

RETURN WITH BID

State of _____)
) ss.
County of _____)

AFFIDAVIT

_____, of _____,
(name of affiant) *(bidder)*

being first duly sworn upon oath, states as follows:

1. That I am the _____ of _____
(Officer or position) *(Bidder)*
and have personal knowledge of the facts herein stated.

2. That, if selected under this bid proposal, _____ will
(Bidder)
maintain a business office in the State of Illinois which will be located in _____
County, Illinois.

3. That this business office will serve as the primary place of employment for any persons
employed in the construction contemplated by this bid proposal.

4. That this Affidavit is given as a requirement of state law as provided in Section 30-22(8) of
the Illinois Procurement Code.

(Signature)

(Printed name of Affiant)

This instrument was signed and attested before me on the _____ day of _____, 20 ____

by _____.
(Notary Public Name)

(Notary Public Signature)

(NOTARY SEAL)

BID PROPOSAL INSTRUCTIONS

ABOUT IDOT PROPOSALS: All proposals are potential bidding proposals. Each proposal contains all certifications and affidavits, a proposal signature sheet and a proposal bid bond.

PREQUALIFICATION

Any contractor who desires to become pre-qualified to bid on work advertised by IDOT must submit the properly completed pre-qualification forms to the Bureau of Construction no later than 4:30 p.m. prevailing time twenty-one days prior to the letting of interest. This pre-qualification requirement applies to first time contractors, contractors renewing expired ratings, contractors maintaining continuous pre-qualification or contractors requesting revised ratings. To be eligible to bid, existing pre-qualification ratings must be effective through the date of letting.

WHO CAN BID ?

Bids will be accepted from only those companies that request and receive written Authorization to Bid from IDOT's Central Bureau of Construction.

REQUESTS FOR AUTHORIZATION TO BID

Contractors wanting to bid on items included in a particular letting must submit the properly completed "Request for Authorization to Bid/or Not For Bid Status" (BDE 124) and the ORIGINAL "Affidavit of Availability" (BC 57) to the proper office no later than 4:30 p.m. prevailing time, three (3) days prior to the letting date.

WHAT CONSTITUTES WRITTEN AUTHORIZATION TO BID?

When a prospective prime bidder submits a "Request for Authorization to Bid/or Not For Bid Status"(BDE 124) he/she must indicate at that time which items are being requested For Bidding purposes. Only those items requested For Bidding will be analyzed. After the request has been analyzed, the bidder will be issued an **Authorization to Bid or Not for Bid Report**, approved by the Central Bureau of Construction and the Chief Procurement Officer that indicates which items have been approved For Bidding. If **Authorization to Bid** cannot be approved, the **Authorization to Bid or Not for Bid Report** will indicate the reason for denial.

ABOUT AUTHORIZATION TO BID

Firms that have not received an Authorization to Bid or Not For Bid Report within a reasonable time of complete and correct original document submittal should contact the Department as to the status. Firms unsure as to authorization status should call the Prequalification Section of the Bureau of Construction at the number listed at the end of these instructions.

ADDENDA AND REVISIONS

It is the bidder's responsibility to determine which, if any, addenda or revisions pertain to any project they may be bidding. Failure to incorporate all relevant addenda or revisions may cause the bid to be declared unacceptable.

Each addendum or revision will be included with the Electronic Plans and Proposals. Addenda and revisions will also be placed on the Addendum/Revision Checklist and each subscription service subscriber will be notified by e-mail of each addendum and revision issued.

The Internet is the Department's primary way of doing business. The subscription service emails are an added courtesy the Department provides. It is suggested that bidders check IDOT's website at <http://www.idot.illinois.gov/doing-business/procurements/construction-services/construction-bulletins/transportation-bulletin/index#TransportationBulletin> before submitting final bid information.

IDOT IS NOT RESPONSIBLE FOR ANY E-MAIL FAILURES.

Addenda questions may be directed to the Contracts Office at (217)782-7806 or DOT.D&Econtracts@illinois.gov

Technical questions about downloading these files may be directed to Tim Garman at (217)524-1642 or Timothy.Garman@illinois.gov.

STANDARD GUIDELINES FOR SUBMITTING BIDS

- All pages should be single sided.
- Use the Cover Page that is provided in the Bid Proposal (posted on the IDOT Web Site) as the first page of your submitted bid. It has the item number in large bold type in the upper left-hand corner and lines provided for your company name and address in the upper right-hand corner.
- Do not use report covers, presentation folders or special bindings and do not staple multiple times on left side like a book. Use only 1 staple in the upper left hand corner. Make sure all elements of your bid are stapled together including the bid bond or guaranty check (if required).
- Do not include any certificates of eligibility, your authorization to bid, Addendum Letters or affidavit of availability.
- Do not include the Subcontractor Documentation with your bid (pages i – iii and pages a – g). This documentation is required only if you are awarded the project.
- Use the envelope cover sheet (provided with the proposal) as the cover for the proposal envelope.
- Do not rely on overnight services to deliver your proposal prior to 10 AM on letting day. It will not be read if it is delivered after 10 AM.
- Do not submit your Substance Abuse Prevention Program (SAPP) with your bid. If you are awarded the contract this form is to be submitted to the district engineer at the pre-construction conference.

BID SUBMITTAL CHECKLIST

- Cover page** (the sheet that has the item number on it) – This should be the first page of your bid proposal, **followed by your bid (the Schedule of Prices/Pay Items)**. If you are using special software or CBID to generate your schedule of prices, do not include the blank pages of the schedule of prices that came with the proposal package.
- Page 4 (Item 9)** – Check “YES” if you will use a subcontractor(s) with an annual value over \$50,000. Include the subcontractor(s) name, address, general type of work to be performed and the dollar amount. If you will use subcontractor(s) but are uncertain who or the dollar amount; check “YES” but leave the lines blank.
- After page 4** – Insert the following documents: The **Illinois Office Affidavit** (Not applicable to federally funded projects) followed by Cost Adjustments for Steel, Bituminous and Fuel (if applicable) and the Contractor Letter of Assent (if applicable). The general rule should be, if you don’t know where it goes, put it after page 4.
- Page 10 (Paragraph J)** – Check “YES” or “NO” whether your company has any business in Iran.
- Page 10 (Paragraph K)** – (Not applicable to federally funded projects) List the name of the apprenticeship and training program sponsor holding the certificate of registration from the US Department of Labor. If no applicable program exists, please indicate the work/job category. Do not include certificates with your bid. Keep the certificates in your office in case they are requested by IDOT.
- Page 11 (Paragraph L)** – A copy of your State Board of Elections certificate of registration is no longer required with your bid.
- Page 11 (Paragraph M)** – Indicate if your company has hired a lobbyist in connection with the job for which you are submitting the bid proposal.
- Page 12 (Paragraph C)** – This is a work sheet to determine if a completed Form A is required. It is not part of the form and you do not need to make copies for each completed Form A.
- Pages 14-17 (Form A)** – One Form A (4 pages) is required for each applicable person in your company. Copies of the forms can be used and only need to be changed when the information changes. The certification signature and date must be original for each letting. **Do not staple the forms together.** If you answered “NO” to all of the questions in Paragraph C (page 12), complete the first section (page 14) with your company information and then sign and date the Not Applicable statement on page 17.
- Page 18 (Form B)** - If you check “YES” to having other current or pending contracts it is acceptable to use the phrase, “See Affidavit of Availability on file”. **Ownership Certification** (at the bottom of the page) - Check N/A if the Form A(s) you submitted accounts for 100 percent of the company ownership. Check YES if any percentage of ownership falls outside of the parameters that require reporting on the Form A. Checking NO indicates that the Form A(s) you submitted is not correct and you will be required to submit a revised Form A.
- Page 20 (Workforce Projection)** – Be sure to include the Duration of the Project. It is acceptable to use the phrase “Per Contract Specifications”.

Proposal Bid Bond – (Insert after the proposal signature page) Submit your proposal Proposal Bid Bond (if applicable) using the current Proposal Bid Bond form provided in the proposal package. The Power of Attorney page should be stapled to the Proposal Bid Bond. If you are using an electronic bond, include your bid bond number on the Proposal Bid Bond and attach the Proof of Insurance printed from the Surety’s Web Site.

Disadvantaged Business Utilization Plan and/or Good Faith Effort – The last items in your bid should be the DBE Utilization Plan (SBE 2026), followed by the DBE Participation Statement (SBE 2025) and supporting paperwork. If you have documentation of a Good Faith Effort, it is to follow the SBE Forms.

The Bid Letting is now available in streaming Audio/Video from the IDOT Web Site. A link to the stream will be placed on the main page of the current letting on the day of the Letting. The stream will not begin until 10 AM. The actual reading of the bids does not begin until approximately 10:30 AM.

Following the Letting, the As-Read Tabulation of Bids will be posted by the end of the day. You will find the link on the main Web page for the current letting.

QUESTIONS: pre-letting up to execution of the contract

Contractor pre-qualification	217-782-3413
Small Business, Disadvantaged Business Enterprise (DBE)	217-785-4611
Contracts, Bids, Letting process or Internet downloads	217-782-7806
Estimates Unit.....	217-785-3483
Aeronautics.....	217-785-8515
IDNR (Land Reclamation, Water Resources, Natural Resources).....	217-782-6302

QUESTIONS: following contract execution

Subcontractor documentation, payments	217-782-3413
Railroad Insurance	217-785-0275

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Proposal Submitted By
Name
Address
City

Letting November 21, 2014

NOTICE TO PROSPECTIVE BIDDERS

This proposal can be used for bidding purposes by only those companies that request and receive written AUTHORIZATION TO BID from IDOT's Central Bureau of Construction.
BIDDERS NEED NOT RETURN THE ENTIRE PROPOSAL

Notice to Bidders, Specifications, Proposal, Contract and Contract Bond



**Illinois Department
of Transportation**

Springfield, Illinois 62764

**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**

PLEASE MARK THE APPROPRIATE BOX BELOW:

- A Bid Bond is included.
- A Cashier's Check or a Certified Check is included.
- An Annual Bid Bond is included or is on file with IDOT.

Prepared by

S

Checked by

(Printed by authority of the State of Illinois)

Page intentionally left blank

RETURN WITH BID



PROPOSAL

TO THE DEPARTMENT OF TRANSPORTATION

1. Proposal of _____

Taxpayer Identification Number (Mandatory) _____ a

For the improvement identified and advertised for bids in the Invitation for Bids as:

**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**

This project consists of installing a new well and making improvements to the pump station at the Missouri Avenue Pump Station on I-64 in St. Clair County.

2. The undersigned bidder will furnish all labor, material and equipment to complete the above described project in a good and workmanlike manner as provided in the contract documents provided by the Department of Transportation. This proposal will become part of the contract and the terms and conditions contained in the contract documents will govern performance and payments.

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3. **ASSURANCE OF EXAMINATION AND INSPECTION/WAIVER.** The undersigned bidder further declares that he/she has carefully examined the proposal, plans, specifications, addenda, form of contract and contract bond, and special provisions, and that he/she has inspected in detail the site of the proposed work, and that he/she has familiarized themselves with all of the local conditions affecting the contract and the detailed requirements of construction, and understands that in making this bid proposal he/she waives all right to plead any misunderstanding regarding the same.

4. **EXECUTION OF CONTRACT AND CONTRACT BOND.** The undersigned bidder further agrees to execute a contract for this work and present the same to the department within fifteen (15) days after the contract has been mailed to him/her. The undersigned further agrees that he/she and his/her surety will execute and present within fifteen (15) days after the contract has been mailed to him/her contract bond satisfactory to and in the form prescribed by the Department of Transportation, in the penal sum of the full amount of the contract, or as specified in the special provisions, guaranteeing the faithful performance of the work in accordance with the terms of the contract.

5. **PROPOSAL GUARANTY.** Accompanying this proposal is either a bid bond on the department form, executed by a corporate surety company satisfactory to the department, or a proposal guaranty check consisting of a bank cashier's check or a properly certified check for not less than 5 per cent of the amount bid or for the amount specified in the following schedule:

<u>Amount of Bid</u>	<u>Proposal Guaranty</u>	<u>Amount of Bid</u>	<u>Proposal Guaranty</u>
Up to \$5,000	to \$150	\$2,000,000	to \$100,000
\$5,000 to \$10,000	to \$300	\$3,000,000	to \$150,000
\$10,000 to \$50,000	to \$1,000	\$5,000,000	to \$250,000
\$50,000 to \$100,000	to \$3,000	\$7,500,000	to \$400,000
\$100,000 to \$150,000	to \$5,000	\$10,000,000	to \$500,000
\$150,000 to \$250,000	to \$7,500	\$15,000,000	to \$600,000
\$250,000 to \$500,000	to \$12,500	\$20,000,000	to \$700,000
\$500,000 to \$1,000,000	to \$25,000	\$25,000,000	to \$800,000
\$1,000,000 to \$1,500,000	to \$50,000	\$30,000,000	to \$900,000
\$1,500,000 to \$2,000,000	to \$75,000	over	\$35,000,000
			to \$1,000,000

Bank cashier's checks or properly certified checks accompanying bid proposals will be made payable to the Treasurer, State of Illinois.

If a combination bid is submitted, the proposal guaranties which accompany the individual bid proposals making up the combination will be considered as also covering the combination bid.

The amount of the proposal guaranty check is _____ \$(_____). If this proposal is accepted and the undersigned will fail to execute a contract bond as required herein, it is hereby agreed that the amount of the proposal guaranty will become the property of the State of Illinois, and shall be considered as payment of damages due to delay and other causes suffered by the State because of the failure to execute said contract and contract bond; otherwise, the bid bond will become void or the proposal guaranty check will be returned to the undersigned.

Attach Cashier's Check or Certified Check Here

In the event that one proposal guaranty check is intended to cover two or more bid proposals, the amount must be equal to the sum of the proposal guaranties which would be required for each individual proposal. If the guaranty check is placed in another bid proposal, state below where it may be found.

The proposal guaranty check will be found in the bid proposal for: Item _____

Section No. _____

County _____

Mark the proposal cover sheet as to the type of proposal guaranty submitted.

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6. **COMBINATION BIDS.** The undersigned bidder further agrees that if awarded the contract for the sections contained in the following combination, he/she will perform the work in accordance with the requirements of each individual contract comprising the combination bid specified in the schedule below, and that the combination bid shall be prorated against each section in proportion to the bid submitted for the same. If an error is found to exist in the gross sum bid for one or more of the individual sections included in a combination, the combination bid shall be corrected as provided in the specifications.

When a combination bid is submitted, the schedule below must be completed in each proposal comprising the combination.

If alternate bids are submitted for one or more of the sections comprising the combination, a combination bid must be submitted for each alternate.

Schedule of Combination Bids

Combination No.	Sections Included in Combination	Combination Bid	
		Dollars	Cents

7. **SCHEDULE OF PRICES.** The undersigned bidder submits herewith, in accordance with the rules and instructions, a schedule of prices for the items of work for which bids are sought. The unit prices bid are in U.S. dollars and cents, and all extensions and summations have been made. The bidder understands that the quantities appearing in the bid schedule are approximate and are provided for the purpose of obtaining a gross sum for the comparison of bids. If there is an error in the extension of the unit prices, the unit prices will govern. Payment to the contractor awarded the contract will be made only for actual quantities of work performed and accepted or materials furnished according to the contract. The scheduled quantities of work to be done and materials to be furnished may be increased, decreased or omitted as provided elsewhere in the contract.
8. **AUTHORITY TO DO BUSINESS IN ILLINOIS.** Section 20-43 of the Illinois Procurement Code (the Code) (30 ILCS 500/20-43) provides that a person (other than an individual acting as a sole proprietor) must be a legal entity authorized to do business in the State of Illinois prior to submitting the bid.
9. **EXECUTION OF CONTRACT:** The Department of Transportation will, in accordance with the rules governing Department procurements, execute the contract and shall be the sole entity having the authority to accept performance and make payments under the contract. Execution of the contract by the Chief Procurement Officer (CPO) or the State Purchasing Officer (SPO) is for approval of the procurement process and execution of the contract by the Department. Neither the CPO nor the SPO shall be responsible for administration of the contract or determinations respecting performance or payment there under except as otherwise permitted in the Code.

