL EQUIPMENT IN THIS CONTRACT.
D. ROOMS IDENTIFIED WITH "ETR", (EXISTING TO REMAIN) ARE ESSENTIALLY TO REMAIN UNCHANGED. ALTHOUGH THIS DESIGNATION IN A GIVEN ROOM REFERS TO THE STATUS OF BASIC ELECTRICAL DEVICES, THERE MAY BE SOME DEMOLITION WORK REQUIRED INVOLVING BACK-FEEDING EXISTING CIRCUITS, REMOVING CIRCUITS THAT ARE DE-ENERGIZED DUE TO DEMOLITION IN OTHER ROOMS, OR OTHER NECESSARY MODIFICATIONS. SEE ALL DOCUMENTS THAT MAKE UP THIS CONTRACT FOR THE TOTAL EXTENT OF WORK REQUIRED IN ALL SPACES.

DEMO SHEET KEYNOTES

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

DEMOLITION PLAN - ELECTRICAL

ED-101

SHEET KEYNOTES

10 EXISTING LIGHT POLE TO REMAIN.

A1 SITE PLAN - ELECTRICAL
1" = 10'-0"

N

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

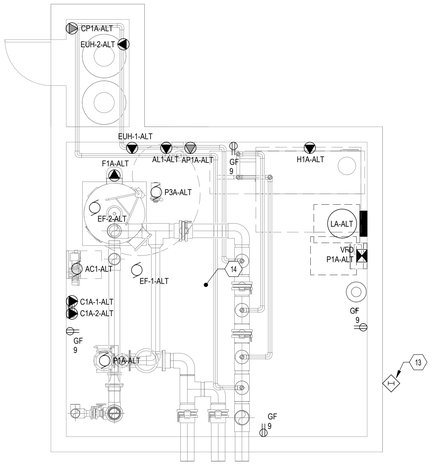
ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RIJ

SITE PLAN - ELECTRICAL

E-100

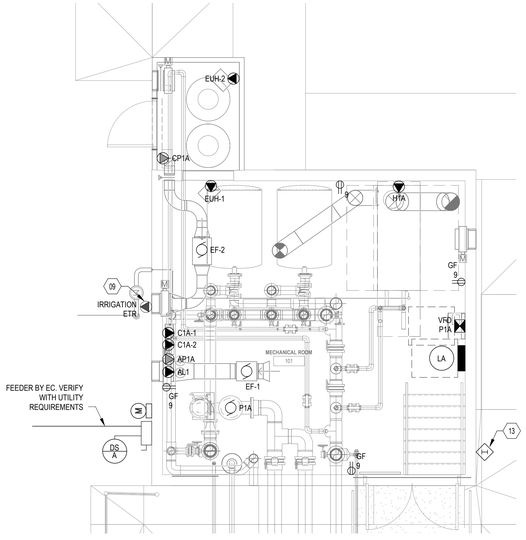
SHEET KEYNOTES

08	MOUNT LIGHT SWITCH 3'-6" FROM POOL DECK LEVEL. SWITCH SHALL CONTROL LIGHT FIXTURES IN MECHANICAL ROOM.
09	DISCONNECT AND RE-CONNECT EXISTING CONNECTION FOR IRRIGATION SYSTEM.
11	MOUNT LIGHT SWITCH 3'-6" FROM POOL DECK LEVEL. SWITCH SHALL CONTROL NEW POOL LIGHT FIXTURES.
12	WIRE TIMER SWITCH TO EXISTING SITE POLE LIGHTS AND NEW EXTERIOR WALL FIXTURES.
13	EMERGENCY PHONE STATION. VERIFY EXACT LOCATION AND REQUIRMENTS WITH OWNER.
14	EQUIPMENT ON THIS PLAN IS PART OF AN ALTERNATE PLAN. SEE ASSOCIATED ALTERNATE EQUIPMENT AND PANEL SCHEDULES FOR ADDITIONAL INFORMATION.



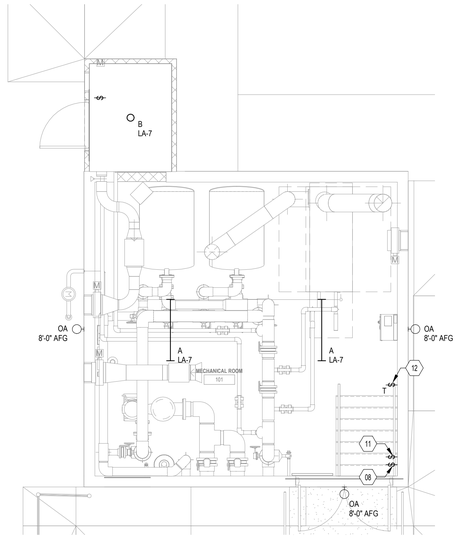
C1 ALTERNATE MECHANICAL ROOM - ELECTRICAL PLAN
1/4" = 1'-0"

N



A1 MECHANICAL ROOM - ELECTRICAL PLAN
1/4" = 1'-0"

N



A3 MECHANICAL ROOM - LIGHTING PLAN
1/4" = 1'-0"

N

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

FLOOR PLAN - ELECTRICAL

E-101

A1 POOL A - EXISTING LAP POOL ELECTRICAL PLAN

3/16" = 1'-0"

N

GENERAL SHEET NOTES

1. THE ELECTRICAL CONTRACTOR SHALL PROVIDE AN EQUIPOTENTIAL BOND GRID IN POOL STRUCTURE SURROUNDINGS OF ALL POOLS PER NFPA 70. BOND AND GROUND ALL PARTS AND PIECES OF THE POOL MECHANICAL EQUIPMENT. POOL, DECK EQUIPMENT, UNDERWATER POOL LIGHTS, ACTIVITIES, PERIMETER SURFACES AND ALL OTHER EMBEDDED METALLIC ITEMS IN ACCORDANCE WITH NFPA 70 ARTICLE 680.26. THIS INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING EQUIPMENT.
   a. THROUGH-WALL LIGHTING ASSEMBLIES AND UNDERWATER LUMINARIES.
   b. ALL ELECTRICAL EQUIPMENT LOCATED WITHIN 5' OF THE INSIDE WALL OF THE SPECIFIED POOL EDGE.
   c. ALL ELECTRICAL EQUIPMENT ASSOCIATED WITH THE RECIRCULATION SYSTEM OF THE SPECIFIED BODY OF WATER.
   d. METALLIC JUNCTION BOXES.
   e. TRANSFORMERS AND POWER SUPPLY ENCLOSURES.
   f. POWER DISTRIBUTION EQUIPMENT ASSOCIATED WITH THE SPECIFIED BODY OF WATER.
2. ELECTRICAL DRAWINGS ATTEMPT TO SHOW REQUIRED BONDING CONNECTIONS BUT NOT ALL REQUIRED BONDING CONNECTIONS ARE SHOWN ON THESE DOCUMENTS. FIELD CONDITIONS AND DRAWINGS OF OTHER DESIGNERS MAY RESULT IN ADDITIONAL BONDING REQUIREMENTS. ALL CODE REQUIRED BONDING SHALL BE PROVIDED WHETHER SHOWN ON THESE PLANS OR NOT, AND THE COST FOR THESE CONNECTIONS SHALL BE INCLUDED IN THE ELECTRICAL CONTRACTOR'S BID.
3. REFER TO POOL SERIES OF DRAWINGS FOR LOCATIONS OF ALL CONDUCTIVE EMBEDDED METALLIC ITEMS IN AND AROUND POOL THAT SHALL BE TIED TO THE EQUIPOTENTIAL GROUNDING GRID.
4. IN ADDITION TO POOL EQUIPMENT EQUIPOTENTIAL BONDING PROVIDE BONDING BETWEEN POOL SHELL REINFORCING STEEL FOR ALL POOLS SO THAT ALL SITE POOL BONDED PARTS ARE CONNECTED TO EACH OTHER. BONDING SYSTEM SHALL BE FURTHER BONDED TO BONDING SYSTEM AT A DESIGNATED LOCATION. COORDINATE WITH BUILDING ELECTRICAL CONTRACTOR FOR EXACT LOCATION OF BONDING SPIKE POINT. REFER TO DETAIL 3/PLE501 (POOL EQUIPMENT BONDING DETAIL) FOR SCHEMATIC REPRESENTATION OF DESIGN INTENT.
5. SEE DETAILS ON SHEET E-501 FOR ADDITIONAL INFORMATION.