10. **The services of a subcontractor will be used.**

Check box Yes
 Check box No

For known subcontractors with subcontracts with an annual value of more than \$50,000, the contract shall include their name, address, general type of work to be performed, and the dollar allocation for each subcontractor. (30 ILCS 500/20-120)

ILLINOIS DEPARTMENT OF TRANSPORTATION
 SCHEDULE OF PRICES
 CONTRACT
 NUMBER -

State Job # - C-98-025-14

76G99

Project Number

Route

County Name - ST CLAIR - -

FAI 55

Code - 163 - -

FAI 70

District - 8 - -

FAI 64

Section Number - 82-4T-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X0301028	PUMP STA SCADA EQUIP	L SUM	1.000				
X0323160	VIDEO INSP OF SS	FOOT	2,619.000				
X0323255	DRILLED WELL	EACH	1.000				
X0323859	DOWNSPOUT CONNECTION	EACH	2.000				
X0324751	HDP PIPE 18"	FOOT	92.000				
X0324757	HDP PIPE 24"	FOOT	4,724.000				
X0326713	SANITARY SEWER CONN	EACH	1.000				
X0326931	RECORDER WELL	EACH	1.000				
X0326934	HDP PIPE 12"	FOOT	246.000				
X0327021	LOC DP WELL FORC MAIN	EACH	7.000				
X0327799	STL CAS P AUG/JKD 36	FOOT	160.000				
X0327801	HORIZONTAL WELL	FOOT	1,540.000				
X0335700	P.S. GENERAL WORK	L SUM	1.000				
X0783300	P.S. ELECTRICAL WORK	L SUM	1.000				
X0783500	P.S. MECHANICAL WORK	L SUM	1.000				

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Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X2090210	POROUS GRAN BACK SPEC	CU YD	3,000.000				
X4240430	PC CONC SIDEWALK 5 SP	SQ FT	683.000				
X4402720	GUTTER REMOV SPL	FOOT	61.000				
X5504000	SS D I T2 8	FOOT	149.000				
X5504020	SS D I T2 18	FOOT	627.000				
X5504026	SS D I T2 24	FOOT	223.000				
X6015015	REM REP C HDWL P UNDR	EACH	1.000				
X6020294	MAN TA 7D T1F CL R-P	EACH	1.000				
X6020502	CB TA 5 DIA T22F&G SP	EACH	2.000				
X6022820	MAN SAN 5 DIA T1F CL	EACH	1.000				
X6040205	FRAMES & LIDS SPECIAL	EACH	19.000				
X6063000	CONC GUTTER TB SPL	FOOT	61.000				
X6640308	CH LK GATES SPL	EACH	2.000				
X6640570	CH LK FENCE 8 SPL	FOOT	1,333.000				
X7010224	TR CONT-PROT BLR22 SP	L SUM	1.000				

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Code - 163 - -

FAI 70

District - 8 - -

FAI 64

Section Number - 82-4T-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X7010410	SPEED DISPLAY TRAILER	CAL MO	4.000				
X7030030	WET REF TEM TAPE T3 4	FOOT	4,247.000				
Z0004002	BOLLARDS	EACH	8.000				
Z0007601	BLDG REMOV NO 1	L SUM	1.000				
Z0012754	STR REP CON DP = < 5	SQ FT	7.000				
Z0013798	CONSTRUCTION LAYOUT	L SUM	1.000				
Z0018500	DRAINAGE STR CLEANED	EACH	23.000				
Z0056700	SAN SEW 4	FOOT	108.000				
Z0068300	STEEL CASINGS 36	FOOT	62.000				
20100110	TREE REMOV 6-15	UNIT	45.000				
20100500	TREE REMOV ACRES	ACRE	1.400				
20200100	EARTH EXCAVATION	CU YD	3,530.000				
20400800	FURNISHED EXCAVATION	CU YD	2,120.000				
20800150	TRENCH BACKFILL	CU YD	388.000				
21001000	GEOTECH FAB F/GR STAB	SQ YD	914.000				

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Section Number - 82-4T-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
21101615	TOPSOIL F & P 4	SQ YD	4,532.000				
25000115	SEEDING CL 1B	ACRE	0.900				
25000200	SEEDING CL 2	ACRE	1.600				
25000400	NITROGEN FERT NUTR	POUND	224.000				
25000500	PHOSPHORUS FERT NUTR	POUND	224.000				
25000600	POTASSIUM FERT NUTR	POUND	224.000				
25100115	MULCH METHOD 2	ACRE	2.500				
25100630	EROSION CONTR BLANKET	SQ YD	2,346.000				
25100900	TURF REINF MAT	SQ YD	270.000				
28000250	TEMP EROS CONTR SEED	POUND	2,050.000				
28000305	TEMP DITCH CHECKS	FOOT	90.000				
28000400	PERIMETER EROS BAR	FOOT	1,550.000				
28000500	INLET & PIPE PROTECT	EACH	3.000				
28100725	STONE DUMP RIP CL B3	SQ YD	83.000				
28200200	FILTER FABRIC	SQ YD	83.000				

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35101800	AGG BASE CSE B 6	SQ YD	1,037.000				
40200700	AGG SURF CSE A 8	SQ YD	190.000				
40201000	AGGREGATE-TEMP ACCESS	TON	40.000				
42000300	PCC PVT 8	SQ YD	914.000				
42300400	PCC DRIVEWAY PAVT 8	SQ YD	123.000				
42400200	PC CONC SIDEWALK 5	SQ FT	289.000				
42400800	DETECTABLE WARNINGS	SQ FT	20.000				
44000500	COMB CURB GUTTER REM	FOOT	221.000				
44000600	SIDEWALK REM	SQ FT	1,418.000				
44200144	PAVT PATCH T2 12	SQ YD	21.000				
44200150	PAVT PATCH T4 12	SQ YD	65.000				
44201377	CL C PATCH T2 12	SQ YD	35.000				
44201383	CL C PATCH T4 12	SQ YD	157.000				
44213200	SAW CUTS	FOOT	272.000				
50102400	CONC REM	CU YD	6.900				

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50105220	PIPE CULVERT REMOV	FOOT	191.000				
50200100	STRUCTURE EXCAVATION	CU YD	2,894.000				
50300225	CONC STRUCT	CU YD	901.000				
50300300	PROTECTIVE COAT	SQ YD	4,475.000				
50500405	F & E STRUCT STEEL	POUND	2,960.000				
50800105	REINFORCEMENT BARS	POUND	195,270.000				
50800515	BAR SPLICERS	EACH	57.000				
51100300	SLOPE WALL 6	SQ YD	4,125.000				
51202100	FUR STL PILE HP14X117	FOOT	960.000				
51202305	DRIVING PILES	FOOT	960.000				
51204100	TEST PILE ST HP14X117	EACH	1.000				
542C0223	P CUL CL C 1 18	FOOT	192.000				
54248510	CONCRETE COLLAR	CU YD	1.000				
54260311	TRAVERS PIPE GRATE	FOOT	19.300				
54261327	CONC ES 542001 27 1:3	EACH	1.000				

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FAI 64

Section Number - 82-4T-1

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54262315	CONC ES 542006 15 1:3	EACH	1.000				
54262318	CONC ES 542006 18 1:3	EACH	3.000				
550A0340	STORM SEW CL A 2 12	FOOT	25.000				
550A0380	STORM SEW CL A 2 18	FOOT	36.000				
550A0420	STORM SEW CL A 2 27	FOOT	109.000				
56104800	WATER VALVES 4	EACH	1.000				
56200500	WATER SERV LINE 1 1/2	FOOT	170.000				
56201120	WATER SERV LINE 4	FOOT	150.000				
56500500	DOM MET VLTS	EACH	1.000				
60100060	CONC HDWL FOR P DRAIN	EACH	2.000				
60100905	PIPE DRAINS 4	FOOT	93.000				
60100925	PIPE DRAINS 8	FOOT	190.000				
60221100	MAN TA 5 DIA T1F CL	EACH	1.000				
60236200	INLETS TA T8G	EACH	1.000				
60600605	CONC CURB TB	FOOT	171.000				

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District - 8 - -

FAI 64

Section Number - 82-4T-1

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60605000	COMB CC&G TB6.24	FOOT	223.000				
60801008	FLAP GATE 8	EACH	1.000				
60801018	FLAP GATE 18	EACH	3.000				
63301990	REM RE-E T B TERM T1	EACH	1.000				
66900200	NON SPL WASTE DISPOSL	CU YD	9,500.000				
66900450	SPL WASTE PLNS/REPORT	L SUM	1.000				
66900530	SOIL DISPOSAL ANALY	EACH	3.000				
67000400	ENGR FIELD OFFICE A	CAL MO	30.000				
67100100	MOBILIZATION	L SUM	1.000				
70100205	TRAF CONT-PROT 701401	EACH	1.000				
70100420	TRAF CONT-PROT 701411	EACH	1.000				
70103815	TR CONT SURVEILLANCE	CAL DA	120.000				
70301000	WORK ZONE PAVT MK REM	SQ FT	1,416.000				
70400100	TEMP CONC BARRIER	FOOT	554.000				
70600260	IMP ATTN TEMP FRN TL3	EACH	1.000				

ILLINOIS DEPARTMENT OF TRANSPORTATION
 SCHEDULE OF PRICES
 CONTRACT
 NUMBER -

State Job # - C-98-025-14

76G99

Project Number

Route

County Name - ST CLAIR -

FAI 55

Code - 163 - -

FAI 70

District - 8 - -

FAI 64

Section Number - 82-4T-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
78009004	MOD URETH PM LINE 4	FOOT	1,050.000				
78009005	MOD URETH PM LINE 5	FOOT	488.000				
78100100	RAISED REFL PAVT MKR	EACH	26.000				
78200410	GUARDRAIL MKR TYPE A	EACH	17.000				
78200520	BAR WALL MKR TYPE B	EACH	13.000				
78300100	PAVT MARKING REMOVAL	SQ FT	968.000				
78300200	RAISED REF PVT MK REM	EACH	26.000				
80300100	LOCATE UNDERGR CABLE	FOOT	4,275.000				
81028320	UNDRGRD C PVC 1	FOOT	554.000				
81028350	UNDRGRD C PVC 2	FOOT	370.000				
81028370	UNDRGRD C PVC 3	FOOT	564.000				
81400700	HANDHOLE PCC	EACH	7.000				
81400720	DBL HANDHOLE PCC	EACH	1.000				
87100020	FOCC62.5/125 MM12SM12	FOOT	614.000				
87800200	CONC FDN TY D	FOOT	7.000				

ILLINOIS DEPARTMENT OF TRANSPORTATION
 SCHEDULE OF PRICES
 CONTRACT
 NUMBER -

76G99

State Job # - C-98-025-14

Project Number

Route

County Name - ST CLAIR - -

FAI 55

Code - 163 - -

FAI 70

District - 8 - -

FAI 64

Section Number - 82-4T-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
87900200	DRILL EX HANDHOLE	EACH	1.000				

CONTRACT NUMBER

76G99

THIS IS THE TOTAL BID

\$ _____

NOTES:

1. Each PAY ITEM should have a UNIT PRICE and a TOTAL PRICE.
2. The UNIT PRICE shall govern if no TOTAL PRICE is shown or if there is a discrepancy between the product of the UNIT PRICE multiplied by the QUANTITY.
3. If a UNIT PRICE is omitted, the TOTAL PRICE will be divided by the QUANTITY in order to establish a UNIT PRICE.
4. A bid may be declared UNACCEPTABLE if neither a unit price nor a total price is shown.

RETURN WITH BID

STATE REQUIRED ETHICAL STANDARDS GOVERNING CONTRACT PROCUREMENT: ASSURANCES, CERTIFICATIONS AND DISCLOSURES

I. GENERAL

A. Article 50 of the Code establishes the duty of all State CPOs, SPOs, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

B. In order to comply with the provisions of Article 50 and to carry out the duty established therein, all bidders are to adhere to ethical standards established for the procurement process, and to make such assurances, disclosures and certifications required by law. Except as otherwise required in subsection III, paragraphs J-M, by execution of the Proposal Signature Sheet, the bidder indicates that each of the mandated assurances have been read and understood, that each certification is made and understood, and that each disclosure requirement has been understood and completed.

C. In addition to all other remedies provided by law, failure to comply with any assurance, failure to make any disclosure or the making of a false certification shall be grounds for the CPO to void the contract, and may result in the suspension or debarment of the bidder or subcontractor. If a false certification is made by a subcontractor the contractor's submitted bid and the executed contract may not be declared void unless the contractor refuses to terminate the subcontract upon the State's request after a finding that the subcontractor's certification was false.

I acknowledge, understand and accept these terms and conditions.

II. ASSURANCES

The assurances hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder.

A. Conflicts of Interest

Section 50-13. Conflicts of Interest.

(a) Prohibition. It is unlawful for any person holding an elective office in this State, holding a seat in the General Assembly, or appointed to or employed in any of the offices or agencies of state government and who receives compensation for such employment in excess of 60% of the salary of the Governor of the State of Illinois, or who is an officer or employee of the Capital Development Board or the Illinois State Toll Highway Authority, or who is the spouse or minor child of any such person to have or acquire any contract, or any direct pecuniary interest in any contract therein, whether for stationery, printing, paper, or any services, materials, or supplies, that will be wholly or partially satisfied by the payment of funds appropriated by the General Assembly of the State of Illinois or in any contract of the Capital Development Board or the Illinois State Toll Highway Authority.

(b) Interests. It is unlawful for any firm, partnership, association or corporation, in which any person listed in subsection (a) is entitled to receive (i) more than 7 1/2% of the total distributable income or (ii) an amount in excess of the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(c) Combined interests. It is unlawful for any firm, partnership, association, or corporation, in which any person listed in subsection (a) together with his or her spouse or minor children is entitled to receive (i) more than 15%, in the aggregate, of the total distributable income or (ii) an amount in excess of 2 times the salary of the Governor, to have or acquire any such contract or direct pecuniary interest therein.

(d) Securities. Nothing in this Section invalidates the provisions of any bond or other security previously offered or to be offered for sale or sold by or for the State of Illinois.

(e) Prior interests. This Section does not affect the validity of any contract made between the State and an officer or employee of the State or member of the General Assembly, his or her spouse, minor child or any combination of those persons if that contract was in existence before his or her election or employment as an officer, member, or employee. The contract is voidable, however, if it cannot be completed within 365 days after the officer, member, or employee takes office or is employed.

The current salary of the Governor is \$177,412.00. Sixty percent of the salary is \$106,447.20.

RETURN WITH BID

The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-13, or that an effective exemption has been issued by the Board of Ethics to any individual subject to the Section 50-13 prohibitions pursuant to the provisions of Section 50-20 of the Code. Information concerning the exemption process is available from the Department upon request.

B. Negotiations

Section 50-15. Negotiations.

It is unlawful for any person employed in or on a continual contractual relationship with any of the offices or agencies of State government to participate in contract negotiations on behalf of that office or agency with any firm, partnership, association, or corporation with whom that person has a contract for future employment or is negotiating concerning possible future employment.

The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-15, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

C. Inducements

Section 50-25. Inducement.

Any person who offers or pays any money or other valuable thing to any person to induce him or her not to bid for a State contract or as recompense for not having bid on a State contract is guilty of a Class 4 felony. Any person who accepts any money or other valuable thing for not bidding for a State contract or who withholds a bid in consideration of the promise for the payment of money or other valuable thing is guilty of a Class 4 felony.

The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-25, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

D. Revolving Door Prohibition

Section 50-30. Revolving door prohibition.

CPOs, SPOs, procurement compliance monitors, their designees whose principal duties are directly related to State procurement, and executive officers confirmed by the Senate are expressly prohibited for a period of 2 years after terminating an affected position from engaging in any procurement activity relating to the State agency most recently employing them in an affected position for a period of at least 6 months. The prohibition includes, but is not limited to: lobbying the procurement process; specifying; bidding; proposing bid, proposal, or contract documents; on their own behalf or on behalf of any firm, partnership, association, or corporation. This Section applies only to persons who terminate an affected position on or after January 15, 1999.

The bidder assures the Department that the award and execution of the contract would not cause a violation of Section 50-30, and that the bidder has no knowledge of any facts relevant to the kinds of acts prohibited therein.

E. Reporting Anticompetitive Practices

Section 50-40. Reporting anticompetitive practices.

When, for any reason, any vendor, bidder, contractor, CPO, SPO, designee, elected official, or State employee suspects collusion or other anticompetitive practice among any bidders, offerors, contractors, proposers, or employees of the State, a notice of the relevant facts shall be transmitted to the Attorney General and the CPO.

The bidder assures the Department that it has not failed to report any relevant facts concerning the practices addressed in Section 50-40 which may involve the contract for which the bid is submitted.

F. Confidentiality

Section 50-45. Confidentiality.

Any CPO, SPO, designee, or executive officer who willfully uses or allows the use of specifications, competitive bid documents, proprietary competitive information, proposals, contracts, or selection information to compromise the fairness or integrity of the procurement, bidding, or contract process shall be subject to immediate dismissal, regardless of the Personnel code, any contract, or any collective bargaining agreement, and may in addition be subject to criminal prosecution.

The bidder assures the Department that it has no knowledge of any fact relevant to the practices addressed in Section 50-45 which may involve the contract for which the bid is submitted.

RETURN WITH BID

G. Insider Information

Section 50-50. Insider information.

It is unlawful for any current or former elected or appointed State official or State employee to knowingly use confidential information available only by virtue of that office or employment for actual or anticipated gain for themselves or another person.

The bidder assures the Department that it has no knowledge of any facts relevant to the practices addressed in Section 50-50 which may involve the contract for which the bid is submitted.

I acknowledge, understand and accept these terms and conditions for the above assurances.

III. CERTIFICATIONS

The certifications hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. Section 50-2 of the Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible CPO whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

(1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or

(2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government, or subcontracting under such a contract, as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

(1) the business has been finally adjudicated not guilty; or

(2) the business demonstrates to the governmental entity with which it seeks to contract, or which is signatory to the contract which the subcontract relates, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 2012.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

Section 50-10. Felons.

(a) Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

(b) Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO may declare the related contract void if any of the certifications required by this Section are false.

RETURN WITH BID

C. Debt Delinquency

Section 50-11 and 50-12. Debt Delinquency.

The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the CPO may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-14 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the CPO may declare the contract void if this certification is false.

F. Educational Loan

Section 3 of the Educational Loan Default Act provides no State agency shall contract with an individual for goods or services if that individual is in default, as defined in Section 2 of this Act, on an educational loan. Any contract used by any State agency shall include a statement certifying that the individual is not in default on an educational loan as provided in this Section.

The bidder, if an individual as opposed to a corporation, partnership or other form of business organization, certifies that the bidder is not in default on an educational loan as provided in Section 3 of the Act.