SHEET KEYNOTES

01 THIS BOLD LINE REPRESENTS THE INSIDE EDGE OF THE REFERENCED POOL. THE ELECTRICAL CONTRACTOR SHALL REFERENCE THIS EDGE LINE FOR THE PURPOSE OF DETERMINING THE EXTENT OF SWIMMING POOL EQUIPOTENTIAL BONDING REQUIREMENTS IN ACCORDANCE WITH NFPA-NEC 70, ARTICLE 680. ELECTRICAL CONTRACTOR SHALL SPECIFICALLY REFERENCE THIS EDGE FOR DETERMINING THE FOLLOWING: CONDUCTIVE POOL SHELL IN REFERENCE TO NEC 680.26(B)(1). EXTENT OF POOL PERIMETER SURFACES IN REFERENCE TO NEC 680.26(B)(2). EXTENT OF POOL RELATED FIXED METAL PARTS TO BE BONDED IN REFERENCE TO NEC 680.26(B)(7). ADDITIONAL EQUIPOTENTIAL BONDING REQUIREMENTS OF NEC ARTICLE 680.21

02 POOL SHELL IS POURED CONCRETE WITH UNENCAPSULATED STEEL REINFORCING, WITH STEEL BEING CONNECTED WITH STEEL TIE WIRES. POOL SHELL REINFORCING STEEL SHALL BE BONDED TO OTHER METAL PARTS AS INDICATED ON THESE PLANS AND AS REQUIRED BY NEC 680.26.

03 THIS DASHED LINE REPRESENTS A DIRECT BURIED, SOLID, #8 AWG BARE COPPER CONDUCTOR. CONDUCTOR SHALL BE USED TO EQUIPOTENTIALLY BOND THE POOL PERIMETER SURFACE TO OTHER METALLIC, CONDUCTIVE POOL EQUIPMENT IN ACCORDANCE WITH NEC 680.26. CONDUCTOR SHALL BE LOCATED HORIZONTALLY BETWEEN 18" AND 24" FROM INSIDE WALLS OF POOL, AND LOCATED UNDER THE PERIMETER SURFACE BETWEEN 4" AND 6" BELOW SUBGRADE. SEE NEC 680.26(B)(2) FOR ADDITIONAL INSTALLATION REQUIREMENTS.

05 BONDING BETWEEN FIXED METAL PARTS AND POOL SHELL REINFORCING STEEL. BONDING SHALL BE SOLID, #8 AWG, BARE COPPER CONDUCTOR. BONDING CONNECTIONS SHALL BE AS REQUIRED BY THE NEC.

06 POOL LIGHT NICHE ENCLOSURE FURNISHED AND INSTALLED BY POOL CONTRACTOR. PROVIDE WATER-TIGHT CONDUIT FROM LIGHT NICHE TO JUNCTION BOXES WITHIN 75' OF LIGHT NICHE LOCATION. JUNCTION BOXES FURNISHED BY ELECTRICAL CONTRACTOR AND SHALL BE LOCATED ABOVE POOL WATER LEVEL. REFER TO DETAIL B3/E-501 BONDING POINT BETWEEN POOL UNDERWATER LIGHTING AND POOL SHELL REINFORCING STEEL. BONDING CONDUCTOR SHALL BE DIRECT BURIED, SOLID, #8 AWG, BARE COPPER CONDUCTOR. BONDING CONNECTIONS SHALL BE AS REQUIRED BY THE NEC.

07 THIS LINE REPRESENTS LINE VOLTAGE CABLE BETWEEN POOL LIGHT AND POOL LIGHTING JUNCTION BOX. ROUTE CABLE IN CONDUIT, 3/4" MINIMUM, DIRECT BURIED AT MINIMUM 2'-6" BETWEEN FINISHED DECK / GRADE. CONDUIT SHALL NOT PASS BELOW POOL BASIN.

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #2271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

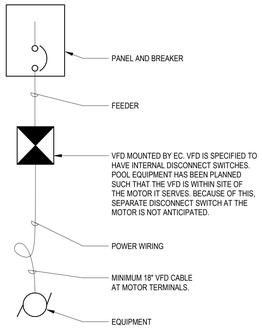
1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

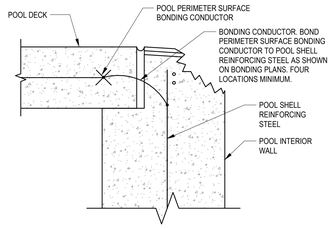
ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

POOL A - ELECTRICAL POOL PLAN

E-111



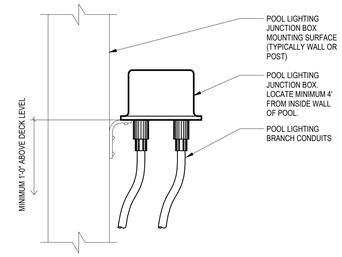
C1 TYPICAL VFD WIRING DETAIL
NTS



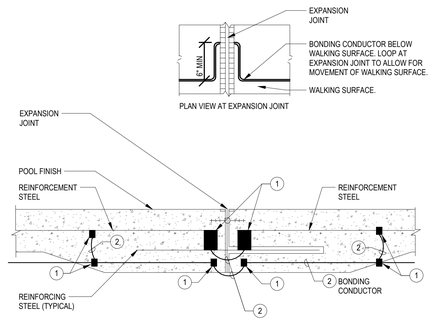
GENERAL DETAIL NOTES:

1. THIS DETAIL IS INTENDED TO ILLUSTRATE THE EQUIPOTENTIAL BONDING AROUND EACH POOL AS REQUIRED BY NEC 680.
2. THIS DETAIL IS NOT INTENDED TO DETAIL THE POOL WALLS OR THE DECKS. THE ABOVE POOL WALL IS GENERIC IN NATURE AND IS NOT TYPICAL FOR EACH POOL WALL. SEE POOL SECTIONS AND DECK SECTIONS FOR ADDITIONAL POOL AND DECK CONSTRUCTION REQUIREMENTS.
3. SEE ELECTRICAL DRAWINGS FOR ADDITIONAL BONDING & GROUNDING REQUIREMENTS.

C3 POOL BONDING DETAIL
NTS



D5 POOL LIGHTING JUNCTION BOX MOUNTING DETAIL
NTS



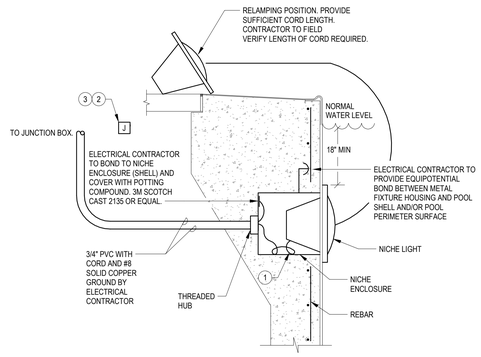
GENERAL DETAIL NOTES:

1. ALL BONDING CONNECTIONS SHALL BE CADWELD OR IRREVERSIBLE CLAMP CONNECTIONS.
2. BONDING CONDUCTORS SHALL BE #8 AWG, SOLID, BARE, COPPER.
3. ALL REINFORCING STEEL SHALL BE TIGHTLY TIED TOGETHER COMPLETING BOND AS STATED PER NEC 680.26(B)(1).
4. REINFORCING STEEL THAT IS EFFECTIVELY INSULATED BY AN ENCAPSULATING NON CONDUCTIVE COMPOUND AT THE TIME OF MANUFACTURING SHALL NOT REQUIRE GROUNDING PER NEC 680.26(B)(1).

DETAIL NOTES:

1. CADWELD OR CLAMP BONDING CONNECTION PER THE NEC.
2. BONDING CONDUCTOR.

B1 POOL FLOOR EXPANSION JOINT BONDING JUMPER DETAIL
NTS



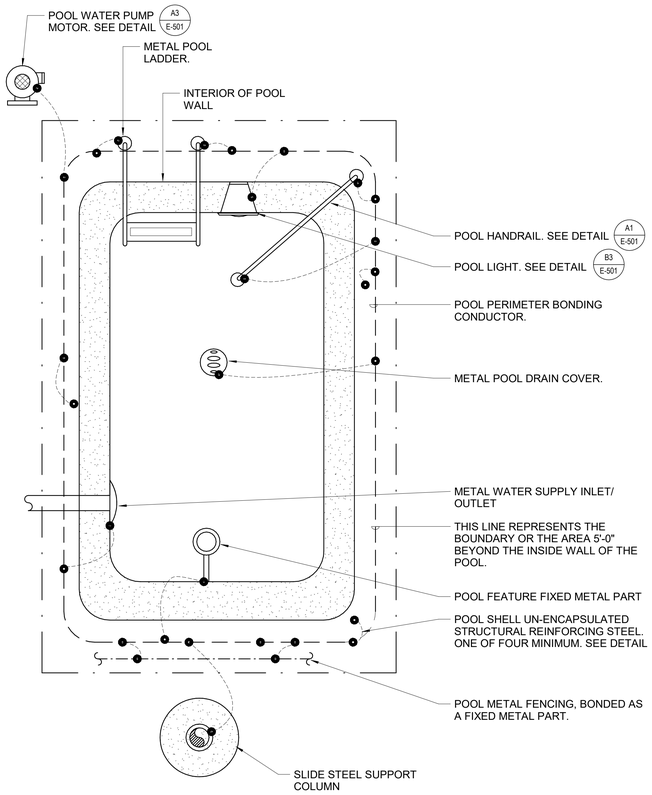
GENERAL DETAIL NOTES:

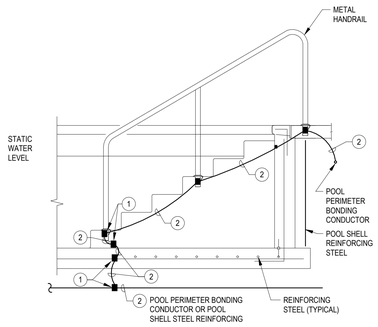
1. LIGHT NICHE FURNISHED AND INSTALLED BY EC.
2. ACTUAL POOL EDGE DETAILS MAY DIFFER FROM THIS DETAIL. REFER TO POOL DRAWINGS FOR EXACT POOL DETAILS.

DETAIL NOTES:

1. INSTALL TO PROVIDE SUFFICIENT CORD LENGTH SO FIXTURE CAN BE RELAMPED ON THE POOL DECK.
2. JUNCTION BOX SHALL BE WITHIN 75-0" OF LIGHTING NICHE LOCATION AND LOCATED A MINIMUM OF 8" ABOVE WATER LEVEL AND A MINIMUM OF 4" ABOVE POOL DECK. MAINTAIN 3'-0" WORKING CLEARANCE IN FRONT OF JUNCTION BOX PER NEC REQUIREMENTS AND 5'-0" FROM WATER EDGE.
3. JUNCTION BOXES SHALL BE UL-1241 LISTED-"JUNCTION BOXES FOR SWIMMING POOL LUMINAIRES" WITH UL CATEGORY CODE "WCEZ".

B3 WET NICHE LIGHT FIXTURE INSTALLATION DETAIL
NTS





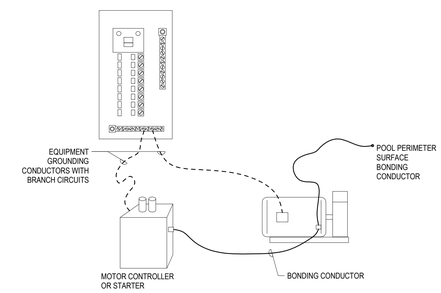
GENERAL DETAIL NOTES:

1. ALL BONDING CONNECTIONS SHALL BE CADWELD OR IRREVERSIBLE CLAMP CONNECTIONS.
2. BONDING CONDUCTORS SHALL BE #8 AWG, SOLID, BARE, COPPER.
3. ALL REINFORCING STEEL SHALL BE TIGHTLY TIED TOGETHER COMPLETING BOND AS STATED PER NEC 680.26(B)(1).
4. REINFORCING STEEL THAT IS EFFECTIVELY INSULATED BY AN ENCAPSULATING NON CONDUCTIVE COMPOUND AT THE TIME OF MANUFACTURING SHALL NOT REQUIRE GROUNDING PER NEC 680.26(B)(1).
5. THIS IS TYPICAL FOR ALL HANDRAILS AND GUARDRAIL POSTS.

DETAIL NOTES:

1. CADWELD OR CLAMP GROUND CONNECTION AS STATED PER THE NEC.
2. BONDING CONDUCTOR.

A1 HANDRAIL EQUIPOTENTIAL BONDING DETAIL
NTS



GENERAL DETAIL NOTES:

1. - - - - - = EQUIPMENT GROUNDING CONDUCTOR IN CONDUIT.
2. ——— = BONDING CONDUCTOR.
3. INSTALLATION SHALL CONFORM TO NEC 680.
4. ALL GROUNDING CONNECTIONS SHALL BE CADWELD OR CLAMP CONNECTIONS AS STATED PER THE NEC.
5. ALL BONDING CONDUCTORS SHALL BE #8 SOLID, BARE, COPPER UNLESS OTHERWISE NOTED.
6. BOND METAL PARTS OF ELECTRICAL EQUIPMENT TO POOL PERIMETER BOND CONDUCTOR OR TO POOL SHELL REINFORCING STEEL AT THE CONTRACTORS OPTION.