G. Bid-Rigging/Bid Rotating

Section 33E-11 of the Criminal Code of 2012 provides:

(a) Every bid submitted to and public contract executed pursuant to such bid by the State or a unit of local government shall contain a certification by the prime contractor that the prime contractor is not barred from contracting with any unit of State or local government as a result of a violation of either Section 33E-3 or 33E-4 of this Article

(b) A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

A violation of Section 33E-3 would be represented by a conviction of the crime of bid-rigging which, in addition to Class 3 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be barred for 5 years from the date of conviction from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

RETURN WITH BID

A violation of Section 33E-4 would be represented by a conviction of the crime of bid-rotating which, in addition to Class 2 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be permanently barred from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent in behalf of the corporation.

The bidder certifies that it is not barred from contracting with the Department by reason of a violation of either Section 33E-3 or Section 33E-4.

H. International Anti-Boycott

Section 5 of the International Anti-Boycott Certification Act provides every contract entered into by the State of Illinois for the manufacture, furnishing, or purchasing of supplies, material, or equipment or for the furnishing of work, labor, or services, in an amount exceeding the threshold for small purchases according to the purchasing laws of this State or \$10,000.00, whichever is less, shall contain certification, as a material condition of the contract, by which the contractor agrees that neither the contractor nor any substantially-owned affiliated company is participating or shall participate in an international boycott in violation of the provisions of the U.S. Export Administration Act of 1979 or the regulations of the U.S. Department of Commerce promulgated under that Act.

The bidder makes the certification set forth in Section 5 of the Act.

I. Drug Free Workplace

The Illinois "Drug Free Workplace Act" applies to this contract and it is necessary to comply with the provisions of the "Act" if the contractor is a corporation, partnership, or other entity (including a sole proprietorship) which has 25 or more employees.

The bidder certifies that if awarded a contract in excess of \$5,000 it will provide a drug free workplace in compliance with the provisions of the Act.

J. Disclosure of Business Operations in Iran

Section 50-36 of the Code, 30ILCS 500/50-36 provides that each bid, offer, or proposal submitted for a State contract shall include a disclosure of whether or not the Company acting as the bidder, offeror, or proposing entity, or any of its corporate parents or subsidiaries, within the 24 months before submission of the bid, offer, or proposal had business operations that involved contracts with or provision of supplies or services to the Government of Iran, companies in which the Government of Iran has any direct or indirect equity share, consortiums or projects commissioned by the Government of Iran, or companies involved in consortiums or projects commissioned by the Government of Iran and either of the following conditions apply:

- (1) More than 10% of the Company's revenues produced in or assets located in Iran involve oil-related activities or mineral-extraction activities; less than 75% of the Company's revenues produced in or assets located in Iran involve contracts with or provision of oil-related or mineral-extraction products or services to the Government of Iran or a project or consortium created exclusively by that government; and the Company has failed to take substantial action.
- (2) The Company has, on or after August 5, 1996, made an investment of \$20 million or more, or any combination of investments of at least \$10 million each that in the aggregate equals or exceeds \$20 million in any 12-month period, which directly or significantly contributes to the enhancement of Iran's ability to develop petroleum resources of Iran.

The terms "Business operations", "Company", "Mineral-extraction activities", "Oil-related activities", "Petroleum resources", and "Substantial action" are all defined in the Code.

Failure to make the disclosure required by the Code shall cause the bid, offer or proposal to be considered not responsive. The disclosure will be considered when evaluating the bid or awarding the contract. The name of each Company disclosed as doing business or having done business in Iran will be provided to the State Comptroller.

Check the appropriate statement:

Company has no business operations in Iran to disclose.

Company has business operations in Iran as disclosed the attached document.

RETURN WITH BID

K. Apprenticeship and Training Certification (Does not apply to federal aid projects)

In accordance with the provisions of Section 30-22 (6) of the Code, the bidder certifies that it is a participant, either as an individual or as part of a group program, in the approved apprenticeship and training programs applicable to each type of work or craft that the bidder will perform with its own forces. The bidder further certifies for work that will be performed by subcontract that each of its subcontractors submitted for approval either (a) is, at the time of such bid, participating in an approved, applicable apprenticeship and training program; or (b) will, prior to commencement of performance of work pursuant to this contract, begin participation in an approved apprenticeship and training program applicable to the work of the subcontract. The Department, at any time before or after award, may require the production of a copy of each applicable Certificate of Registration issued by the United States Department of Labor evidencing such participation by the contractor and any or all of its subcontractors. Applicable apprenticeship and training programs are those that have been approved and registered with the United States Department of Labor. The bidder shall list in the space below, the official name of the program sponsor holding the Certificate of Registration for all of the types of work or crafts in which the bidder is a participant and that will be performed with the bidder's forces. Types of work or craft work that will be subcontracted shall be included and listed as subcontract work. The list shall also indicate any type of work or craft job category that does not have an applicable apprenticeship or training program. **The bidder is responsible for making a complete report and shall make certain that each type of work or craft job category that will be utilized on the project as reported on the Construction Employee Workforce Projection (Form BC-1256) and returned with the bid is accounted for and listed.**

The requirements of this certification and disclosure are a material part of the contract, and the contractor shall require this certification provision to be included in all approved subcontracts. In order to fulfill this requirement, it shall not be necessary that an applicable program sponsor be currently taking or that it will take applications for apprenticeship, training or employment during the performance of the work of this contract.

TO BE RETURNED WITH BID

L. Political Contributions and Registration with the State Board of Elections

Sections 20-160 and 50-37 of the Code regulate political contributions from business entities and any affiliated entities or affiliated persons bidding on or contracting with the state. Generally under Section 50-37, any business entity, and any affiliated entity or affiliated person of the business entity, whose current year contracts with all state agencies exceed an awarded value of \$50,000, are prohibited from making any contributions to any political committees established to promote the candidacy of the officeholder responsible for the awarding of the contracts or any other declared candidate for that office for the duration of the term of office of the incumbent officeholder or a period 2 years after the termination of the contract, whichever is longer. Any business entity and affiliated entities or affiliated persons whose state contracts in the current year do not exceed an awarded value of \$50,000, but whose aggregate pending bids and proposals on state contracts exceed \$50,000, either alone or in combination with contracts not exceeding \$50,000, are prohibited from making any political contributions to any political committee established to promote the candidacy of the officeholder responsible for awarding the pending contract during the period beginning on the date the invitation for bids or request for proposals is issued and ending on the day after the date of award or selection if the entity was not awarded or selected. Section 20-160 requires certification of registration of affected business entities in accordance with procedures found in Section 9-35 of The Election Code.

By submission of a bid, the contractor business entity acknowledges and agrees that it has read and understands Sections 20-160 and 50-37 of the Code, and that it makes the following certification:

The undersigned bidder certifies that it has registered as a business with the State Board of Elections and acknowledges a continuing duty to update the registration in accordance with the above referenced statutes. If the business entity is required to register, the CPO shall verify that it is in compliance on the date the bid or proposal is due. The CPO shall not accept a bid or proposal if the business entity is not in compliance with the registration requirements.

These requirements and compliance with the above referenced statutory sections are a material part of the contract, and any breach thereof shall be cause to void the contract under Section 50-60 of the Code. This provision does not apply to Federal-aid contracts.

M. Lobbyist Disclosure

Section 50-38 of the Code requires that any bidder or offeror on a State contract that hires a person required to register under the Lobbyist Registration Act to assist in obtaining a contract shall:

- (i) Disclose all costs, fees, compensation, reimbursements, and other remunerations paid or to be paid to the lobbyist related to the contract,
- (ii) Not bill or otherwise cause the State of Illinois to pay for any of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration, and
- (iii) Sign a verification certifying that none of the lobbyist's costs, fees, compensation, reimbursements, or other remuneration were billed to the State.

This information, along with all supporting documents, shall be filed with the agency awarding the contract and with the Secretary of State. The CPO shall post this information, together with the contract award notice, in the online Procurement Bulletin.

Pursuant to Subsection (c) of this Section, no person or entity shall retain a person or entity to attempt to influence the outcome of a procurement decision made under the Code for compensation contingent in whole or in part upon the decision or procurement. Any person who violates this subsection is guilty of a business offense and shall be fined not more than \$10,000.

Bidder acknowledges that it is required to disclose the hiring of any person required to register pursuant to the Illinois Lobbyist Registration Act (25 ILCS 170) in connection with this contract.

Bidder has not hired any person required to register pursuant to the Illinois Lobbyist Registration Act in connection with this contract.

Or

Bidder has hired the following persons required to register pursuant to the Illinois Lobbyist Registration Act in connection with the contract:

Name and address of person: _____
All costs, fees, compensation, reimbursements and other remuneration paid to said person: _____

I acknowledge, understand and accept these terms and conditions for the above certifications.

RETURN WITH BID

IV. DISCLOSURES

- A. The disclosures hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder. The bidder further certifies that the Department has received the disclosure forms for each bid.

The CPO may void the bid, or contract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Code. Furthermore, the CPO may void the contract and the surety providing the performance bond shall be responsible for completion of the contract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Code provides that all bids of more than \$25,000 shall be accompanied by disclosure of the financial interests of the bidder. This disclosed information for the successful bidder, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the contract. Furthermore, pursuant to Section 5-5, the Procurement Policy Board may review a proposal, bid, or contract and issue a recommendation to void a contract or reject a proposal or bid based on any violation of the Code or the existence of a conflict of interest as provided in subsections (b) and (d) of Section 50-35.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the bidding entity or its parent entity, whichever is less, unless the contractor or bidder is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 200 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

The current annual salary of the Governor is \$177,412.00

In addition, all disclosures shall indicate any other current or pending contracts, proposals, leases, or other ongoing procurement relationships the bidding entity has with any other unit of state government and shall clearly identify the unit and the contract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. A separate Disclosure Form A must be submitted with the bid for each individual meeting the above requirements. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies and a total ownership certification. **The forms must be included with each bid.**

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the bidder is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a bidder is a privately held entity that is exempt from Federal 10K reporting, but has more than 200 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a bidder is not subject to Federal 10K reporting, the bidder must determine if any individuals are required by law to complete a financial disclosure form. To do this, the bidder should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the NOT APPLICABLE STATEMENT on Form A must be signed and dated by a person that is authorized to execute contracts for the bidding company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES ___ NO ___
2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than 60% of the annual salary of the Governor? YES ___ NO ___
3. Does anyone in your organization receive more than 60% of the annual salary of the Governor of the bidding entity's or parent entity's distributive income? YES ___ NO ___

(Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.)

4. Does anyone in your organization receive greater than 5% of the bidding entity's or parent entity's total distributive income, but which is less than 60% of the annual salary of the Governor? YES ___ NO ___

(Note: Only one set of forms needs to be completed per person per bid even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The bidder must determine each individual in the bidding entity or the bidding entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable.** The person signing can be, but does not have to be, the person for which the form is being completed. The bidder is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the NOT APPLICABLE STATEMENT of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

RETURN WITH BID

Form B: Instructions for Identifying Other Contracts & Procurement Related Information

Disclosure Form B must be completed for each bid submitted by the bidding entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the bidder to ignore Form B. Form B must be completed, checked, and dated or the bidder may be considered nonresponsive and the bid will not be accepted.*

The Bidder shall identify, by checking Yes or No on Form B, whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the bidder only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the bidder must do one of the following:

Option I: If the bidder did not submit an Affidavit of Availability to obtain authorization to bid, the bidder must list all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Do not include IDOT contracts. Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included. Bidders who submit Affidavits of Availability are suggested to use Option II.

Option II: If the bidder is required and has submitted an Affidavit of Availability in order to obtain authorization to bid, the bidder may write or type "See Affidavit of Availability" which indicates that the Affidavit of Availability is incorporated by reference and includes all non-IDOT State of Illinois agency pending contracts, leases, bids, proposals, and other ongoing procurement relationships. For any contracts that are not covered by the Affidavit of Availability, the bidder must identify them on Form B or on an attached sheet(s). These might be such things as leases.

**ILLINOIS DEPARTMENT
OF TRANSPORTATION**

**Form A
Financial Information &
Potential Conflicts of Interest
Disclosure**

Contractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Code (30 ILCS 500). Vendors desiring to enter into a contract with the State of Illinois must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for bids in excess of \$25,000, and for all open-ended contracts. **A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.**

The current annual salary of the Governor is \$177,412.00.

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the BIDDER (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than 60% of the annual salary of the Governor. **(Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)**

<p>FOR INDIVIDUAL (type or print information)</p> <p>NAME: _____</p> <p>ADDRESS _____</p> <p>Type of ownership/distributable income share:</p> <p>stock _____ sole proprietorship _____ Partnership _____ other: (explain on separate sheet): _____</p> <p>% or \$ value of ownership/distributable income share: _____</p>

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

(a) State employment, currently or in the previous 3 years, including contractual employment of services. Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Are you currently an officer or employee of either the Capitol Development Board or the Illinois State Toll Highway Authority? Yes ___ No ___

2. Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, provide the name the State agency for which you are employed and your annual salary. _____

RETURN WITH BID

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the salary of the Governor?
Yes ___ No ___

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment for services in the previous 2 years.

Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capitol Development Board or the Illinois State Toll Highway Authority?
Yes ___ No ___

2. Is your spouse or any minor children currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary. _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the salary of the Governor?
Yes ___ No ___

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years.
Yes ___ No ___

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years.
Yes ___ No ___

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government.
Yes ___ No ___

RETURN WITH BID

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes ___ No ___

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

3. Communication Disclosure.

Disclose the name and address of each lobbyist and other agent of the bidder or offeror who is not identified in Section 2 of this form, who is has communicated, is communicating, or may communicate with any State officer or employee concerning the bid or offer. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the contract. If no person is identified, enter "None" on the line below:

Name and address of person(s): _____

RETURN WITH BID

4. Debarment Disclosure. For each of the persons identified under Sections 2 and 3 of this form, disclose whether any of the following has occurred within the previous 10 years: debarment from contracting with any governmental entity; professional licensure discipline; bankruptcies; adverse civil judgments and administrative findings; and criminal felony convictions. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the procurement process and term of the contract. If no person is identified, enter "None" on the line below:

Name of person(s): _____

Nature of disclosure: _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: _____ Date _____
Signature of Individual or Authorized Representative

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the CONTRACTOR listed on the previous page.

_____ Date _____
Signature of Authorized Representative

The bidder has a continuing obligation to supplement these disclosures under Sec. 50-35 of the Code.

RETURN WITH BID

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form B Other Contracts & Financial Related Information Disclosure

Contractor Name, Legal Address, City, State, Zip, Telephone Number, Email Address, Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Code (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for bids in excess of \$25,000, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The BIDDER shall identify whether it has any pending contracts (including leases), bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency: Yes ___ No ___

If "No" is checked, the bidder only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

Signature of Authorized Representative, Date

OWNERSHIP CERTIFICATION

Please certify that the following statement is true if the individuals for all submitted Form A disclosures do not total 100% of ownership.

Any remaining ownership interest is held by individuals receiving less than \$106,447.20 of the bidding entity's or parent entity's distributive income or holding less than a 5% ownership interest.

Yes No N/A (Form A disclosure(s) established 100% ownership)

RETURN WITH BID

SPECIAL NOTICE TO CONTRACTORS

The following requirements of the Illinois Department of Human Rights' Rules and Regulations are applicable to bidders on all construction contracts advertised by the Illinois Department of Transportation:

CONSTRUCTION EMPLOYEE UTILIZATION PROJECTION

- (a) All bidders on construction contracts shall complete and submit, along with and as part of their bids, a Bidder's Employee Utilization Form (Form BC-1256) setting forth a projection and breakdown of the total workforce intended to be hired and/or allocated to such contract work by the bidder including a projection of minority and female employee utilization in all job classifications on the contract project.
- (b) The Department of Transportation shall review the Employee Utilization Form, and workforce projections contained therein, of the contract awardee to determine if such projections reflect an underutilization of minority persons and/or women in any job classification in accordance with the Equal Employment Opportunity Clause and Section 7.2 of the Illinois Department of Human Rights' Rules and Regulations for Public Contracts adopted as amended on September 17, 1980. If it is determined that the contract awardee's projections reflect an underutilization of minority persons and/or women in any job classification, it shall be advised in writing of the manner in which it is underutilizing and such awardee shall be considered to be in breach of the contract unless, prior to commencement of work on the contract project, it submits revised satisfactory projections or an acceptable written affirmative action plan to correct such underutilization including a specific timetable geared to the completion stages of the contract.
- (c) The Department of Transportation shall provide to the Department of Human Rights a copy of the contract awardee's Employee Utilization Form, a copy of any required written affirmative action plan, and any written correspondence related thereto. The Department of Human Rights may review and revise any action taken by the Department of Transportation with respect to these requirements.