A3 POOL WATER CIRCULATING SYSTEM EQUIPMENT EQUIPOTENTIAL BONDING DETAIL
NTS

GENERAL DETAIL NOTES:

1. THIS DETAIL IS DIAGRAMMATIC IN NATURE .IT DOES NOT DEPICT SPECIFIC POOL CONSTRUCTION DETAILS, NOR ALL EQUIPMENT THAT MAY REQUIRE BONDING, BUT INSTEAD IS INTENDED TO INDICATE THE VARIOUS ITEMS AND EQUIPMENT THAT ARE REQUIRED TO BE BONDED. ACTUAL EQUIPMENT REQUIRED TO BE BONDED WILL VARY FROM POOL TO POOL. SEE POOL PLANS DEPICT ITEMS REQUIRED TO BE BONDED ON AN INDIVIDUAL BASIS BUT MAY OR MAY NOT SHOW ALL REQUIRED POOL EQUIPOTENTIAL BONDING CONNECTIONS. REFER TO POOL DRAWINGS, SLIDE CONTRACTOR DRAWINGS, AND ALL OTHER RELEVANT DRAWINGS THAT COMPRISE THE PROJECT CONSTRUCTION DOCUMENTS FOR ADDITIONAL EQUIPMENT THAT MAY BE REQUIRED TO BE BONDED. DURING CONSTRUCTION, FURTHER CONFIRM BONDING REQUIREMENTS WITH ACTUAL FIELD CONDITIONS. ALL REQUIRED EQUIPETENTIAL BONDING SHALL BE INCLUDED IN THE POOL ELECTRICAL CONTRACTORS BASE PRICE.
2. INSTALLATION SHALL CONFORM TO NEC ARTICLE 680.
3. ALL BONDING CONNECTIONS SHALL BE CADWELD OR IRREVERSIBLE CLAMP AS STATED IN THE NEC.
4. ALL BONDING CONDUCTORS SHALL BE #8 AWG, BARE SOLID COPPER UNLESS OTHERWISE NOTED.
5. BOND ALL METAL DEVICES WITHIN 5' OF THE EDGE OF THE POOLS AND METAL ITEMS LOCATED WITHIN 12' VERTICALLY AND 5' HORIZONTALLY OF THE SLIDE TOWERS.
6. ISOLATED METAL PARTS THAT ARE NOT OVER 4 INCHES IN ANY DIMENSION AND DO NOT PENETRATE THE POOL STRUCTURE MORE THAN 1 INCH SHALL NOT REQUIRE BONDING.
7. IN ADDITION TO REQUIREMENTS SHOWN HERE, SEE MOTOR CHASSIS EQUIPOTENTIAL BONDING DETAILS SHOWN ON POOL PLANS FOR ADDITIONAL INFORMATION.

A5 POOL EQUIPMENT EQUIPOTENTIAL BONDING DETAIL
NTS

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

ELECTRICAL DETAILS

E-501

LIGHT FIXTURE SCHEDULE

GENERAL NOTES:

A. SEE SPECIFICATION SECTION FOR ADDITIONAL INFORMATION REGARDING FIXTURE AND INSTALLATION REQUIREMENTS.

B. MANUFACTURERS LISTED AS ACCEPTABLE SHALL MEET ALL REQUIREMENTS AND FEATURES INDICATED. ACCEPTABLE MANUFACTURERS MUST MEET THE PHOTOMETRIC PERFORMANCE OF THE LISTED UNIT. ELECTRICAL CONTRACTOR SHALL ENSURE THE FIXTURE DEPTH / HEIGHT WILL COMPLY WITH ADA REQUIREMENTS AND WILL NOT INTERFERE WITH OTHER TRADES WITHIN THE CEILING CAVITY.

C. ELECTRICAL CONTRACTOR SHALL COORDINATE T-GRID, WOOD AND SPECIALTY CEILING SYSTEMS WITH ARCHITECT PRIOR TO ORDERING.

D. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL REQUIRED PARTS AND PIECES FOR A COMPLETE INSTALLATION.

E. ALL REMOTE DRIVERS SHALL BE LOCATED IN AN ACCESSIBLE LOCATION THAT MEETS THE AMBIENT TEMPERATURE REQUIREMENTS OF THE DRIVER. ELECTRICAL CONTRACTOR SHALL VERIFY WITH SUBMITTED SHOP DRAWING WIRING DIAGRAMS THAT ALL DRIVER LOCATIONS ARE WITHIN MANUFACTURER'S RECOMMENDED DISTANCE REQUIREMENTS.

NOTES:

1.

TAG	PERFORMANCE & ELECTRICAL DATA				LIGHT FIXTURE PROPERTIES				OPTIONS & ACCESSORIES							NO EQUALS	ACCEPTABLE MANUFACTURERS	MOUNTING				SEE NOTE
	LUMENS	KELVIN TEMP	LOAD	FIXTURE VOLTAGE	DESCRIPTION	MANUFACTURER	CATALOG SERIES	DEPTH OR HEIGHT	ACCESSORIES / DOOR / REFLECTOR / TRIM TYPE	COLOR / FINISH	DIMMING TYPE	DRIVER LOCATION	LENS TYPE	REQUIRED LISTINGS	SENSOR TYPE			MATERIAL	TYPE	HEIGHT	HEIGHT TO	
A	3050 LM	4000K	18 VA	120V	LED STRIP FIXTURE	LITHONIA	FEM LED L48 3000LM MD MVOLT GZ10 40K 80CRI	0' - 6"										ES	PENDANT	10'-0"	LOWER LEVEL	
B	600 LM	4000K	15 VA	120V	SURFACE LED VAPORTIGHT	LITHONIA	OLVTCM	0' - 10 5/8"										ES	SURFACE	-	-	
OA			37 VA	120 V	EXTERIOR WALL PACK	NUVO	65/060R1	0' - 9"										-	WALL	ON PLANS	-	

MOTOR WIRING SCHEDULE

GENERAL NOTES:

A. OBTAIN SUPPLIERS SHOP DRAWINGS/WIRING DIAGRAMS TO VERIFY LOCATION AND REQUIREMENTS PRIOR TO ROUGH-IN.

B. FURNISH HACR TYPE BREAKERS FOR ALL HVAC EQUIPMENT.

NOTE:

1. ***

TAG	DRIVING	LOCATION	POWER				FEED FROM		BREAKER		WIRING				SEE NOTE
			SPECIFIED SIZE	VOLTAGE	PHASE	ELECTRICAL LOAD	PANEL	CIRCUIT	SIZE	POLES	PHASE & NEUTRAL QTY	PHASE & NEUTRAL SIZE	GROUND SIZE	COND.	
EF-1	EXHAUST FAN	101	1/6 HP	120 V	1	456 VA	LA	17	15	1	2	12	12	1/2"	
EF-2	EXHAUST FAN	101	1/15 HP	120 V	1	252 VA	LA	14	15	1	2	12	12	1/2"	
P1A	POOL PUMP	101	30 HP	208 V	3	31700 VA	LA	1,3,5	175	3	3	2	6	1-1/2"	

MOTOR WIRING SCHEDULE - ALTERNATE

GENERAL NOTES:

A. OBTAIN SUPPLIERS SHOP DRAWINGS/WIRING DIAGRAMS TO VERIFY LOCATION AND REQUIREMENTS PRIOR TO ROUGH-IN.

B. FURNISH HACR TYPE BREAKERS FOR ALL HVAC EQUIPMENT.

NOTE:

1. EQUIPMENT IS SHOWN FOR ALTERNATE BID. SEE PANEL SCHEDULE LA-ALT FOR ADDITIONAL INFORMATION.
2. VERIFY EXACT EQUIPMENT REQUIREMENTS WITH MANUFACTURER.