RETURN WITH BID



**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**

PART I. IDENTIFICATION

Dept. Human Rights # _____ Duration of Project: _____

Name of Bidder: _____

PART II. WORKFORCE PROJECTION

A. The undersigned bidder has analyzed minority group and female populations, unemployment rates and availability of workers for the location in which this contract work is to be performed, and for the locations from which the bidder recruits employees, and hereby submits the following workforce projection including a projection for minority and female employee utilization in all job categories in the workforce to be allocated to this contract:

TOTAL Workforce Projection for Contract													TABLE B CURRENT EMPLOYEES TO BE ASSIGNED TO CONTRACT			
JOB CATEGORIES	TOTAL EMPLOYEES		MINORITY EMPLOYEES						TRAINEES				TOTAL EMPLOYEES		MINORITY EMPLOYEES	
			BLACK		HISPANIC		*OTHER MINOR.		APPREN- TICES		ON THE JOB TRAINEES					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
OFFICIALS (MANAGERS)																
SUPERVISORS																
FOREMEN																
CLERICAL																
EQUIPMENT OPERATORS																
MECHANICS																
TRUCK DRIVERS																
IRONWORKERS																
CARPENTERS																
CEMENT MASONS																
ELECTRICIANS																
PIPEFITTERS, PLUMBERS																
PAINTERS																
LABORERS, SEMI-SKILLED																
LABORERS, UNSKILLED																
TOTAL																

TABLE C TOTAL Training Projection for Contract								
EMPLOYEES IN TRAINING	TOTAL EMPLOYEES		BLACK		HISPANIC		*OTHER MINOR.	
	M	F	M	F	M	F	M	F
APPRENTICES								
ON THE JOB TRAINEES								

FOR DEPARTMENT USE ONLY

* Other minorities are defined as Asians (A) or Native Americans (N).
Please specify race of each employee shown in Other Minorities column.

Note: See instructions on page 2

RETURN WITH BID

**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**

PART II. WORKFORCE PROJECTION - continued

- B. Included in "Total Employees" under Table A is the total number of **new hires** that would be employed in the event the undersigned bidder is awarded this contract.

The undersigned bidder projects that: (number) _____ new hires would be recruited from the area in which the contract project is located; and/or (number) _____ new hires would be recruited from the area in which the bidder's principal office or base of operation is located.

- C. Included in "Total Employees" under Table A is a projection of numbers of persons to be employed directly by the undersigned bidder as well as a projection of numbers of persons to be employed by subcontractors.

The undersigned bidder estimates that (number) _____ persons will be directly employed by the prime contractor and that (number) _____ persons will be employed by subcontractors.

PART III. AFFIRMATIVE ACTION PLAN

- A. The undersigned bidder understands and agrees that in the event the foregoing minority and female employee utilization projection included under **PART II** is determined to be an underutilization of minority persons or women in any job category, and in the event that the undersigned bidder is awarded this contract, he/she will, prior to commencement of work, develop and submit a written Affirmative Action Plan including a specific timetable (geared to the completion stages of the contract) whereby deficiencies in minority and/or female employee utilization are corrected. Such Affirmative Action Plan will be subject to approval by the contracting agency and the **Department of Human Rights**.

- B. The undersigned bidder understands and agrees that the minority and female employee utilization projection submitted herein, and the goals and timetable included under an Affirmative Action Plan if required, are deemed to be part of the contract specifications.

Company _____

Telephone Number _____

Address _____

NOTICE REGARDING SIGNATURE

The Bidder's signature on the Proposal Signature Sheet will constitute the signing of this form. The following signature block needs to be completed if revisions are required.

Signature: _____ Title: _____ Date: _____

Instructions: All tables must include subcontractor personnel in addition to prime contractor personnel.

Table A - Include both the number of employees that would be hired to perform the contract work and the total number currently employed (Table B) that will be allocated to contract work, and include all apprentices and on-the-job trainees. The "Total Employees" column should include all employees including all minorities, apprentices and on-the-job trainees to be employed on the contract work.

Table B - Include all employees currently employed that will be allocated to the contract work including any apprentices and on-the-job trainees currently employed.

Table C - Indicate the racial breakdown of the total apprentices and on-the-job trainees shown in Table A.

RETURN WITH BID
Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds

PROPOSAL SIGNATURE SHEET

The undersigned bidder hereby makes and submits this bid on the subject Proposal, thereby assuring the Department that all requirements of the Invitation for Bids and rules of the Department have been met, that there is no misunderstanding of the requirements of paragraph 3 of this Proposal, and that the contract will be executed in accordance with the rules of the Department if an award is made on this bid.

(IF AN INDIVIDUAL) Firm Name _____
Signature of Owner _____
Business Address _____

(IF A CO-PARTNERSHIP) Firm Name _____
By _____
Business Address _____
Name and Address of All Members of the Firm:

(IF A CORPORATION)
(IF A JOINT VENTURE, USE THIS SECTION FOR THE MANAGING PARTY AND THE SECOND PARTY SHOULD SIGN BELOW)

Corporate Name _____
By _____
Signature of Authorized Representative _____
Typed or printed name and title of Authorized Representative _____
Attest _____
Signature _____
Business Address _____

(IF A JOINT VENTURE)

Corporate Name _____
By _____
Signature of Authorized Representative _____
Typed or printed name and title of Authorized Representative _____
Attest _____
Signature _____
Business Address _____

If more than two parties are in the joint venture, please attach an additional signature sheet.



This Annual Proposal Bid Bond shall become effective at 12:01 AM (CDST) on _____ and shall be valid until _____ 11:59 PM (CDST).

KNOW ALL PERSONS BY THESE PRESENTS, That We _____

as PRINCIPAL, and _____

as SURETY, and held jointly, severally and firmly bound unto the STATE OF ILLINOIS in the penal sum of 5 percent of the total bid price, or for the amount specified in the bid proposal under "Proposal Guaranty" in effect on the date of the Invitation for Bids, whichever is the lesser sum, well and truly to be paid unto said STATE OF ILLINOIS, for the payment of which we bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH that whereas, the PRINCIPAL may submit bid proposal(s) to the STATE OF ILLINOIS, acting through the Department of Transportation, for various improvements published in the Transportation Bulletin during the effective term indicated above.

NOW, THEREFORE, if the Department shall accept the bid proposal(s) of the PRINCIPAL; and if the PRINCIPAL shall, within the time and as specified in the bidding and contract documents; and if, after award by the Department, the PRINCIPAL shall enter into a contract in accordance with the terms of the bidding and contract documents including evidence of the required insurance coverages and providing such bond as specified with good and sufficient surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof; or if, in the event of the failure of the PRINCIPAL to enter into such contract and to give the specified bond, the PRINCIPAL pays to the Department the difference not to exceed the penalty hereof between the amount specified in the bid proposal and such larger amount for which the Department may contract with another party to perform the work covered by said bid proposal, then this obligation shall be null and void, otherwise, it shall remain in full force and effect.

IN THE EVENT the Department determines the PRINCIPAL has failed to comply with any requirement as set forth in the preceding paragraph, then Surety shall pay the penal sum to the Department within fifteen (15) days of written demand therefor. If Surety does not make full payment within such period of time, the Department may bring an action to collect the amount owed. Surety is liable to the Department for all its expenses, including attorney's fees, incurred in any litigation in which it prevails either in whole or in part.

In TESTIMONY WHEREOF, the said PRINCIPAL has caused this instrument to be signed by its officer _____ day of _____ A.D., _____.

In TESTIMONY WHEREOF, the said SURETY has caused this instrument to be signed by its officer _____ day of _____ A.D., _____.

(Company Name)

(Company Name)

By _____
(Signature and Title)

By _____
(Signature of Attorney-in-Fact)

Notary for PRINCIPAL

Notary for SURETY

STATE OF _____
COUNTY OF _____

STATE OF _____
COUNTY OF _____

Signed and attested before me on _____ (date)

Signed and attested before me on _____ (date)

by _____
(Name of Notary Public)

by _____
(Name of Notary Public)

(Seal) _____
(Signature of Notary Public)

(Seal) _____
(Signature of Notary Public)

(Date Commission Expires)

(Date Commission Expires)

In lieu of completing the above section of the Annual Proposal Bid Bond form, the Principal may file an Electronic Bid Bond. By signing the proposal(s) the Principal is ensuring the identified electronic bid bond has been executed and the Principal and Surety are firmly bound unto the State of Illinois under the conditions of the bid bond as shown above.

Electronic Bid Bond ID #	Company/Bidder Name	Signature and Title
--------------------------	---------------------	---------------------

This bond may be terminated, at Surety's request, upon giving not less than thirty (30) days prior written notice of the cancellation/termination of the bond. Said written notice shall be issued to the Illinois Department of Transportation, Chief Contracts Official, 2300 South Dirksen Parkway, Springfield, Illinois, 62764, and shall be served in person, by receipted courier delivery or certified or registered mail, return receipt requested. Said notice period shall commence on the first calendar day following the Department's receipt of written cancellation/termination notice. Surety shall remain firmly bound to all obligations herein for proposals submitted prior to the cancellation/termination. Surety shall be released and discharged from any obligation(s) for proposals submitted for any letting or date after the effective date of cancellation/termination.



Item No. _____

Letting Date _____

KNOW ALL PERSONS BY THESE PRESENTS, That We _____

as PRINCIPAL, and _____

as SURETY, and held jointly, severally and firmly bound unto the STATE OF ILLINOIS in the penal sum of 5 percent of the total bid price, or for the amount specified in the bid proposal under "Proposal Guaranty" in effect on the date of the Invitation for Bids, whichever is the lesser sum, well and truly to be paid unto said STATE OF ILLINOIS, for the payment of which we bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH that whereas, the PRINCIPAL has submitted a bid proposal to the STATE OF ILLINOIS, acting through the Department of Transportation, for the improvement designated by the Transportation Bulletin Item Number and Letting Date indicated above.

NOW, THEREFORE, if the Department shall accept the bid proposal of the PRINCIPAL; and if the PRINCIPAL shall, within the time and as specified in the bidding and contract documents; and if, after award by the Department, the PRINCIPAL shall enter into a contract in accordance with the terms of the bidding and contract documents including evidence of the required insurance coverages and providing such bond as specified with good and sufficient surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof; or if, in the event of the failure of the PRINCIPAL to enter into such contract and to give the specified bond, the PRINCIPAL pays to the Department the difference not to exceed the penalty hereof between the amount specified in the bid proposal and such larger amount for which the Department may contract with another party to perform the work covered by said bid proposal, then this obligation shall be null and void, otherwise, it shall remain in full force and effect.

IN THE EVENT the Department determines the PRINCIPAL has failed to comply with any requirement as set forth in the preceding paragraph, then Surety shall pay the penal sum to the Department within fifteen (15) days of written demand therefor. If Surety does not make full payment within such period of time, the Department may bring an action to collect the amount owed. Surety is liable to the Department for all its expenses, including attorney's fees, incurred in any litigation in which it prevails either in whole or in part.

In TESTIMONY WHEREOF, the said PRINCIPAL has caused this instrument to be signed by its officer _____ day of _____ A.D., _____.

In TESTIMONY WHEREOF, the said SURETY has caused this instrument to be signed by its officer _____ day of _____ A.D., _____.

(Company Name)

(Company Name)

By _____
(Signature and Title)

By _____
(Signature of Attorney-in-Fact)

Notary for PRINCIPAL

Notary for SURETY

STATE OF _____
COUNTY OF _____

STATE OF _____
COUNTY OF _____

Signed and attested before me on _____ (date)
by _____
(Name of Notary Public)

Signed and attested before me on _____ (date)
by _____
(Name of Notary Public)

(Seal) _____
(Signature of Notary Public)

(Seal) _____
(Signature of Notary Public)

(Date Commission Expires)

(Date Commission Expires)

In lieu of completing the above section of the Proposal Bid Bond form, the Principal may file an Electronic Bid Bond. By signing the proposal the Principal is ensuring the identified electronic bid bond has been executed and the Principal and Surety are firmly bound unto the State of Illinois under the conditions of the bid bond as shown above.

Electronic Bid Bond ID # _____ Company/Bidder Name _____ Signature and Title _____



(1) Policy

It is public policy that disadvantageded businesses as defined in 49 CFR Part 26 and the Special Provision shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal or State funds. Consequently the requirements of 49 CFR Part 26 apply to this contract.

(2) Obligation

The contractor agrees to ensure that disadvantageded businesses as defined in 49 CFR Part 26 and the Special Provision have the maximum opportunity to participate in the performance of contracts or subcontracts financed in whole or in part with Federal or State funds. The contractor shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 and the Special Provision to ensure that said businesses have the maximum opportunity to compete for and perform under this contract. The contractor shall not discriminate on the basis of race, color, national origin or sex in the award and performance of contracts.

(3) Project and Bid Identification

Complete the following information concerning the project and bid:

Route _____

Section _____

Project _____

County _____

Letting Date _____

Contract No. _____

Letting Item No. _____

Total Bid _____

Contract DBE Goal _____

(Percent) (Dollar Amount)

(4) Assurance

I, acting in my capacity as an officer of the undersigned bidder (or bidders if a joint venture), hereby assure the Department that on this project my company : (check one)

- Meets or exceeds contract award goals and has provided documented participation as follows:
Disadvantaged Business Participation _____ percent

Attached are the signed participation statements, forms SBE 2025, required by the Special Provision evidencing availability and use of each business participating in this plan and assuring that each business will perform a commercially useful function in the work of the contract.

- Failed to meet contract award goals and has included good faith effort documentation to meet the goals and that my company has provided participation as follows:
Disadvantaged Business Participation _____ percent

The contract goals should be accordingly modified or waived. Attached is all information required by the Special Provision in support of this request including good faith effort. Also attached are the signed participation statements, forms SBE 2025, required by the Special Provision evidencing availability and use of each business participating in this plan and assuring that each business will perform a commercially useful function in the work of the contract.

_____ Company

By _____

Title _____

Date _____

The "as read" Low Bidder is required to comply with the Special Provision.

Submit only one utilization plan for each project. The utilization plan shall be submitted in accordance with the special provision.

Bureau of Small Business Enterprises **Local Let Projects**
 2300 South Dirksen Parkway Submit forms to the
 Springfield, Illinois 62764 Local Agency

The Department of Transportation is requesting disclosure of information that is necessary to accomplish the purpose as outlined under State and Federal law. Disclosure of this information is **REQUIRED**. Failure to provide any information will result in the contract not being awarded. This form has been approved by the State Forms Manager Center.



Subcontractor Registration Number _____

Letting _____

Participation Statement

Item No. _____

(1) Instructions

Contract No. _____

This form must be completed for each disadvantaged business participating in the Utilization Plan. This form shall be submitted in accordance with the special provision and will be attached to the Utilization Plan form. If additional space is needed complete an additional form for the firm.

(2) Work:

Please indicate: J/V _____ Manufacturer _____ Supplier (60%) _____ Subcontractor _____ Trucking _____

Pay Item No.	Description	Quantity	Unit Price	Total
Total				

(3) Partial Payment Items (For any of the above items which are partial pay items)

Description must be sufficient to determine a Commercially Useful Function, specifically describe the work and subcontract dollar amount:

(4) Commitment

When a DBE is to be a second-tier subcontractor, or if the first-tier DBE subcontractor is going to be subcontracting a portion of its subcontract, it must be clearly indicated on the DBE Participation Statement, and the details of the transaction fully explained.

In the event a DBE subcontractor second-tiers a portion of its subcontract to one or more subcontractors during the work of a contract, the prime must submit a DBE Participation Statement, with the details of the transaction(s) fully explained.

The undersigned certify that the information included herein is true and correct, and that the DBE firm listed below has agreed to perform a commercially useful function in the work of the contract item(s) listed above and to execute a contract with the prime contractor or 1st Tier subcontractor. The undersigned further understand that no changes to this statement may be made without prior approval from the Department's Bureau of Small Business Enterprises and that complete and accurate information regarding actual work performed on this project and the payment therefore must be provided to the Department.

Signature for Contractor __ 1st Tier __ 2nd Tier

Signature for DBE Firm __ 1st Tier __ 2nd Tier

Title _____

Title _____

Date _____

Date _____

Contact Person _____

Contact Person _____

Phone _____

Phone _____

Firm Name _____

Firm Name _____

Address _____

Address _____

City/State/Zip _____

City/State/Zip _____

E _____

WC _____

The Department of Transportation is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under the state and federal law. Disclosure of this information is **REQUIRED**. Failure to provide any information will result in the contract not being awarded. This form has been approved by the State Forms Management Center.

PROPOSAL ENVELOPE



PROPOSALS

for construction work advertised for bids by the
Illinois Department of Transportation

Item No.	Item No.	Item No.

Submitted By:

Name:
Address:
Phone No.

Bidders should use an IDOT proposal envelope or affix this form to the front of a 10" x 13" envelope for the submittal of bids. If proposals are mailed, they should be enclosed in a second or outer envelope addressed to:

Engineer of Design and Environment - Room 326
Illinois Department of Transportation
2300 South Dirksen Parkway
Springfield, Illinois 62764

NOTICE

Individual bids, including Bid Bond and/or supplemental information if required, should be securely stapled.

CONTRACTOR OFFICE COPY OF CONTRACT SPECIFICATIONS

NOTICE

None of the following material needs to be returned with the bid package unless the special provisions require documentation and/or other information to be submitted.

**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**



Illinois Department of Transportation

SUBCONTRACTOR DOCUMENTATION

Public Acts 96-0795, 96-0920, and 97-0895 enacted substantial changes to the provisions of the Code (30 ILCS 500). Among the changes are provisions affecting subcontractors. The Contractor awarded this contract will be required as a material condition of the contract to implement and enforce the contract requirements applicable to subcontractors that entered into a contractual agreement with a total value of \$50,000 or more with a person or entity who has a contract subject to the Code and approved in accordance with article 108.01 of the Standard Specifications for Road and Bridge Construction.

If the Contractor seeks approval of subcontractors to perform a portion of the work, and approval is granted by the Department, the Contractor shall provide a copy of the subcontract to the Illinois Department of Transportation's CPO upon request within 15 calendar days after execution of the subcontract.

Financial disclosures required pursuant to Sec. 50-35 of the Code must be submitted for all applicable subcontractors. The subcontract shall contain the certifications required to be made by subcontractors pursuant to Article 50 of the Code. This Notice to Bidders includes a document incorporating all required subcontractor certifications and disclosures for use by the Contractor in compliance with this mandate. The document is entitled State Required Ethical Standards Governing Subcontractors.

RETURN WITH SUBCONTRACT

STATE ETHICAL STANDARDS GOVERNING SUBCONTRACTORS

Article 50 of the Code establishes the duty of all State CPOs, SPOs, and their designees to maximize the value of the expenditure of public moneys in procuring goods, services, and contracts for the State of Illinois and to act in a manner that maintains the integrity and public trust of State government. In discharging this duty, they are charged by law to use all available information, reasonable efforts, and reasonable actions to protect, safeguard, and maintain the procurement process of the State of Illinois.

The certifications hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed should the Department approve the subcontractor. The CPO may terminate or void the contract approval if it is later determined that the bidder or subcontractor rendered a false or erroneous certification. If a false certification is made by a subcontractor the contractor's submitted bid and the executed contract may not be declared void unless the contractor refuses to terminate the subcontract upon the State's request after a finding that the subcontractor's certification was false.

Section 50-2 of the Code provides that every person that has entered into a multi-year contract and every subcontractor with a multi-year subcontract shall certify, by July 1 of each fiscal year covered by the contract after the initial fiscal year, to the responsible CPO whether it continues to satisfy the requirements of Article 50 pertaining to the eligibility for a contract award. If a contractor or subcontractor is not able to truthfully certify that it continues to meet all requirements, it shall provide with its certification a detailed explanation of the circumstances leading to the change in certification status. A contractor or subcontractor that makes a false statement material to any given certification required under Article 50 is, in addition to any other penalties or consequences prescribed by law, subject to liability under the Whistleblower Reward and Protection Act for submission of a false claim.

A. Bribery

Section 50-5. Bribery.

(a) Prohibition. No person or business shall be awarded a contract or subcontract under this Code who:

(1) has been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer's or employee's official capacity; or

(2) has made an admission of guilt of that conduct that is a matter of record but has not been prosecuted for that conduct.

(b) Businesses. No business shall be barred from contracting with any unit of State or local government, or subcontracting under such a contract, as a result of a conviction under this Section of any employee or agent of the business if the employee or agent is no longer employed by the business and:

(1) the business has been finally adjudicated not guilty; or

(2) the business demonstrates to the governmental entity with which it seeks to contract, or which is signatory to the contract to which the subcontract relates, and that entity finds that the commission of the offense was not authorized, requested, commanded, or performed by a director, officer, or high managerial agent on behalf of the business as provided in paragraph (2) of subsection (a) of Section 5-4 of the Criminal Code of 2012.

(c) Conduct on behalf of business. For purposes of this Section, when an official, agent, or employee of a business committed the bribery or attempted bribery on behalf of the business and in accordance with the direction or authorization of a responsible official of the business, the business shall be chargeable with the conduct.

(d) Certification. Every bid submitted to and contract executed by the State, and every subcontract subject to Section 20-120 of the Code shall contain a certification by the contractor or the subcontractor, respectively, that the contractor or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO may declare the related contract void if any certifications required by this Section are false. A contractor who makes a false statement, material to the certification, commits a Class 3 felony.

The contractor or subcontractor certifies that it is not barred from being awarded a contract under Section 50.5.

B. Felons

Section 50-10. Felons.

Unless otherwise provided, no person or business convicted of a felony shall do business with the State of Illinois or any State agency, or enter into a subcontract, from the date of conviction until 5 years after the date of completion of the sentence for that felony, unless no person held responsible by a prosecutorial office for the facts upon which the conviction was based continues to have any involvement with the business.

Certification. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Code shall contain a certification by the bidder or contractor or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO may declare the related contract void if any of the certifications required by this Section are false.

RETURN WITH SUBCONTRACT

C. Debt Delinquency

Section 50-11 and 50-12. Debt Delinquency.

The contractor or bidder or subcontractor, respectively, certifies that it, or any affiliate, is not barred from being awarded a contract or subcontract under the Code. Section 50-11 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it knows or should know that it, or any affiliate, is delinquent in the payment of any debt to the State as defined by the Debt Collection Board. Section 50-12 prohibits a person from entering into a contract with a State agency, or entering into a subcontract, if it, or any affiliate, has failed to collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with the provisions of the Illinois Use Tax Act. The bidder or contractor or subcontractor, respectively, further acknowledges that the CPO may declare the related contract void if this certification is false or if the bidder, contractor, or subcontractor, or any affiliate, is determined to be delinquent in the payment of any debt to the State during the term of the contract.

D. Prohibited Bidders, Contractors and Subcontractors

Section 50-10.5 and 50-60(c). Prohibited bidders, contractors and subcontractors.

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 or if in violation of Subsection (c) for a period of five years from the date of conviction. Every bid submitted to and contract executed by the State and every subcontract subject to Section 20-120 of the Code shall contain a certification by the bidder, contractor, or subcontractor, respectively, that the bidder, contractor, or subcontractor is not barred from being awarded a contract or subcontract under this Section and acknowledges that the CPO shall declare the related contract void if any of the certifications completed pursuant to this Section are false.

E. Section 42 of the Environmental Protection Act

The bidder or contractor or subcontractor, respectively, certifies in accordance with 30 ILCS 500/50-14 that the bidder, contractor, or subcontractor, is not barred from being awarded a contract or entering into a subcontract under this Section which prohibits the bidding on or entering into contracts with the State of Illinois or a State agency, or entering into any subcontract, that is subject to the Code by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order. The bidder or contractor or subcontractor, respectively, acknowledges that the CPO may declare the contract void if this certification is false.

The undersigned, on behalf of the subcontracting company, has read and understands the above certifications and makes the certifications as required by law.

Name of Subcontracting Company

Authorized Officer

Date

RETURN WITH SUBCONTRACT
SUBCONTRACTOR DISCLOSURES

I. DISCLOSURES

A. The disclosures hereinafter made by the subcontractor are each a material representation of fact upon which reliance is placed. The subcontractor further certifies that the Department has received the disclosure forms for each subcontract.

The CPO may void the bid, contract, or subcontract, respectively, if it is later determined that the bidder or subcontractor rendered a false or erroneous disclosure. A contractor or subcontractor may be suspended or debarred for violations of the Code. Furthermore, the CPO may void the contract.

B. Financial Interests and Conflicts of Interest

1. Section 50-35 of the Code provides that all subcontracts with a total value of \$50,000 or more from subcontractors identified in Section 20-120 of the Code, shall be accompanied by disclosure of the financial interests of the subcontractor. This disclosed information for the subcontractor, will be maintained as public information subject to release by request pursuant to the Freedom of Information Act, filed with the Procurement Policy Board, and shall be incorporated as a material term of the Prime Contractor's contract. Furthermore, pursuant to this Section, the Procurement Policy Board may recommend to allow or void a contract or subcontract based on a potential conflict of interest.

The financial interests to be disclosed shall include ownership or distributive income share that is in excess of 5%, or an amount greater than 60% of the annual salary of the Governor, of the subcontracting entity or its parent entity, whichever is less, unless the subcontractor is a publicly traded entity subject to Federal 10K reporting, in which case it may submit its 10K disclosure in place of the prescribed disclosure. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 200 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. The disclosure shall include the names, addresses, and dollar or proportionate share of ownership of each person making the disclosure, their instrument of ownership or beneficial relationship, and notice of any potential conflict of interest resulting from the current ownership or beneficial interest of each person making the disclosure having any of the relationships identified in Section 50-35 and on the disclosure form.

The current annual salary of the Governor is \$177,412.00.

In addition, all disclosures shall indicate any other current or pending contracts, subcontracts, proposals, leases, or other ongoing procurement relationships the subcontracting entity has with any other unit of state government and shall clearly identify the unit and the contract, subcontract, proposal, lease, or other relationship.

2. Disclosure Forms. Disclosure Form A is attached for use concerning the individuals meeting the above ownership or distributive share requirements. A separate Disclosure Form A must be submitted with the bid for each individual meeting the above requirements. In addition, a second form (Disclosure Form B) provides for the disclosure of current or pending procurement relationships with other (non-IDOT) state agencies and a total ownership certification. **The forms must be included with each bid.**

C. Disclosure Form Instructions

Form A Instructions for Financial Information & Potential Conflicts of Interest

If the subcontractor is a publicly traded entity subject to Federal 10K reporting, the 10K Report may be submitted to meet the requirements of Form A. If a subcontractor is a privately held entity that is exempt from Federal 10K reporting, but has more than 200 shareholders, it may submit the information that Federal 10K companies are required to report, and list the names of any person or entity holding any ownership share that is in excess of 5%. If a subcontractor is not subject to Federal 10K reporting, the subcontractor must determine if any individuals are required by law to complete a financial disclosure form. To do this, the subcontractor should answer each of the following questions. A "YES" answer indicates Form A must be completed. If the answer to each of the following questions is "NO", then the **NOT APPLICABLE STATEMENT** on the second page of Form A must be signed and dated by a person that is authorized to execute contracts for the subcontracting company. Note: These questions are for assistance only and are not required to be completed.

1. Does anyone in your organization have a direct or beneficial ownership share of greater than 5% of the bidding entity or parent entity? YES ___ NO ___
2. Does anyone in your organization have a direct or beneficial ownership share of less than 5%, but which has a value greater than 60% of the annual salary of the Governor? YES ___ NO ___
3. Does anyone in your organization receive more than 60% of the annual salary of the Governor of the subcontracting entity's or parent entity's distributive income? YES ___ NO ___

(Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.)

4. Does anyone in your organization receive greater than 5% of the subcontracting entity's or parent entity's total distributive income, but which is less than 60% of the annual salary of the Governor? YES ___ NO ___

(Note: Only one set of forms needs to be completed per person per subcontract even if a specific individual would require a yes answer to more than one question.)

A "YES" answer to any of these questions requires the completion of Form A. The subcontractor must determine each individual in the subcontracting entity or the subcontracting entity's parent company that would cause the questions to be answered "Yes". Each form must be signed and dated by a person that is authorized to execute contracts for your organization. **Photocopied or stamped signatures are not acceptable.** The person signing can be, but does not have to be, the person for which the form is being completed. The subcontractor is responsible for the accuracy of any information provided.

If the answer to each of the above questions is "NO", then the **NOT APPLICABLE STATEMENT** on page 2 of Form A must be signed and dated by a person that is authorized to execute contracts for your company.

RETURN WITH SUBCONTRACT

Form B: Instructions for Identifying Other Contracts & Procurement Related Information

Disclosure Form B must be completed for each subcontract submitted by the subcontracting entity. *Note: Checking the NOT APPLICABLE STATEMENT on Form A does not allow the subcontractor to ignore Form B. Form B must be completed, checked, and dated or the subcontract will not be approved.*

The Subcontractor shall identify, by checking Yes or No on Form B, whether it has any pending contracts, subcontracts, leases, bids, proposals, or other ongoing procurement relationship with any other (non-IDOT) State of Illinois agency. If "No" is checked, the subcontractor only needs to complete the check box on the bottom of Form B. If "Yes" is checked, the subcontractor must list all non-IDOT State of Illinois agency pending contracts, subcontracts, leases, bids, proposals, and other ongoing procurement relationships. These items may be listed on Form B or on an attached sheet(s). Contracts with cities, counties, villages, etc. are not considered State of Illinois agency contracts and are not to be included. Contracts or subcontracts with other State of Illinois agencies such as the Department of Natural Resources or the Capital Development Board must be included.

**ILLINOIS DEPARTMENT
OF TRANSPORTATION**

**Form A
Subcontractor: Financial
Information & Potential Conflicts
of Interest Disclosure**

Subcontractor Name		
Legal Address		
City, State, Zip		
Telephone Number	Email Address	Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Code (30 ILCS 500). Subcontractors desiring to enter into a subcontract of a State of Illinois contract must disclose the financial information and potential conflict of interest information as specified in this Disclosure Form. This information shall become part of the publicly available contract file. This Form A must be completed for subcontracts with a total value of \$50,000 or more, from subcontractors identified in Section 20-120 of the Code, and for all open-ended contracts. **A publicly traded company may submit a 10K disclosure (or equivalent if applicable) in satisfaction of the requirements set forth in Form A. See Disclosure Form Instructions.**

The current annual salary of the Governor is \$177,412.00.

DISCLOSURE OF FINANCIAL INFORMATION

1. Disclosure of Financial Information. The individual named below has an interest in the SUBCONTRACTOR (or its parent) in terms of ownership or distributive income share in excess of 5%, or an interest which has a value of more than 60% of the annual salary of the Governor. **(Make copies of this form as necessary and attach a separate Disclosure Form A for each individual meeting these requirements)**

FOR INDIVIDUAL (type or print information)	
NAME:	_____
ADDRESS	_____
Type of ownership/distributable income share:	
stock _____ sole proprietorship _____ Partnership _____ other: (explain on separate sheet):	
% or \$ value of ownership/distributable income share:	_____

2. Disclosure of Potential Conflicts of Interest. Check "Yes" or "No" to indicate which, if any, of the following potential conflict of interest relationships apply. If the answer to any question is "Yes", please attach additional pages and describe.

(a) State employment, currently or in the previous 3 years, including contractual employment of services.

Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Are you currently an officer or employee of either the Capitol Development Board or the Illinois State Toll Highway Authority? Yes ___ No ___

2. Are you currently appointed to or employed by any agency of the State of Illinois? If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, provide the name the State agency for which you are employed and your annual salary. _____

RETURN WITH SUBCONTRACT

3. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you entitled to receive (i) more than 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If you are currently appointed to or employed by any agency of the State of Illinois, and your annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the salary of the Governor?
Yes ___ No ___

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment services in the previous 2 years.

Yes ___ No ___

If your answer is yes, please answer each of the following questions.

1. Is your spouse or any minor children currently an officer or employee of the Capitol Development Board or the Illinois Toll Highway Authority?
Yes ___ No ___

2. Is your spouse or any minor children currently appointed to or employed by any agency of the State of Illinois? If your spouse or minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, provide the name of your spouse and/or minor children, the name of the State agency for which he/she is employed and his/her annual salary. _____

3. If your spouse or any minor children is/are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, as of 7/1/07) are you entitled to receive (i) more then 7 1/2% of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of 100% of the annual salary of the Governor?
Yes ___ No ___

4. If your spouse or any minor children are currently appointed to or employed by any agency of the State of Illinois, and his/her annual salary exceeds 60% of the annual salary of the Governor, are you and your spouse or minor children entitled to receive (i) more than 15 % in the aggregate of the total distributable income of your firm, partnership, association or corporation, or (ii) an amount in excess of two times the annual salary of the Governor?
Yes ___ No ___

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years.
Yes ___ No ___

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of the expenses incurred in the discharge of that office currently or in the previous 3 years.
Yes ___ No ___

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter.
Yes ___ No ___

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government.
Yes ___ No ___

RETURN WITH SUBCONTRACT

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter. Yes ___ No ___

(i) Compensated employment, currently or in the previous 3 years, by any registered election or reelection committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who was a compensated employee in the last 2 years by any registered election or re-election committee registered with the Secretary of State or any county clerk of the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections. Yes ___ No ___

3 Communication Disclosure.

Disclose the name and address of each lobbyist and other agent of the bidder or offeror who is not identified in Section 2 of this form, who is has communicated, is communicating, or may communicate with any State officer or employee concerning the bid or offer. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the contract. If no person is identified, enter "None" on the line below:

Name and address of person(s): _____

RETURN WITH SUBCONTRACT

4. Debarment Disclosure. For each of the persons identified under Sections 2 and 3 of this form, disclose whether any of the following has occurred within the previous 10 years: debarment from contracting with any governmental entity; professional licensure discipline; bankruptcies; adverse civil judgments and administrative findings; and criminal felony convictions. This disclosure is a continuing obligation and must be promptly supplemented for accuracy throughout the procurement process and term of the contract. If no person is identified, enter "None" on the line below:

Name of person(s): _____

Nature of disclosure: _____

APPLICABLE STATEMENT

This Disclosure Form A is submitted on behalf of the INDIVIDUAL named on previous page. Under penalty of perjury, I certify the contents of this disclosure to be true and accurate to the best of my knowledge.

Completed by: _____ Date _____
Signature of Individual or Authorized Officer

NOT APPLICABLE STATEMENT

Under penalty of perjury, I have determined that no individuals associated with this organization meet the criteria that would require the completion of this Form A.

This Disclosure Form A is submitted on behalf of the SUBCONTRACTOR listed on the previous page.

_____ Date _____
Signature of Authorized Officer

RETURN WITH SUBCONTRACT

ILLINOIS DEPARTMENT OF TRANSPORTATION

Form B
Subcontractor: Other Contracts & Financial Related Information Disclosure

Form with fields: Subcontractor Name, Legal Address, City, State, Zip, Telephone Number, Email Address, Fax Number (if available)

Disclosure of the information contained in this Form is required by the Section 50-35 of the Code (30 ILCS 500). This information shall become part of the publicly available contract file. This Form B must be completed for subcontracts with a total value of \$50,000 or more, from subcontractors identified in Section 20-120 of the Code, and for all open-ended contracts.

DISCLOSURE OF OTHER CONTRACTS, SUBCONTRACTS, AND PROCUREMENT RELATED INFORMATION

1. Identifying Other Contracts & Procurement Related Information. The SUBCONTRACTOR shall identify whether it has any pending contracts, subcontracts, including leases, bids, proposals, or other ongoing procurement relationship with any other State of Illinois agency: Yes ___ No ___

If "No" is checked, the subcontractor only needs to complete the signature box on the bottom of this page.