TAG	DRIVING	LOCATION	POWER				FEED FROM		BREAKER		WIRING				SEE NOTE
			SPECIFIED SIZE	VOLTAGE	PHASE	ELECTRICAL LOAD	PANEL	CIRCUIT	SIZE	POLES	PHASE & NEUTRAL QTY	PHASE & NEUTRAL SIZE	GROUND SIZE	COND.	
AC1-ALT	AIR COMPRESSOR	101		120 V	1	0 VA	LA-ALT	20	0	1	2	2			1, 2
EF-1-ALT	EXHAUST FAN	101	1/6 HP	120 V	1	456 VA	LA-ALT	17	15	1	2	12	12	1/2"	1
EF-2-ALT	EXHAUST FAN	101	1/15 HP	120 V	1	252 VA	LA-ALT	14	15	1	2	12	12	1/2"	1
P1A-ALT	POOL PUMP	101	30 HP	208 V	3	31700 VA	LA-ALT	1,3,5	175	3	3	2	6	1-1/2"	1
P3A-ALT	FILTER BACKWASH PUMP	101	5 HP	208 V	3	6016 VA	LA-ALT	19,21,23	20	3	3	8	10	3/4"	1

SPECIAL PURPOSE OUTLET SCHEDULE

GENERAL NOTE:

A. LOADS SHOWN ON THE SPECIAL PURPOSE OUTLET SCHEDULE MAY REQUIRE EITHER A RECEPTACLE (A PLUG-IN CONTACT DEVICE AS DEFINED BY THE NEC) OR MAY REQUIRE A DIRECT CONNECTION (HARDWIRED) TO THE LOADS BRANCH CIRCUIT. FOR EACH LOAD THE ELECTRICAL CONTRACTOR SHALL CONFIRM THE TYPE OF TERMINATION REQUIRED AS INDICATED ON THE EQUIPMENT MANUFACTURER'S SHOP DRAWINGS. ALL RECEPTACLES, DISCONNECT SWITCHES, OR OTHER DEVICES REQUIRED FOR TERMINATION OF THESE CIRCUITS SHALL BE INCLUDED IN THE CONTRACTOR'S BASE BID. LOADS ON THIS SCHEDULE MAY ALSO REQUIRE NON-STANDARD ELECTRICAL ROUGH-IN HEIGHTS. ELECTRICAL CONTRACTOR SHALL ALOS VERIFY RACEWAY ROUGH-IN...

B. ALL MOUNTING HEIGHTS ARE MEASURED FROM ABOVE FINISHED FLOOR OR GRADE TO THE CENTER OF BOX, UNLESS OTHERWISE INDICATED.

C. IF THE NEMA TYPE IS LEFT BLANK IT IS A DIRECT CONNECTION.

NOTE:

1. SUBFED FROM CHEMICAL CONTROLLER (C1A). SEE WIRING SCHEMATIC ON SHEET PL501 FOR ADDITIONAL INFORMATION.

TAG	DRIVING	LOCATION	POWER				FEED FROM		BREAKER		WIRING				SEE NOTE
			SPECIFIED SIZE	VOLTAGE	PHASE	ELECTRICAL LOAD	PANEL	CIRCUIT	SIZE	POLES	PHASE & NEUTRAL QTY	PHASE & NEUTRAL SIZE	GROUND SIZE	COND.	
AL1	CO2 SENSOR	101	-	120 V	1	500 VA	LA	11	20	1	2	12	12	1/2"	
AP1A	PH CONTROL	101	-	120 V	1	70 VA	---	---	---	1	2	12	12	1/2"	1
C1A-1	CHEMICAL CONTROLLER	101	-	120 V	1	1200 VA	LA	6	20	1	2	12	12	1/2"	
C1A-2	CHEMICAL CONTROLLER	101	-	120 V	1	1200 VA	LA	8	20	1	2	12	12	1/2"	
CP1A	CHLORINE FEEDER	101	-	120 V	1	70 VA	---	---	---	1	2	12	12	1/2"	1
EUH-1	ELECTRIC UNIT HEATER	101	22.5 MCA	208 V	1	4680 VA	LA	13,15	30	2	2	10	10	3/4"	
EUH-2	ELECTRIC UNIT HEATER	101	11.3 MCA	208 V	1	2350 VA	LA	10,12	20	2	2	12	12	1/2"	
H1A	HEATER	101	14 A	120 V	1	1680 VA	LA	4	20	1	2	12	12	1/2"	

SPECIAL PURPOSE OUTLET SCHEDULE - ALTERNATIVE

GENERAL NOTE:

A. LOADS SHOWN ON THE SPECIAL PURPOSE OUTLET SCHEDULE MAY REQUIRE EITHER A RECEPTACLE (A PLUG-IN CONTACT DEVICE AS DEFINED BY THE NEC) OR MAY REQUIRE A DIRECT CONNECTION (HARDWIRED) TO THE LOADS BRANCH CIRCUIT. FOR EACH LOAD THE ELECTRICAL CONTRACTOR SHALL CONFIRM THE TYPE OF TERMINATION REQUIRED AS INDICATED ON THE EQUIPMENT MANUFACTURER'S SHOP DRAWINGS. ALL RECEPTACLES, DISCONNECT SWITCHES, OR OTHER DEVICES REQUIRED FOR TERMINATION OF THESE CIRCUITS SHALL BE INCLUDED IN THE CONTRACTOR'S BASE BID. LOADS ON THIS SCHEDULE MAY ALSO REQUIRE NON-STANDARD ELECTRICAL ROUGH-IN HEIGHTS. ELECTRICAL CONTRACTOR SHALL ALOS VERIFY RACEWAY ROUGH-IN...

B. ALL MOUNTING HEIGHTS ARE MEASURED FROM ABOVE FINISHED FLOOR OR GRADE TO THE CENTER OF BOX, UNLESS OTHERWISE INDICATED.

C. IF THE NEMA TYPE IS LEFT BLANK IT IS A DIRECT CONNECTION.

NOTE:

1. SUBFED FROM CHEMICAL CONTROLLER (C1A-ALT). SEE WIRING SCHEMATIC ON SHEET PL501 FOR ADDITIONAL INFORMATION.
2. EQUIPMENT IS SHOWN FOR ALTERNATE BID. SEE PANEL SCHEDULE LA-ALT FOR ADDITIONAL INFORMATION.