2. If "Yes" is checked. Identify each such relationship by showing State of Illinois agency name and other descriptive information such as bid or project number (attach additional pages as necessary). SEE DISCLOSURE FORM INSTRUCTIONS:

THE FOLLOWING STATEMENT MUST BE CHECKED

Signature box with fields: Signature of Authorized Representative, Date

OWNERSHIP CERTIFICATION

Please certify that the following statement is true if the individuals for all submitted Form A disclosures do not total 100% of ownership

Any remaining ownership interest is held by individuals receiving less than \$106,447.20 of the bidding entity's or parent entity's distributive income or holding less than a 5% ownership interest.

Yes No N/A (Form A disclosure(s) established 100% ownership)



NOTICE TO BIDDERS

- 1. TIME AND PLACE OF OPENING BIDS.** Sealed proposals for the improvement described herein will be received by the Department of Transportation. Electronic bids are to be submitted to the electronic bidding system (icx-Integrated Contractors Exchange). Paper-based bids are to be submitted to the Chief Procurement Officer for the Department of Transportation in care of the Chief Contracts Official at the Harry R. Hanley Building, 2300 South Dirksen Parkway, in Springfield, Illinois until 10:00 o'clock a.m. November 21, 2014. All bids will be gathered, sorted, publicly opened and read in the auditorium at the Department of Transportation's Harry R. Hanley Building shortly after the 10:00 a.m. cut off time.
- 2. DESCRIPTION OF WORK.** The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

**Contract No. 76G99
ST CLAIR County
Section 82-4T-1
Route FAI 55/70/64
District 8 Construction Funds**

This project consists of installing a new well and making improvements to the pump station at the Missouri Avenue Pump Station on I-64 in St. Clair County.

- 3. INSTRUCTIONS TO BIDDERS.** (a) This Notice, the invitation for bids, proposal and letter of award shall, together with all other documents in accordance with Article 101.09 of the Standard Specifications for Road and Bridge Construction, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

(b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.
- 4. AWARD CRITERIA AND REJECTION OF BIDS.** This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the rules, Invitation for Bids and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to readvertise the proposed improvement, and to waive technicalities.

By Order of the
Illinois Department of Transportation

Erica J. Borggren,
Acting Secretary

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2014

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS, frequently used RECURRING SPECIAL PROVISIONS, and LOCAL ROADS AND STREETS RECURRING SPECIAL PROVISIONS.

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 1-1-12) (Revised 1-1-14)

SUPPLEMENTAL SPECIFICATIONS

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RECURRING SPECIAL PROVISIONS

The following RECURRING SPECIAL PROVISIONS indicated by an "X" are applicable to this contract and are included by reference:

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STATE OF ILLINOIS

SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction," adopted January 1, 2012, the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," and the "Manual of Test Procedures for Materials" in effect on the date of invitation for bids, and the Supplemental Specifications and Recurring Special Provisions indicated on the Check Sheet included herein which apply to and govern the construction of FAI Route 55/70/64 (I-55/70/64), Section 82-4T-1, St. Clair County, Contract 76G99 and in case of conflict with any part or parts of said Specifications, the said Special Provisions shall take precedence and shall govern.

LOCATION OF PROJECT

The project is located in East St. Louis north of the I-64/55 westbound lanes at the intersection of Missouri Avenue and 2nd Street and along the north side of I-64/55 from the MLK Bridge Approach east to the junction chamber just east of St. Clair Avenue.

DESCRIPTION OF THE PROJECT

This project consists of upgrading the Missouri Avenue Deep Well Facility Water Management System and Pump Station. The major work includes:

- Construction of horizontal groundwater collector well.
- Construction of a new well house enclosure building and site facilities.
- Construction of a concrete detention basin.
- Modifications to the existing pump station and installation of new pumps.
- Construction of a new 24" HDPE force main to the St. Clair Avenue junction chamber.
- Construction of new inlets along I-64/55 westbound lanes.

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES

Revise Article 669.01 of the Standard Specifications to read:

"669.01 Description. This work shall consist of the transportation and proper disposal of contaminated soil and water. This work shall also consist of the removal, transportation, and proper disposal of underground storage tanks (UST), their content and associated underground piping to the point where the piping is above the ground, including determining the content types and estimated quantities."

Revise Article 669.08 of the Standard Specifications to read:

“669.08 Contaminated Soil and/or Groundwater Monitoring. The Contractor shall hire a qualified environmental firm to monitor the area containing the regulated substances. The affected area shall be monitored with a photoionization detector (PID) utilizing a lamp of 10.6eV or greater or a flame ionization detector (FID). Any field screen reading on the PID or FID in excess of background levels indicates the potential presence of contaminated material requiring handling as a non-special waste, special waste, or hazardous waste. No excavated soils can be taken to a clean construction and demolition debris (CCDD) facility or an uncontaminated soil fill operation with detectable PID or FID meter readings that are above background. The PID or FID meter shall be calibrated on-site and background level readings taken and recorded daily. All testing shall be done by a qualified engineer/technician. Such testing and monitoring shall be included in the work. The Contractor shall identify the exact limits of removal of non-special waste, special waste, or hazardous waste. All limits shall be approved by the Engineer prior to excavation. The Contractor shall take all necessary precautions.

Based upon the land use history of the subject property and/or PID or FID readings indicating contamination, a soil or groundwater sample shall be taken from the same location and submitted to an approved laboratory. Soil or groundwater samples shall be analyzed for the contaminants of concern, including pH, based on the property's land use history or the parameters listed in the maximum allowable concentration (MAC) for chemical constituents in uncontaminated soil established pursuant to Subpart F of 35 Illinois Administrative Code 1100.605. The analytical results shall serve to document the level of soil contamination. Soil and groundwater samples may be required at the discretion of the Engineer to verify the level of soil and groundwater contamination.

Samples shall be grab samples (not combined with other locations). The samples shall be taken with decontaminated or disposable instruments. The samples shall be placed in sealed containers and transported in an insulated container to the laboratory. The container shall maintain a temperature of 39 °F (4 °C). All samples shall be clearly labeled. The labels shall indicate the sample number, date sampled, location and elevation, and any other observations.

The laboratory shall use analytical methods which are able to meet the lowest appropriate practical quantitation limits (PQL) or estimated quantitation limit (EQL) specified in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", EPA Publication No. SW-846 and "Methods for the Determination of Organic Compounds in Drinking Water", EPA, EMSL, EPA-600/4-88/039. For parameters where the specified cleanup objective is below the acceptable detection limit (ADL), the ADL shall serve as the cleanup objective. For other parameters the ADL shall be equal to or below the specified cleanup objective.”

Replace the first two paragraphs of Article 669.09 of the Standard Specifications with the following:

“669.09 Contaminated Soil and/or Groundwater Management and Disposal. The management and disposal of contaminated soil and/or groundwater shall be according to the following:

- (a) Soil Analytical Results Exceed Most Stringent MAC. When the soil analytical results indicate that detected levels exceed the most stringent maximum allowable concentration (MAC) for chemical constituents in uncontaminated soil established pursuant to Subpart F of 35 Illinois Administrative Code 1100.605, the soil shall be managed as follows:
 - (1) When analytical results indicate inorganic chemical constituents exceed the most stringent MAC but they are still considered within area background levels by the Engineer, the excavated soil can be utilized within the construction limits as fill, when suitable. Such soil excavated for storm sewers can be placed back into the excavated trench as backfill, when suitable, unless trench backfill is specified. If the soils cannot be utilized within the construction limits, they shall be managed and disposed of off-site as a non-special waste, special waste, or hazardous waste as applicable.
 - (2) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for a Metropolitan Statistical Area (MSA) County, the excavated soil can be utilized within the construction limits as fill, when suitable, or managed and disposed of off-site as “uncontaminated soil” at a CCDD facility or an uncontaminated soil fill operation within an MSA County provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.
 - (3) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, or the MAC within the Chicago corporate limits, the excavated soil can be utilized within the construction limits as fill, when suitable, or managed and disposed of off-site as “uncontaminated soil” at a CCDD facility or an uncontaminated soil fill operation within an MSA County excluding Chicago or within the Chicago corporate limits provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.
 - (4) When analytical results indicate chemical constituents exceed the most stringent MAC but do not exceed the MAC for an MSA County excluding Chicago, the excavated soil can be utilized within the construction limits as fill, when suitable, or managed and disposed of off-site as “uncontaminated soil” at a CCDD facility or an uncontaminated soil fill operation within an MSA County excluding Chicago provided the pH of the soil is within the range of 6.25 - 9.0, inclusive.
 - (5) When the Engineer determines soil cannot be managed according to Articles 669.09(a)(1) through (a)(4) above, the soil shall be managed and disposed of off-site as a non-special waste, special waste, or hazardous waste as applicable.

- (b) Soil Analytical Results Do Not Exceed Most Stringent MAC. When the soil analytical results indicate that detected levels do not exceed the most stringent MAC, the excavated soil can be utilized within the construction limits or managed and disposed of off-site as “uncontaminated soil” according to Article 202.03. However the excavated soil cannot be taken to a CCDD facility or an uncontaminated soil fill operation for the following reason.
- (1) The pH of the soil is less than 6.25 or greater than 9.0.
 - (2) The soil exhibited elevated photoionization detector (PID) utilizing a lamp of 10.6eV or greater or a flame ionization detector (FID) readings.
- (c) Soil Analytical Results Exceed Most Stringent MAC but Do Not Exceed TACO Residential. When the soil analytical results indicate that detected levels exceed the most stringent MAC but do not exceed TACO Tier 1 Soil Remediation Objectives for Residential Properties pursuant to 35 IAC 742 Appendix B Table A, the excavated soil can be utilized within the right-of-way or managed and disposed of off-site as “uncontaminated soil” according to Article 202.03. However the excavated soil cannot be taken to a CCDD facility or an uncontaminated soil fill operation.
- (d) Groundwater. When groundwater analytical results indicate the detected levels are above Appendix B, Table E of 35 Illinois Administrative Code 742, the most stringent Tier 1 Groundwater Remediation Objectives for Groundwater Component of the Groundwater Ingestion Route for Class 1 groundwater, the groundwater shall be managed off-site as a special waste.

All groundwater encountered within lateral trenches may be managed within the trench and allowed to infiltrate back into the ground. If the groundwater cannot be managed within the trench it must be removed as a special or hazardous waste. The Contractor is prohibited from managing groundwater within the trench by discharging it through any existing or new storm sewer. The Contractor shall install backfill plugs within the area of groundwater contamination.

One backfill plug shall be placed down gradient to the area of groundwater contamination. Backfill plugs shall be installed at intervals not to exceed 50 ft (15 m). Backfill plugs are to be 4 ft (1.2 m) long, measured parallel to the trench, full trench width and depth. Backfill plugs shall not have any fine aggregate bedding or backfill, but shall be entirely cohesive soil or any class of concrete. The Contractor shall provide test data that the material has a permeability of less than 10^{-7} cm/sec according to ASTM D 5084, Method A or per another test method approved by the Engineer.”

Revise Article 669.14 of the Standard Specifications to read:

“669.14 Final Environmental Construction Report. At the end of the project, the Contractor will prepare and submit three copies of the Environmental Construction Report on the activities conducted during the life of the project, one copy shall be submitted to the Resident Engineer, one copy shall be submitted to the District's Environmental Studies Unit, and one copy shall be submitted with an electronic copy in Adode.pdf format to the Geologic and Waste Assessment Unit, Bureau of Design and Environment, IDOT, 2300 South Dirksen Parkway, Springfield, Illinois 62764. The technical report shall include all pertinent information regarding the project including, but not limited to:

- (a) Measures taken to identify, monitor, handle, and dispose of soil or groundwater containing regulated substances, to prevent further migration of regulated substances, and to protect workers,
- (b) Cost of identifying, monitoring, handling, and disposing of soil or groundwater containing regulated substances, the cost of preventing further migration of regulated substances, and the cost for worker protection from the regulated substances. All cost should be in the format of the contract pay items listed in the contract plans (identified by the preliminary environmental site assessment (PESA) site number),
- (c) Plan sheets showing the areas containing the regulated substances,
- (d) Field sampling and testing results used to identify the nature and extent of the regulated substances,
- (e) Waste manifests (identified by the preliminary environmental site assessment (PESA) site number) for special or hazardous waste disposal, and
- (f) Landfill tickets (identified by the preliminary environmental site assessment (PESA) site number) for non-special waste disposal.”

Revise the second paragraph of Article 669.16 of the Standard Specifications to read:

“The transportation and disposal of soil and other materials from an excavation determined to be contaminated will be paid for at the contract unit price per cubic yard (cubic meter) for NON-SPECIAL WASTE DISPOSAL, SPECIAL WASTE DISPOSAL, or HAZARDOUS WASTE DISPOSAL.”

Qualifications. The term environmental firm shall mean an environmental firm with at least five (5) documented leaking underground storage tank (LUST) cleanups or that is pre-qualified in hazardous waste by the Department. Documentation includes but not limited to verifying remediation and special waste operations for sites contaminated with gasoline, diesel, or waste oil in accordance with all Federal, State, or local regulatory requirements and shall be provided to the Engineer for approval. The environmental firm selected shall not be a former or current consultant or have any ties with any of the properties contained within and/or adjacent to this construction project.

General. This Special Provision will likely require the Contractor to subcontract for the execution of certain activities.

All contaminated materials shall be managed as either “uncontaminated soil” or non-special waste. This work shall include monitoring and potential sampling, analytical testing, and management of a material contaminated by regulated substances. The Environmental Firm shall continuously monitor all soil excavation for worker protection and soil contamination. **Phase I Preliminary Engineering information is available through the District’s Environmental Studies Unit.** Soil samples or analysis without the approval of the Engineer will be at no additional cost to the Department. The lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit whichever is less.

The Contractor shall manage any excavated soils and sediment within the following areas:

- Station 118+00 to Station 120+20 (WB FAI 64) 0 to 120 feet LT (Vacant Lot, PESA Site 601AN-5, 300 block of Riverpark Drive). This material meets the criteria of Article 669.09(a)(5) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: Benzo(a)Anthracene, Benzo(a)Pyrene, Benzo(b)Fluoranthene, Carbazole, Dibenzo(a,h)Anthracene, Indeno(1,2,3-cd)Pyrene, Lead, and Manganese.
- Station 120+20 to Station 122+00 (WB FAI 64) 0 to 100 feet LT (IDOT Pump Station, PESA Site 601AN-6, 200 Missouri Avenue). This material meets the criteria of Article 669.09(a)(5) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: Benzo(a)Anthracene, Benzo(a)Pyrene, Benzo(b)Fluoranthene, Carbazole, Dibenzo(a,h)Anthracene, Indeno(1,2,3-cd)Pyrene, Lead, and Manganese.
- Station 122+00 to Station 126+00 (WB FAI 64) 0 to 300 feet LT (State ROW, PESA Site 601AN-1, Martin Luther King Bridge approach between Missouri Avenue and B Street). This material meets the criteria of Article 669.09(a)(1) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: Benzo(a)Anthracene, Benzo(a)Pyrene, Dibenzo(a,h)Anthracene, Lead, and Manganese.
- Station 120+20 to Station 122+00 (WB FAI 64) 100 to 300 feet LT (IDOT Pump Station, PESA Site 601AN-6, 200 Missouri Avenue). This material meets the criteria of Article 669.09(a)(3) and shall be managed in accordance to Article 669.09. Contaminants of concern sampling parameters: Benzo(a)Pyrene and Dibenzo(a,h)Anthracene.

STAGING AND SEQUENCE OF CONSTRUCTION

Construction Staging: The Contractor shall be responsible for and include all work for implementing and maintaining and construction staging as may be required and as described in the Contract Documents and indicated on the Drawings to maintain all pumping capabilities through the rehabilitation work under this Contract.

The existing Missouri Avenue Pump Station and Deep Well Facility is currently and continuously receiving both surface water and ground water and discharging this water into to sewer system and to the Bowman Avenue Pump Station. The Contractor shall coordinate their work to avoid any interference with normal operation of this system.

The overall sequence of construction specified herein provides a general guide for the sequence of construction and does not provide phasing details for all aspects of the project. Additional sequencing for specific items of work is shown in the plans.

Stage 1 – Construct the following items:

- Detention basin
- Detention basin inlet & outlet structures
- 7' Diameter Manhole (A3) without restrictor plate to the sump elevation.
- 18" and 24" Ductile Iron and HDPE force main from manhole (A3) to existing outlet box structure at Station 61+17.
- Pipe bridge modifications over St. Clair Avenue.
- All force main vaults and fittings.
- Detention basin outlet sewer.
- Storm water discharge force main up to the existing pump house.

Stage 2 – Construct the following items:

- Drilled well and horizontal well.

Material and groundwater from the construction of the wells shall be discharged into the detention basin where the solids and ground water shall be separated. The Contractor may pump the construction ground water from Manhole A3 to the Bowman Avenue Pump Station through the newly constructed force main. Solid material shall be disposed of according to Section 202.03 of the Standard Specifications.

Stage 3 – Construct the following items:

- Well House Building.
- New ground water well pumping system.
- PCC parking lot.
- Related site work and utilities.

Prior to Stage 4 construction the Contractor shall have the new well house and ground water pumping system fully operational.

Stage 4 – Construct the following items:

- Restrictor plate and final floor in Manhole A3.
- Rehabilitation and pump replacement at the existing pump station.

Stage 5 – Construct the following items:

- New inlets along I-55/64.
- Cleaning of the existing storm sewers.
- New Recorder Well.