TAG	DRIVING	LOCATION	POWER				FEED FROM		BREAKER		WIRING				SEE NOTE
			SPECIFIED SIZE	VOLTAGE	PHASE	ELECTRICAL LOAD	PANEL	CIRCUIT	SIZE	POLES	PHASE & NEUTRAL QTY	PHASE & NEUTRAL SIZE	GROUND SIZE	COND.	
AL1-ALT	CO2 SENSOR	101	-	120 V	1	500 VA	LA-ALT	11	20	1	2	12	12	1/2"	2
AP1A-ALT	PH CONTROL	101	-	120 V	1	70 VA	---	---	---	1	2	12	12	1/2"	1, 2
C1A-1-ALT	CHEMICAL CONTROLLER	101	-	120 V	1	1200 VA	LA-ALT	6	20	1	2	12	12	1/2"	2
C1A-2-ALT	CHEMICAL CONTROLLER	101	-	120 V	1	1200 VA	LA-ALT	8	20	1	2	12	12	1/2"	2
CP1A-ALT	CHLORINE FEEDER	101	-	120 V	1	70 VA	---	---	---	1	2	12	12	1/2"	1, 2
EUH-1-ALT	ELECTRIC UNIT HEATER	101	22.5 MCA	208 V	1	4680 VA	LA-ALT	13,15	30	2	2	10	10	3/4"	2
EUH-2-ALT	ELECTRIC UNIT HEATER	101	11.3 MCA	208 V	1	2350 VA	LA-ALT	10,12	20	2	2	12	12	1/2"	2
F1A-ALT	FILTER	101	-	120 V	1	500 VA	LA-ALT	18	20	1	2	12	12	1/2"	2
H1A-ALT	HEATER	101	14 A	120 V	1	1680 VA	LA-ALT	4	20	1	2	12	12	1/2"	2

LIGHT FIXTURE SCHEDULE ABBREVIATIONS

NOTE: NOT ALL ABBREVIATIONS INDICATED HERE ARE USED IN THE SCHDULE AND MAY NOT APPLY TO CURRENT PROJECT.

ACCESSORIES / DOOR / REFLECTOR / TRIM TYPE

AS = ASYMMETRIC
B = BAFFLE REFLECTOR
CR = CONTINUOUS RUN
D = DIRECT
D/ID = DIRECT / INDIRECT
DG = DOUBLE GASKETED DOOR FRAME
EM = REMOTE EMERGENCY DRIVER
ID = INDIRECT
S = SYMMETRIC
SG = SINGLE GASKETED DOOR FRAME
SS = STAINLESS STEEL TRIM AND DOOR FRAME
SR = STANDARD REFLECTOR
TG = TRIPLE GASKETED DOOR FRAME, LENS AND BODY
VR = VANDAL RESISTANT
WG = WIRE GUARD
WW = WALL WASH

COLOR / FINISH

B = BLACK
BZ = BRONZE
C = CLEAR
CU = COPPER
CUS = CUSTOM PAINTED FINISH - COLOR AS SELECTED BY ARCHITECT
DBZ = DARK BRONZE
G = GOLD
GL = GLOSS
M = MATTE
NA = NATURAL ALUMINUM
RAL# = RAL NUMBER
S = SILVER
SSP = SEMI-SPECULAR / HAZE
W = WHITE

DIMMING TYPE

0-10-0.1 = 0-10 V 0.1%
0-10-1 = 0-10 V 1%
0-10-5 = 0-10 V 5%
0-10-10 = 0-10 V 10%
BL = BILEVEL / STEP
E = ELDOLED
FF = FORWARD PHASE
D = DALI
DX = DMX
L = LUTRON
N = NONE
O = OSRAM
P = PHASE
RF = REVERSE PHASE

DRIVER LOCATION

I = INTEGRAL
N = NONE
R = REMOTE

LENS TYPE

C = CLEAR
D = DROP DOWN
F = FLUSH
N = NONE
R = REGRESSED
O = OPAL
P = POP UP
PA = PATTERN 12 ACRYLIC LENS - .125" MINIMUM THICKNESS

REQUIRED LISTINGS

= IP ## RATED
AT = AIR TIGHT
C## = CLASS # DIVISION #
DL = DAMP LOCATION
F = FIRE RATED
IC = IC RATED
IR = IMPACT RESISTANT
LR = LIGATURE RESISTANT
SL = SHOWER LIGHT
TR = TAMPER RESISTANT
VR = VANDAL RESISTANT
WL = WET LOCATION

MOUNTING MATERIAL

B = BRICK
C = CONCRETE
CB = CONCRETE BASE
DW = DRYWALL
ES = EXPOSED STRUCTURE
G = GROUND
LG = LAY-IN GRID
M = METAL
PL = PLASTER
S = STONE
T = TILE
V = VARIES
W = WOOD

MOUNTING TYPE

C = COVE
CH = CHAIN - PROVIDE ACCESSORY KIT
CA = CATENARY
MP = MONOPOINT
MPC = MULTIPORT CANOPY
PC = PENDANT - CABLE
PCH = PENDANT - CHAIN
PRS = PENDANT - RIGID STEM
PS = PENDANT - SWAG
PO = POLE
R = RECESSED
S = SURFACE
TC = TRACK - CABLE
TMC = TRACK - MONORAIL - CURVED
TMF = TRACK - MONORAIL - FLEXIBLE
TMS = TRACK - MONORAIL - STRAIGHT
W = WALL

SENSOR TYPE

D = DAYLIGHT SENSOR
MO = MULTI-LEVEL OCCUPANCY SENSOR
N = NONE
O = OCCUPANCY SENSOR
P = PHOTOCELL

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE

Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RJJ

ELECTRICAL SCHEDULES

E-601

PANEL: LA — New Construction

VOLTAGE:	208Y/120V	BUS RATING:	225 A
PHASE / WIRE:	3P / 4W	MAIN TYPE:	MCB
SVC. ENTRANCE LABEL:		MAIN RATING:	225 A
MINIMUM AIC:	42,000 AMPS	UPSTREAM BREAKER RATING:	225 A
IS SERIES RATED ALLOWED:		SPD:	

FEED-THRU LUGS:	
MOUNTING:	SURFACE
ENCLOSURE:	NEMA 3R
200% NEUTRAL:	
PANELBOARD TYPE:	

CKT	DESCRIPTION	TRIP	POLE	CB TYPE	LOAD TYPE	LOAD	A		B		C		LOAD	LOAD TYPE	CB TYPE	POLE	TRIP	DESCRIPTION	CKT
1	MOTOR - P1A	175 A	3		EQ	31700 W	10567 VA	700 VA					700 W	Lighting		1	20 A	POOL LIGHTING (GFI)	2
3	--	--	--	--	--	--			10567 VA	1680 VA			1680 W	EQ		1	20 A	SPO - H1A	4
5	--	--	--	--	--	--					10567 VA	1200 VA	1200 W	EQ		1	20 A	SPO - C1A-1	6
7	MECHANICAL ROOM LIGHTING	20 A	1		L	51 W	51 VA	1200 VA					1200 W	EQ		1	20 A	SPO - C1A-2	8
9	MECHANICAL ROOM RECEPTACLES	20 A	1		R	720 W			720 VA	1175 VA			2350 W	H		2	20 A	SPO - EUH-2	10
11	SPO - AL1	20 A	1		EQ	500 W					500 VA	1175 VA	--	--	--	--	--	--	12
13	SPO - EUH-1	20 A	2		H	4680 W	2340 VA	252 VA					252 W	V		1	15 A	MOTOR - EF-2	14
15	--	--	--	--	--	--			2340 VA	0 VA			0 W	EQ		1	20 A	SPO - IRRIGATION (EXISTING)	16
17	MOTOR - EF-1	15 A	1		V	456 W					456 VA	0 VA	--	--		1	20 A	SPARE	18
19	SPARE	20 A	1		--	--	0 VA	0 VA					--	--		1	20 A	SPARE	20
21	SPARE	20 A	1		--	--			0 VA	0 VA			--	--		1	20 A	SPARE	22
23	SPARE	20 A	1		--	--					0 VA	0 VA	--	--		1	20 A	SPARE	24
25	SPACE	--	1		--	--	--	--					--	--		1	--	SPACE	26
27	SPACE	--	1		--	--			--	--			--	--		1	--	SPACE	28
29	SPACE	--	1		--	--					--	--	--	--		1	--	SPACE	30
31	SPACE	--	1		--	--	--	--					--	--		1	--	SPACE	32
33	SPACE	--	1		--	--			--	--			--	--		1	--	SPACE	34
35	SPACE	--	1		--	--					--	--	--	--		1	--	SPACE	36
37	SPACE	--	1		--	--	--	--					--	--		1	--	SPACE	38
39	SPACE	--	1		--	--			--	--			--	--		1	--	SPACE	40
41	SPACE	--	1		--	--					--	--	--	--		1	--	SPACE	42
							15110 VA		16482 VA		13898 VA								

PANEL TOTALS	
TOTAL CONN. LOAD:	45489 VA
TOTAL EST. DEMAND:	53427 VA
TOTAL CONN. AMPS:	126 A
TOTAL EST. DEMAND AMPS:	148 A

NOTES:

LOAD TYPE	CONNECTED LOAD	DEMAND FACTOR	ESTIMATED DEMAND
EQ	4580 VA	100.00%	4580 VA
H	7030 VA	100.00%	7030 VA
L	51 VA	125.00%	64 VA
Motor	31700 VA	125.00%	39625 VA
R	720 VA	100.00%	720 VA
V	708 VA	100.00%	708 VA
Lighting	700 VA	100.00%	700 VA

CIRCUIT BREAKER TYPE ABBREVIATIONS:	LOAD TYPE ABBREVIATIONS:		
GFCI = GROUND FAULT CIRCUIT INTERRUPTER	C = COOLING	F = FARM	R = RECEPTACLE
HACR = HEATING AND AIR CONDITIONING RATED	ECD = ELECTRIC CLOTHES DRYER	GL1 = GENERAL LIGHTING - 2 W / SQ FT	SA = SMALL APPLIANCE
HB = HAND-BLOCKING DEVICE	EL = ELEVATOR	GL2 = GENERAL LIGHTING - 3 W / SQ FT	T = TRANSFORMER
L = LOCKABLE	EQ = EQUIPMENT	H = HEATING	V = VENTILATING
ST = SHUNT TRIP	ER1 = ELECTRIC RANGE LESS THAN 3.5 KW	K = KITCHEN EQUIPMENT - NON-DWELLING UNIT	W = WELDING
	ER2 = ELECTRIC RANGE 3.5 - 8.75 KW	L = LIGHTING	X = XRAY
	EX = EXISTING	P = PANEL	YR = YEAR ROUND

PANEL: LA-ALT — New Construction

VOLTAGE:	208Y/120V	BUS RATING:	225 A
PHASE / WIRE:	3P / 4W	MAIN TYPE:	MCB
SVC. ENTRANCE LABEL:		MAIN RATING:	225 A
MINIMUM AIC:	42,000 AMPS	UPSTREAM BREAKER RATING:	225 A
IS SERIES RATED ALLOWED:		SPD:	

FEED-THRU LUGS:	
MOUNTING:	SURFACE
ENCLOSURE:	NEMA 3R
200% NEUTRAL:	
PANELBOARD TYPE:	

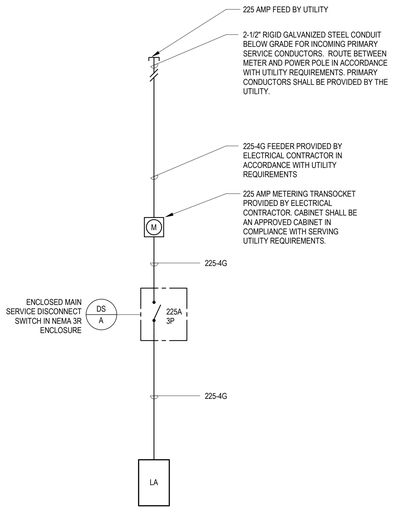
CKT	DESCRIPTION	TRIP	POLE	CB TYPE	LOAD TYPE	LOAD	A		B		C		LOAD	LOAD TYPE	CB TYPE	POLE	TRIP	DESCRIPTION	CKT
1	MOTOR - P1A-ALT	175 A	3		EQ	31700 W	10567 VA	0 VA					--	--		1	20 A	POOL LIGHTING (GFI)	2
3	--	--	--	--	--	--			10567 VA	1680 VA			1680 W	EQ		1	20 A	SPO - H1A-ALT	4
5	--	--	--	--	--	--					10567 VA	1200 VA	1200 W	EQ		1	20 A	SPO - C1A-1-ALT	6
7	MECHANICAL ROOM LIGHTING	20 A	1		--	--	0 VA	1200 VA					1200 W	EQ		1	20 A	SPO - C1A-2-ALT	8
9	MECHANICAL ROOM RECEPTACLES	20 A	1		R	720 W			720 VA	1175 VA			2350 W	H		2	20 A	SPO - EUH-2-ALT	10
11	SPO - AL1-ALT	20 A	1		EQ	500 W					500 VA	1175 VA	--	--	--	--	--	--	12
13	SPO - EUH-1-ALT	20 A	2		H	4680 W	2340 VA	252 VA					252 W	V		1	15 A	MOTOR - EF-2-ALT	14
15	--	--	--	--	--	--			2340 VA	0 VA			0 W	EQ		1	20 A	SPO - IRRIGATION (EXISTING)	16
17	MOTOR - EF-01	20 A	1		V	456 W					456 VA	500 VA	500 W	EQ		1	20 A	SPO - F1A-ALT	18
19	MOTOR - P3A-ALT	35 A	3		EQ	6016 W	2005 VA	0 VA					0 W	EQ		1	20 A	MOTOR - AC1-ALT	20
21	--	--	--	--	--	--			2005 VA	0 VA			--	--		1	20 A	SPARE	22
23	--	--	--	--	--	--					2005 VA	0 VA	--	--		1	20 A	SPARE	24
25	SPARE	20 A	1		--	--	0 VA	0 VA					--	--		1	20 A	SPARE	26
27	SPARE	20 A	1		--	--			0 VA	0 VA			--	--		1	20 A	SPARE	28
29	SPARE	20 A	1		--	--					0 VA	0 VA	--	--		1	20 A	SPARE	30
31	SPACE	--	1		--	--	--	--					--	--		1	--	SPACE	32
33	SPACE	--	1		--	--			--	--			--	--		1	--	SPACE	34
35	SPACE	--	1		--	--					--	--	--	--		1	--	SPACE	36
37	SPACE	--	1		--	--	--	--					--	--		1	--	SPACE	38
39	SPACE	--	1		--	--			--	--			--	--		1	--	SPACE	40
41	SPACE	--	1		--	--					--	--	--	--		1	--	SPACE	42
							16364 VA		18487 VA		16403 VA								

PANEL TOTALS	
TOTAL CONN. LOAD:	51254 VA
TOTAL EST. DEMAND:	59179 VA
TOTAL CONN. AMPS:	142 A
TOTAL EST. DEMAND AMPS:	164 A

NOTES:
EQUIPMENT IS SHOWN ON THIS PANEL SCHEDULE IS FOR ALTERNATE BID.