The Contractor shall prepare and submit to the Engineer for approval his proposed sequence of operations for the rehabilitation of the Pump Station. The submittal shall include all details and descriptions for the work under this Contract including, but not limited to, maintenance of electric service to existing and new pumps; maintenance of pumping capacity as specified in the Contract Documents; protection of existing and new equipment during all rehabilitation work; demolition sequence; reconstruction sequence; the proposed construction schedule indicating critical path the Contractor proposes to pursue on all work under this Contract; and all matters relating to this Contract. The submittal shall be a form acceptable to the DEPARTMENT and shall be subject to approval by the DEPARTMENT.

The Contractor shall obtain all permits, easements or other requirements and shall pay all fees, rent or other expense for easements for access to the work area or for storage of materials, equipment or construction operations. The contractor shall submit shop drawings or proposed access plan and for such additional areas, as he may require, to the Engineer for approval before commencing construction. No separate measurements or payment will be made for providing, maintaining and restoring any areas used for access or other construction operations.

In general, the work described herein and on the Drawings shall not be considered as all inclusive and will not be listed in order but only to give a brief description of the work required and which shall be executed concurrently under this Contract.

COOPERATION BETWEEN CONTRACTORS

It is anticipated that this project will be constructed concurrently with other highway projects for the same area. The project(s) that may be under contract concurrent with this project are as follows:

- FAI 064 (I-64), Section (82-(1,4)B-1), Contract 76G09, M. L. King Bridge Eastbound To I-55/64 Westbound

The Contractor shall schedule their work in order to minimum a conflict that may arise between contracts as specified in Article 105.08 of the Standard Specifications.

No additional compensation will be allowed this Contractor for compliance with the above requirements, nor for any delays or inconvenience resulting from the activities of the other contractors.

SITE SECURITY

All work shall be protected from damage by vandals, the weather, or other sources until final acceptance by DEPARTMENT. Such protection shall include temporary fencing or other barriers, if necessary, to restrict access to the work. Open pits, doors, hatches, etc. shall be covered, closed and locked. No additional compensation will be granted and no additional time will be allowed due to delays caused by failure to adequately protect the work from damage. In addition, the Contractor shall make the worksite safe at the end of each work day, leaving no attractive nuisance hazards and no open electrical boxes and the like. All entrances, doors, roof hatches at the pump station must be secured at the end of the day. DEPARTMENT will not patrol the construction area. Anything inside temporary construction fence shall be Contractor's responsibility. DEPARTMENT authorized personnel will have access to the pump station at any times. The Contractor shall provide extra keys (3 or 4) for DEPARTMENT personnel.

PROGRESS SCHEDULE

The Contractor shall submit a Critical Path Method (CPM) Progress Schedule for the Engineer's approval before the work can be started. This work shall consist of preparing, revising and updating a detailed progress schedule based upon the Critical Path Method (CPM). This work shall also consist of performing time impact analysis of the progress schedule based upon the various revisions and updates as they occur. The required software shall be Primavera SureTrak 3.0 Project Manager, published by Primavera systems, Inc. The schedule format shall contain the following: Project Name, Contract Number, Company Name, Planning Unit (calendar/working days), Start Date, Completion Date, and Number/Version (original or updated schedule number). Updates to the schedule shall be submitted according to Article 108.02 except that at a minimum, updated schedule shall be submitted at the 25, 50 and 75 percent completion points of the Contract.

In the event the Contractor falls more than seven (7) days behind the approved progress schedule, the Contractor shall work seven (7) days a week at extended hours in order to meet the Progress Schedule.

The Contractor will not be allowed any extra compensation for working longer hours or using extra shifts; and working on weekends or during holidays; working during winter months, etc., to meet the Progress Schedule.

ABBREVIATIONS AND ACRONYMS

Wherever the following abbreviations are used in these Special Provisions or on the Plans, they are to be construed the same as the respective expressions represented:

AASHTO	<i>American Association of STATE Highways and Transportation Officials</i>
ACI	<i>American Concrete Institute</i>
ANSI	<i>American National Standards Institute</i>
ASME	<i>American Society of Mechanical Engineers</i>
ASTM	<i>American Society for Testing and Materials</i>
AWG	<i>American Wire Gauge</i>
FM	<i>Factory Mutual</i>
ICEA	<i>Insulated Power Cable Engineers Association</i>
IEEE	<i>Institute of Electrical and Electronic Engineers</i>
IES	<i>Illuminating Engineering Society of North America</i>
NEC	<i>National Electrical Code</i>
NEMA	<i>National Electrical Manufacturer's Association</i>
NESC	<i>National Electrical Safety Code</i>
SSPC	<i>Steel Structures Painting Council</i>
UL	<i>Underwriter's Laboratories</i>

SUBMITTAL PROCEDURES

1.1 Submittals

- 1.1.1 Except as specified elsewhere herein, materials and equipment shall be in conformance with the requirements of Section 106 of the Standard Specifications. All iron and steel products which are incorporated into the work shall be domestically manufactured, or produced, or fabricated. Contractor shall provide documents certifying domestic source. Also all coating (epoxy, galvanizing, painting) shall be domestically applied.

- 1.1.2 Materials and equipment shall be the products of established and reputable manufacturers and shall be suitable for the service required. Unless otherwise specifically indicated, all materials and equipment shall be new. The Contractor is obligated to conduct his own search into the timely availability of the specified equipment and materials to ensure that they are in strict conformance with the contract documents and that delivery schedules are compatible with project time constraints. Materials or equipment items which are similar or identical shall be the product of the same manufacturer. The cost of submittals, certifications, any required samples, and similar costs shall not be separately paid for but shall be included in the pay item bid price for the respective material or work.
- 1.1.3 All equipment, products and materials incorporated in the work shall be submitted for approval.
- 1.1.4 Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, requirements specified herein shall be complied with for each indicated type of submittal. Procedures concerning items such as listing of manufacturers, suppliers, subcontractors, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.
- 1.1.5 Work-Related Submittals
- (a) Substitution or "Or Equal" Items include material or equipment CONTRACTOR requests ENGINEER to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.
 - (b) Shop Drawings include technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.
 - (c) Product Data include standard printed information on manufactured products and systems that has not been specially prepared for this Project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.
 - (d) Samples include both fabricated and manufactured physical examples of materials, products, and units of work, partial cuts of manufactured or fabricated work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.

- (e) Miscellaneous Submittals are work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, Operating and Maintenance Manuals, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the Work.

1.1.6 Scheduling

- (a) A preliminary schedule of shop drawings and samples submittals shall be submitted for approval, in duplicate.
- (b) Each submittal shall be prepared and transmitted to ENGINEER sufficiently in advance of scheduled performance of related work and other applicable activities.
- (c) Within 60 days of the contract award, the Contractor shall submit, for approval, complete manufacturer's product data (for standard products and components) and detailed shop drawings (for fabricated equipment). Submittals need not include all project equipment and materials in one submittal, however, the submittals for the equipment and materials for each individual pay item shall be complete in every respect. Partial submittals may be returned without review. The Contractor may request, in writing, permission to make a partial submittal; the Engineer will evaluate the circumstances of the request and may accept to review such partial submittal. However, no additional compensation or extension of time will be allowed for extra costs or delays incurred due to partial or late submittals.

1.1.7 Each submittal shall be accompanied by a transmittal containing the following information: (4 copies of each submittal are required)

- (a) Contractor's Name
- (b) Supplier's Name
- (c) Manufacturer's Name
- (d) Date of submittal and dates of previous submittals containing the same material
- (e) Project Route/Name
- (f) Section
- (g) Submittal and transmittal number
- (h) Contract identification
- (i) Identification of equipment and material with equipment identification numbers, motor numbers, and Specification section number Variations from Contract Documents and any limitations which may impact the Work Drawing sheet and detail number as appropriate
- (j) Variations from Contract Documents and any limitations which may impact the Work.
- (k) Drawing sheet and detail number as appropriate.

1.1.8 Exceptions, Deviations, and Substitutions

- (a) In general, exceptions to and deviations from the requirements of the Contract Documents will not be allowed. It is the Contractor's responsibility to note any deviations from Contract requirements at the time of submittal and to make any requests for deviations in writing. In general, substitutions must demonstrate that the proposed substitution is superior to the equipment or material required by the Contract Documents. No exceptions, deviations, or substitutions will be permitted without approval.
- (b) Data for items to be submitted for review as substitution shall be collected into one submittal for each item of material or equipment.
- (c) Request shall be submitted with other scheduled submittals for the material or equipment allowing time for ENGINEER to evaluate the additional information required to be submitted. If CONTRACTOR requests to substitute for material or equipment specified but not identified in Specifications as requiring submittals, substitution submittal request shall be included in Submittal schedule and submitted as scheduled.

1.1.9 Shop Drawings

- (a) Shop drawing information shall be newly prepared and submitted with graphic information at accurate scale. The name of manufacturer or supplier (firm name) shall be indicated. Dimensions shall be shown and clearly noted which are based on field measurement; materials and products which are included in the Work shall be identified; revision shall be identified. Compliance with standards and notation of coordination requirements with other work shall be indicated. Variations from Contract Documents or previous submittals shall be highlighted, encircled or otherwise indicated.

- (b) The following information shall be included on each drawing or page:
- 1) Submittal date and revision dates.
 - 2) Project name, division number and descriptions.
 - 3) Detailed specifications section number and page number.
 - 4) Identification of equipment, product or material.
 - 5) Name of CONTRACTOR and Subcontractor.
 - 6) Name of Supplier and Manufacturer.
 - 7) Relation to adjacent structure or material.
 - 8) Field dimensions, clearly identified.
 - 9) Standards or Industry Specification references.
 - 10) Identification of deviations from the Contract Documents.
 - 11) CONTRACTOR's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.
 - 12) Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.
- (c) An 8-inch by 3-inch blank space shall be provided for CONTRACTOR and ENGINEER stamps.
- (d) Three blue line or black line prints or two reverse sepia reproducible and 1 blue or black line print shall be submitted. One reproducible or one print will be returned.
- (e) Materials, products or systems shall not be installed until copy of applicable product data showing only approved information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site. Four additional copies shall be marked with the date of approval and forwarded to the ENGINEER for use in field and for DEPARTMENT'S O & M Manual and records.

1.1.10 Product Data

- (a) Required product data shall be collected into a single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project or are not included in submittal, copies shall be marked to clearly show such information is not applicable.
- (b) Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, data shall be submitted as a Shop Drawing and not as product data.
- (c) Submittal is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal shall be final when returned by ENGINEER marked "Approved".

- (d) Three submittal copies, in addition to the number the Contractor requires returned, including those required for Operation and Maintenance Manual shall be submitted to the Engineer.

An additional two submittal copies shall be submitted to the Design Engineer:

Klingner & Associates, P.C.
616 North 24th Street
Quincy, IL 62301
Attn: Missouri Ave Pump Station

- (e) Materials, products or systems shall not be installed until copy of applicable product data showing only approval information is in possession of installer. One set of product data (for each submittal) shall be maintained at Project site, available for reference by ENGINEER and others.

1.1.11 Samples

- (a) Where possible, samples shall be physically identical with proposed materials or products to be incorporated into the Work. Where variations in color, pattern or texture are inherent in material or product represented by sample, multiple units (not less than 3 units) shall be submitted showing approximate limits of variations.
- (b) A full set of optional samples shall be provided where ENGINEER's selection required. Samples shall be prepared to match ENGINEER's selection where so indicated.
- (c) Each sample shall include generic description, source or product name and manufacturer, limitations, and compliance with standards.
- (d) Samples for ENGINEER's visual review and final check of coordination of these characteristics with other related elements of work shall be of general generic kind, color, pattern, texture.

- (e) At CONTRACTOR's option, and depending upon nature of anticipated response from ENGINEER, initial submittal of samples may be either preliminary or final submittal.

A preliminary submittal, consisting of a single set of samples, is required where specifications indicate ENGINEER's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with ENGINEER's "Action" marking.

Three sets of samples shall be submitted in final submittal, 1 set will be returned.

- (f) The returned final set of samples shall be maintained at Project site, in suitable condition and available for quality control comparisons throughout course of performing work.

Returned samples intended or permitted to be incorporated in the Work are indicated in Specification sections, and shall be in undamaged condition at time of use.

1.1.12 Mock-ups and similar samples specified in Specification sections are recognized as special type of samples. Requirements for samples submittal shall be complied with to greatest extent possible. Transmittal forms shall be processed to provide record of activity.

1.1.13 Miscellaneous Submittals

- (a) Inspection and Test Reports

- 1) Each inspection and test report shall be classified as either "Shop Drawings" or "product data", depending on whether report is specially prepared for Project or standard publication of workmanship control testing at point of production. Inspection and test reports shall be processed accordingly.

- (b) Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds

- 1) Refer to Specification sections and section Guarantees and Warranties of this Division for specific requirements. Submittal is final when returned by ENGINEER marked "Approved" or "Approved as Noted".

- 2) In addition to copies desired for CONTRACTOR's use, 2 executed copies shall be furnished. Two additional copies shall be provided where required for maintenance data.

(c) Certifications

- 1) Refer to Specification sections for specific requirements on submittal of certifications. Seven copies shall be submitted. Certifications are submitted for review of conformance with specified requirements and information. Submittal shall be final when returned by ENGINEER marked "Approved".
- 2) Where certifications are specified, the information submitted for approval shall incorporate certification information. When a certification can be made prior to manufacture, the certification shall be included with initial submittal information. When certification is possible only after manufacture, the initial submittal information shall include a statement of intent to furnish the certification after equipment approval and manufacture. Certifications involving inspections and/or tests shall be complete with all test data presented in a neat, descriptive format, with all test data, applicable dates, times, and persons responsible.

(d) Tools

- 1) Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units shall be submitted.
- 2) Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.
- 3) For each type of equipment provided under this CONTRACT, a complete set of all special tools shall be furnished including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be of high grade, smooth forged alloy tool steel. Grease guns shall be of the lever type.
- 4) One or more neat and substantial steel wall cases or cabinets shall be furnished and erected with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

1.1.14 Contractor's Stamp

- (a) Prior to submittal, the Contractor shall review the submittal material and shall affix his stamp of approval, with comments as applicable, signed by a responsible representative, to each appropriate submittal item. In the case of Subcontractor's submittals, both the Sub-contractor and the General Contractor shall review and stamp the submittal. Submittals which are not approved or approved-as-noted by the Contractor shall not be submitted to the Engineer. The Contractor shall not give an approved-as-noted status to submittals having incompleteness or major corrective notations as this will only delay the ultimate approval process.
- (b) The receipt of submittal information from the Contractor will be construed as the Contractor's assurance that he has reviewed the submittal information and attests to the submittal's accuracy and conformance to the requirements of the contract documents. Submitted information shall be complete and in sufficient detail to demonstrate compliance with all requirement of the contract documents, including fitting in the space provided and meeting all salient features of the specifications.

1.1.15 Submittal information must be particularly detailed in every respect. Product data shall present information to demonstrate the complete nature of the product, including dimensions, wiring diagrams, operating information, and the like. Shop drawings shall be extremely detailed and shall include all appropriate dimensions, fabrication details, component bill of material, information relative to mounting, detailed wiring, finish, and the like. Wiring diagrams shall include both schematic and point-to-point representations, complete with references to circuiting as indicated on the Contract Drawings as well as terminal points of component devices.

1.1.16 Unless required elsewhere, submittals shall be distributed to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

1.1.17 Except for submittals for record and similar purposes, where action and return on submittals are required or requested, ENGINEER will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, ENGINEER will also advise CONTRACTOR without delay. ENGINEER will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

1.1.18 Where submittals are marked "Approved", Work covered by submittal may proceed PROVIDED IT COMPLIES WITH CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.

- 1.1.19 When submittals are marked "Approved as Noted" or "Approved Subject to Corrections Marked", Work covered by submittal may proceed provided it complies with both ENGINEER's notations or corrections on submittal and with Contract Documents. Acceptance of Work will depend on that compliance. Resubmittal is not required.
- 1.1.20 When submittals are marked "Examined and Returned for Correction or disapproved", Work covered by submittal shall not proceed. Work covered by submittal shall not be used at Project site or elsewhere where Work is in progress. The submittal shall be revised or a new submittal shall be prepared in accordance with ENGINEER's notations in accordance with Resubmittal Preparation procedures specified in this section. The submittal shall be resubmitted without delay and repeated if necessary to obtain different action marking.
- 1.1.21 Any need for more than one resubmission, or any other delay in ENGINEER's review of submittals, will not entitle CONTRACTOR to extension of the Contract Time.
- 1.1.22 Coordination
- (a) Preparation and processing of submittals shall be coordinated with performance of the work, other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.
 - (b) Submission of different units of interrelated work shall be coordinated so that one submittal will not be delayed by ENGINEER's need to review a related submittal. ENGINEER may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.
- 1.1.23 Unless otherwise indicated, guarantees as specified herein shall be included with the submittal information of all applicable equipment and materials. Incompleteness, inaccuracy, or lack of coordination shall be grounds for rejection. The Contractor shall clearly understand no equipment or material shall be installed prior to approval and that any equipment or material installed prior to approval is subject to removal from the right-of-way solely at the Contractor's expense.

1.2. Resubmittal Preparation

- 1.2.1 Resubmittal Preparation shall comply with the requirements described in subsection 1.1, Submittal, of this section. In addition, it shall be identified on the transmittal form that the submittal is a resubmission.
- 1.2.2 Any corrections or changes in submittals required by ENGINEER's notations shall be made on returned submittal.