LOAD TYPE	CONNECTED LOAD	DEMAND FACTOR	ESTIMATED DEMAND
EQ	11096 VA	100.00%	11096 VA
H	7030 VA	100.00%	7030 VA
Motor	31700 VA	125.00%	39625 VA
R	720 VA	100.00%	720 VA
V	708 VA	100.00%	708 VA

CIRCUIT BREAKER TYPE ABBREVIATIONS:	LOAD TYPE ABBREVIATIONS:		
GFCI = GROUND FAULT CIRCUIT INTERRUPTER	C = COOLING	F = FARM	R = RECEPTACLE
HACR = HEATING AND AIR CONDITIONING RATED	ECD = ELECTRIC CLOTHES DRYER	GL1 = GENERAL LIGHTING - 2 W / SQ FT	SA = SMALL APPLIANCE
HB = HAND-BLOCKING DEVICE	EL = ELEVATOR	GL2 = GENERAL LIGHTING - 3 W / SQ FT	T = TRANSFORMER
L = LOCKABLE	EQ = EQUIPMENT	H = HEATING	V = VENTILATING
ST = SHUNT TRIP	ER1 = ELECTRIC RANGE LESS THAN 3.5 KW	K = KITCHEN EQUIPMENT - NON-DWELLING UNIT	W = WELDING
	ER2 = ELECTRIC RANGE 3.5 - 8.75 KW	L = LIGHTING	X = XRAY
	EX = EXISTING	P = PANEL	YR = YEAR ROUND



A1 ONE-LINE POWER DIAGRAM
NOT TO SCALE

COPPER FEEDER SCHEDULE

FEEDER AMPACITY	CONDUCTOR SIZE (kcmil)		CONDUIT SIZE	
	PH AND N	GRD	(3) AND (3G)	(4) AND (4G)
50	#8	#10	3/4"	1"
60	#6	#10	3/4"	1"
70	#4	#8	1-1/4"	1-1/4"
80	#4	#8	1-1/4"	1-1/4"
100	#3	#8	1-1/4"	1-1/4"
110	#2	#6	1-1/4"	1-1/2"
125	#1	#6	1-1/2"	2"
150	#1/0	#6	1-1/2"	2"
175	#2/0	#6	2"	2"
200	#3/0	#6	2"	2-1/2"
225	#4/0	#4	2"	2-1/2"
250	#250	#4	2-1/2"	3"
300	#350	#4	3"	3"
350	#500	#3	3"	3-1/2"
400	(2) #3/0	(2) #3	(2) 2"	(2) 2-1/2"
450	(2) #4/0	(2) #2	(2) 2"	(2) 2-1/2"
500	(2) #250	(2) #2	(2) 2-1/2"	(2) 3"
600	(2) #350	(2) #1	(2) 3"	(2) 3"
700	(2) #500	(2) #1/0	(2) 3"	(2) 3-1/2"
800	(2) #600	(2) #1/0	(2) 3-1/2"	(2) 4"
1000	(3) #400	(3) #2/0	(3) 3"	(3) 3-1/2"
1200	(3) 600	(3) #3/0	(3) 3-1/2"	(3) 4"
1600	(4) 600	(4) #4/0	(4) 3-1/2"	(4) 4"
2000	(5) 600	(5) #250	(5) 3-1/2"	(5) 4"

GENERAL NOTES:

1. THE ABOVE FEEDER SCHEDULE IS A SCHEDULE OF TYPICAL FEEDERS AND SOME SIZES MAY NOT BE UTILIZED.
2. ALL CONDUCTOR AMPACITIES ARE BASED ON TABLE 310.15(B)(16) OF THE NEC FOR COPPER CONDUCTOR TYPE THW/THWN.
3. FEEDER SIZES SHOWN ON THE RISER DIAGRAM INDICATE CIRCUIT BREAKER AMPACITIES AND DO NOT ACCOUNT FOR VOLTAGE DROP.

200 - 4G
- FEEDER DESIGNATION
- SYSTEM DESCRIPTION
  (3) 3PH, 3W
  (3G) 3PH, 3W + GRD
  (4) 3PH, 4W
  (4G) 3PH, 4W + GRD
- CONDUCTOR AMPACITY (SEE FEEDER SCHEDULE)

ONE LINE DIAGRAM SYMBOLS

- X — DISCONNECT SWITCH; SIZE AS INDICATED ON DRAWINGS; - (X) INDICATES TYPE: (NONE) NON-FUSED, (F) FUSED, (CB) CIRCUIT BREAKER
- M X — MANUAL MOTOR STARTER; - (X) INDICATES MOTOR CONTROLLED
- X — MAGNETIC MOTOR STARTER; - (X) INDICATES MOTOR CONTROLLED
- X — MAGNETIC MOTOR STARTER AND DISCONNECT COMBINATION; - (X) INDICATES MOTOR CONTROLLED
- VFD X — VARIABLE FREQUENCY DRIVE; - (X) INDICATES MOTOR CONTROLLED
- N, E, L — TRANSFER SWITCH
- K — KIRK KEY INTERLOCK SYSTEM
- GROUND CONNECTION TO SYSTEM AND / OR EQUIPMENT
- LIGHTNING ARRESTER WITH GROUND CONNECTION TO PROTECT ALL PHASES
- POTHEAD
- STRESS CONE
- RESISTOR
- CAPACITOR
- XXX / XXX — PANELBOARD; - TOP DESIGNATES PANELBOARD TYPE; - BOTTOM DESIGNATES PANELBOARD ID
- XA, XP — CIRCUIT BREAKER; - (XA) INDICATES TRIP SIZE; - (XP) INDICATES NUMBER OF POLES
- XAF, XAT — CIRCUIT BREAKER; - PRIMARY DRAW OUT; - (XAF) INDICATES FRAME SIZE; - (XAT) INDICATES TRIP SIZE
- XAF, XAT — CIRCUIT BREAKER; - LOW VOLTAGE DRAW OUT; - (XAF) INDICATES FRAME SIZE; - (XAT) INDICATES TRIP SIZE
- ST — SHUNT TRIP
- MO — MOTOR OPERATOR FOR CIRCUIT BREAKERS OR SWITCHES
- SWITCH; - FUSED CUTOUT
- SWITCH; - UN-FUSED CUTOUT
- CONTACT; - NORMALLY OPEN
- CONTACT; - NORMALLY CLOSED
- OVERLOAD RELAY
- XA — FUSE; - (XA) INDICATES RATING
- GF — GROUND FAULT
- G — GENERATOR
- Δ, Y — TRANSFORMER; - DRY TYPE, UOI IDENTIFICATION
- TRANSFORMER; - POTENTIAL
- TRANSFORMER; - CURRENT
- EMERGENCY POWER OFF

WTI
WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #22271

CONSULTANTS

GRAEF
116 S. Adams St., Suite 201
Green Bay, WI 54301
920 / 592 9440

KIWANIS OUTDOOR POOL PHASE II

550 GARLAND DR,
NORTHGLENN, CO 80234

1/27/2023
COLORADO LICENSED
JESSICA LEE CULVER
56059
PROFESSIONAL ENGINEER

REVISION SCHEDULE		
Number	Description	Date

ISSUE DATE: 01/27/23
DRAWN BY: JTO
CHECKED BY: RIJ

ELECTRICAL ONE-LINE POWER DIAGRAM & PANEL SCHEDULES

E-701