- 1.2.3 On the transmittal or on a separate page attached to CONTRACTOR's resubmission transmittal, all notations or questions indicated by ENGINEER on ENGINEER's transmittal form shall be answered or acknowledged in writing. Each response shall be identified by question or notation number established by ENGINEER. If CONTRACTOR does not respond to each notation or question, resubmission will be returned without action by ENGINEER until CONTRACTOR provides a written response to all ENGINEER's notations or questions.
- 1.2.4 Variations or revisions from previously reviewed submittal, other than those called for by ENGINEER, shall be identified on transmittal form.

QUALITY CONTROL

1.1 Quality Control

1.1.1 Submittals

All submittals, including the following, shall be provided as specified in SUBMITTAL PROCEDURES herein.

Authoritative evidence in the form of Certificates of Manufacture shall be furnished to the ENGINEER to show that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Copies of the results of physical tests that have been made directly on the product or on similar products of the manufacturer shall be included where necessary.

- 1.1.2 At all times during the progress of the Work and until the date of final completion, afford DEPARTMENT and ENGINEER every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. Work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, shall be replaced with satisfactory work at no additional cost to DEPARTMENT. Finished or unfinished work found not to be in strict accordance with the Contract shall be replaced as directed even though such work may have been previously approved and payment made therefore.
- 1.1.3 DEPARTMENT and his Authorized Representatives have the right to reject materials and workmanship which are defective or require correction. Rejected work and materials shall be promptly removed from the site.

- 1.1.4 Failure or neglect on the part of DEPARTMENT or his Authorized Representatives to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring DEPARTMENT or his Authorized Representatives at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.
- 1.1.5 Should it be considered necessary or advisable by DEPARTMENT or his Authorized Representatives, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, all necessary facilities, labor, and material to make such an examination shall be promptly furnished. If such Work is found to be defective in any respect, all expenses of such examination and of satisfactory reconstruction shall be paid for by the CONTRACTOR. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.
- 1.1.6 Proper operation of equipment during tests and instruction periods shall be the full responsibility of the CONTRACTOR. The CONTRACTOR shall make no claim for damage which may occur to equipment prior to the time when DEPARTMENT accepts the Work.
- 1.1.7 If at any time prior to the expiration of any applicable warranties or guarantees, equipment is rejected by DEPARTMENT, all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices shall be repaid to DEPARTMENT. Upon the receipt of the sum of money, DEPARTMENT will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. The equipment shall not be removed from the premises of the DEPARTMENT until DEPARTMENT obtains, from other sources, equipment to take the place of that rejected. DEPARTMENT hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that DEPARTMENT may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.

- 1.1.8 Notice shall be given in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice shall include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. These provisions shall be complied with before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.
- 1.1.9 Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or IEEE, except as may otherwise be stated herein.
- 1.1.10 Personnel shall be provided to assist the ENGINEER in performing the following periodic observation and associated services.
- (a) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.
 - (b) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by ENGINEER.
 - (c) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.
- 1.1.11 When specified in Divisions 2 through 16 of the Contract Documents, an independent laboratory testing facility shall be provided to perform required testing. The laboratory shall be qualified as having performed previous satisfactory work. Prior to use, such qualifications shall be submitted to the ENGINEER for approval.
- 1.1.12 Cooperate with the ENGINEER and laboratory testing representatives. At least 24 hours notice shall be given prior to when specified testing is required. Labor and materials, and necessary facilities shall be provided by the CONTRACTOR at the site as required by the ENGINEER and the testing laboratory.
- 1.1.13 Equipment test procedures shall be coordinated and demonstrated as specified in the Contract Documents or as otherwise required during the formal tests.
- 1.1.14 Test procedures and requirements for pipelines and other testing shall conform to that specified in the appropriate Specification Sections.

- 1.1.15 Where transcripts or certified test reports are required by the Contract Documents, the following requirements shall be met: For all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents, submit and obtain approval of the ENGINEER before delivery of materials or equipment. All testing shall be performed in an approved independent laboratory or the manufacturer's laboratory. Reports of shop equipment tests shall be submitted for approval within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.
- 1.1.16 At the option of the ENGINEER, or where not otherwise specified, a notarized Certificate of Compliance shall be submitted for approval. The Certificates may be in the form of a letter stating the following:
- (a) Manufacturer has performed all required tests.
 - (b) Materials to be supplied meet all test requirements.
 - (c) Tests were performed not more than one year prior to submittal of the certificate.
 - (d) Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified.
 - (e) Identification of the materials.
- 1.1.17 Initial inspection and testing of materials furnished under this Contract will be performed by DEPARTMENT or his authorized Representatives or inspection bureaus without cost to the CONTRACTOR. However, if the test required is beyond DEPARTMENT capability, the test shall be conducted by DEPARTMENT approved testing service and paid for by the Contractor, unless otherwise expressly specified. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, the tests shall be conducted by DEPARTMENT approved testing service and paid for by the Contractor.
- 1.1.18 Except as expressly provided elsewhere herein, all the costs of shop and field tests of equipment and other tests specifically called for in the Contract Documents shall be included in the Contract Price.
- 1.1.19 Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by DEPARTMENT or by DEPARTMENT approved testing service for compliance.
- 1.1.20 DEPARTMENT shall be bear the costs of any job site inspection.
- 1.1.21 DEPARTMENT shall be reimbursed for all costs associated with Witness Tests which exceed 5 Calendar Days per kind of equipment.

- 1.1.22 As soon as conditions permit, all labor and materials and services to perform preliminary field tests of all equipment shall be furnished as provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, all changes, adjustments and replacements required shall be made prior to the acceptance tests.
- 1.1.23 Upon completion of the Work and prior to final payment, all equipment, piping and appliances installed under this Contract shall be subjected to specified acceptance tests to demonstrate compliance with the Contract Documents.
- 1.1.24 All labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests shall be furnished by the CONTRACTOR.
- 1.1.25 Field tests shall be conducted in the presence of the ENGINEER. The field tests shall demonstrate that under all conditions of operation each equipment item:
- (a) Has not been damaged by transportation or installation
 - (b) Has been properly installed
 - (c) Has no mechanical defects
 - (d) Is in proper alignment
 - (e) Has been properly connected
 - (f) Is free of overheating of any parts
 - (g) Is free of all objectionable vibration
 - (h) Is free of overloading of any parts
 - (i) Operates as intended
- 1.1.26 Work or portions of work shall be operated for a minimum of 100 hours or 14 days continuous service, whichever comes first. Test on those systems which require load produced by weather (heating or cooling) exercise shall be conducted only when weather will produce proper load.
- 1.1.27 If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, such deficiencies shall be promptly corrected. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the DEPARTMENT, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

- 1.1.28 If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, said material or equipment shall not be delivered, or if delivered it shall be promptly removed from the site or from the Work and replaced with acceptable material without additional cost to DEPARTMENT. All obligations under the terms and conditions of the Contract shall be fulfilled even though DEPARTMENT or his Authorized Representatives fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.
- 1.1.29 A final inspection and Field Testing of all work completed and equipment furnished shall be required before acceptance by DEPARTMENT. This final Field Testing must include an operational demonstration to verify complete compliance with all contract requirements. This inspection and testing must be requested by the contractor a minimum of seven calendar days prior to the proposed date. All test equipment, materials, and labor necessary to conduct the inspection shall be furnished by the contractor at his expense. Final Field Testing shall be conducted over consecutive calendar days. A record of the initial performance of the equipment shall be kept for placement in the Operation and Maintenance Data. Four copies of completed record drawings for the pump station shall be submitted after final Field Testing. The Field Testing shall comply with all requirements as outlined in DEPARTMENT Drainage Manual.

PRODUCT STORAGE AND HANDLING REQUIREMENTS

Add the following paragraphs to Article 106.06 of the Standard Specifications to read:

“Unless specifically permitted by the Engineer, all mechanical and electrical equipment such as pumps, fans, electrical apparatus, valve operators, SCADA equipment, and the like shall be stored indoors out of exposure to the weather. Items having electrical parts, such as motors, electronic panels, and the like, shall be kept in heated storage, at a temperature to prohibit the accumulation of condensation on the equipment. Where equipment is provided with integral space/strip heaters, (such as the motor control center), these heaters shall be energized as soon as the equipment is present at the job site and they shall remain energized from temporary circuits until final permanent energization is attained.

Unless otherwise specifically permitted by these specifications or as allowed by the Engineer, all materials for use on the building(s) shall be stored indoors out of exposure to the weather. Such materials would include ductwork, doors and frames, louvers, grating, slate roofing, building hardware, windows and glass block, wire and cable, conduit, and piping. Certain materials such as building steel, exterior hatch covers, fencing, and the like which will be applied exposed to the weather, may be stored outdoors in a safe manner as approved.”

WARRANTIES

Guarantees and Warranties:

All equipment shall be furnished complete with the manufacturer's standard trade guarantee / warranty or any warranty specified herein these Special Provisions, applicable to the Illinois Department of Transportation, from the date of final acceptance. Such guarantee shall accompany submittal shop drawings and product data.

Prior to final payment, the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period shall be delivered to the DEPARTMENT.

PROJECT RECORD DOCUMENTS

Record Drawings:

One record copy of all Contract Documents, reference documents and all technical documents submitted in good order shall be kept and maintained at the site. On mylar tracing media, and using drafting symbols and standards consistent with the original documents, Contract Drawings shall be annotated in red to show all changes made during the construction period. Annotated drawings are to be made available to ENGINEER for reference at all times.

At completion of the CONTRACT and before final payment is made, one set of clearly readable, reproducible mylar Contract Drawings reflecting all changes made during construction shall be delivered to the ENGINEER. The drawings shall each be stamped "RECORD DRAWING", and shall be marked with the contractor's stamp, the date, and the signature of the contractor's representative. Refer to individual sections for addition requirements.

Four copies of completed Record Drawings for the pump station must be submitted and must be acceptable to the Engineer prior to final acceptance.

Method of Measurement. This work will not be measured for payment.

START-UP AND FINAL ACCEPTANCE

1.1 Functional testing of equipment prior to pump station Start-up:

- (a) After certification of proper installation by the Manufacturer's representative, equipment shall undergo testing, as outlined in the Special Provisions. In addition to this individual unit testing, the specific equipment system shall be tested in its entirety. This testing may disclose a punch list of issues which must be resolved before Stat-up can begin.

- 1.2 Performance testing during pump station Start-up:
- (a) When the work at the pump station is complete, the Contractor shall begin Start-up operations. During start-up, the complete storm water, collector well, and vertical well facilities shall be taken through various scenarios of operation, including normal starting/stopping of the pumps, generator, ventilation systems and emergency operation. This testing shall also be conducted during a simulated storm water event.
 - (b) During this period, equipment performance shall be evaluated as well as individual system performance.
 - (c) In addition, each system shall be tested to demonstrate its compatibility with interrelated systems. The overall operation of the entire station shall be evaluated, adjustments made and settings recorded for inclusion in the Final Operation and Maintenance Data.
 - (d) A punch list of operational problems, identified during this testing, shall be prepared and submitted to the Engineer for review. Problems with equipment, systems and/or problems with the interaction between the various systems shall be rectified by the Contractor, at no cost, to the satisfaction of the Engineer. This testing shall be repeated until the Engineer determines satisfactory results have been obtained.
 - (e) When the punch list of operating issues has been resolved, a 90-day period of continuous station operation shall begin. Upon completion of this period, to the satisfactory of the Engineer, Final Acceptance of the facility shall be granted.
- 1.3 Item to be checked on start-up include, but not limited to, the following:
- (a) Demonstration of pump control system
 - (b) Gas detection calibration kit shall be always stored on site
 - (c) Demonstration of transfer switch operation and maintenance
 - (d) Demonstration of generator system operation
 - (e) Check alarm operation SCADA system
- 1.4 The contractor shall be prepared to demonstrate operation and maintenance procedures for all equipment installed.

STATUS OF UTILITIES TO BE ADJUSTED

Agencies known to have facilities in the area of this project are:

Ameren Illinois (gas & electric)
2600 N. Center
P.O. Box 378
Maryville, IL 62062-0378

AT&T Illinois (communications)
1420 Frontage Road
O'Fallon, IL 62269

Charter Communications, Inc. (cable)
941 Charter Commons
Town & Country, MO 63017-

Illinois American Water Company (water)
4436 Industrial Drive
P.O. Box 186
Alton, IL 62002

Level (3) Communications, LLC (communications)
Network Relocations Dept.
1025 Eldorado Boulevard
Broomfield, CO 80021

Verizon Business (communications)
7719 West 60th Place
Summit, IL 60501

Qwest Solutions Center (communications)
1801 California St.
Suite 26
Denver, CO 80202

Metro East Sanitary District
1800 Edison Avenue
P.O. Box 1366
Granite City, IL 62040
618-452-9400

The above represents the best information of the Department and is only included for the convenience of the bidder. The applicable provisions of Articles 105.07, 107.20, 107.31, and 108.02 of the Standard Specifications for Road and Bridge Construction shall apply.

TRAFFIC CONTROL PLAN

Effective: September 30, 1985

Revised: January 1, 2007

Traffic Control shall be according to the applicable sections of the Standard Specifications, the Supplemental Specifications, the "Illinois Manual on Uniform Traffic Control Devices for Streets and Highways", any special details and Highway Standards contained in the plans, and the Special Provisions contained herein.

Special attention is called to Article 107.09 of the Standard Specifications and the following Highway Standards, Details, Quality Standard for Work Zone Traffic Control Devices, Recurring Special Provisions and Special Provisions contained herein, relating to traffic control.

The Contractor shall contact the District Eight Bureau of Traffic at least 72 hours in advance of beginning work.

STANDARDS:

701101	701106	701400	701401	701402	701406
701411	701428	701901	704001	720001	720011
728001	729001	B.L.R. 22			

SPECIAL PROVISIONS:

"Traffic Control Plan"

"Work During Peak Hours"

"Failure to Open Traffic Lanes To Traffic For Peak Periods"

"Maintenance of Roadways"

"Type III Temporary Tape for Wet Conditions"

"Traffic Control and Protection, Standard BLR 22 (Special)

"Construction and Maintenance Sign Supports" – District 8

"Speed Display Trailer" – IDOT BDE

"Impact Attenuator, Temporary" – IDOT Supplemental Specifications

"Pavement Marking Removal" – IDOT Recurring Special Provisions

Signs:

No bracing shall be allowed on post-mounted signs.

Post-mounted signs shall be installed using standard 720011, 728001, and 729001, on 4"x4" wood posts, or on any other "break away" connection if accepted by the FHWA and corresponding letter is provided to the Engineer.

All signs are required on both sides of the road when the median is greater than 10 feet and on one way roadways.

All conflicting existing roadway signs shall be covered during the maintenance of traffic staging. When covering existing Department signs, no tape shall be used on the reflective portion of the sign. Sign covers shall be paid for under Temporary Information Signing.

Devices:

A minimum of 3 drums spaced at 1.2 meters (4 feet) shall be placed at each return when the side road is open.

Direction Indicator Barricades shall exclusively be used in lane closure tapers. They shall be used only when traffic is being merged with an adjacent through lane.

Lights:

Steady burn mono-directional lights are required on devices delineating a widening trench.

Maintenance of Traffic:

The Contractor shall be required to notify the corresponding emergency response agencies (i.e.: fire, ambulance, police), school bus companies and the Department of Transportation (Bureau of Project Implementation) regarding any changes in traffic control.

The Contractor shall be required to notify the corresponding City of East St. Louis for any side road closure or opening.

In addition to field reviews, plan dimensions and details relative to the existing facilities have been taken from existing plans and are subject to construction variations. It shall be the Contractor's responsibility to verify such dimensions and details in the field. Such variations shall not be a cause for additional compensation due to a change in the scope of work; however, the Contractor will be paid for the quantity actually furnished at the unit price bid for the work.

Unless otherwise provided in the plan quantities, all labor, equipment, and materials necessary to provide the traffic control as shown in the plans, in accordance with the applicable Standards.

WORK DURING PEAK HOURS

The Contractor shall have at least two (2) lanes of traffic open on FAI Route 64 (I-64) during peak hours in each direction. The Contractor will not be allowed to conduct any type of operation in the open lanes or any type of operation that would impede the flow of traffic during peak hours. Peak hours are defined as 6:00 a.m. to 9:00 a.m. for the west bound traffic and 3:00 p.m. to 6:00 p.m. for the east bound traffic.

FAILURE TO OPEN TRAFFIC LANES TO TRAFFIC FOR PEAK PERIODS

The Contractor is required to open the road to traffic at certain specified times described in these Special Provisions. Should the Contractor fail to completely open and keep open the lanes to traffic, as described elsewhere in these Special Provisions, he shall be liable to the Department in the amount of \$1,000.00 for each and every 15 minute interval or portion thereof, that a lane is blocked outside the allowable time limitations. No provisions of this clause shall be construed as a penalty but as liquidated and ascertained damages. Such damages may be deducted by the Department from any moneys due the Contractor. These damages shall apply during the contract time and during any extensions of the contract time.

MAINTENANCE OF ROADWAYS

Effective: September 30, 1985

Revised: November 1, 1996

Beginning on the date that work begins on this project, the Contractor shall assume responsibility for normal maintenance of all existing roadways within the limits of the improvement. This normal maintenance shall include all repair work deemed necessary by the Engineer, but shall not include snow removal operations. Traffic control and protection for maintenance of roadways will be provided by the Contractor as required by the Engineer.

If items of work have not been provided in the contract, or otherwise specified for payment, such items, including the accompanying traffic control and protection required by the Engineer, will be paid for in accordance with Article 109.04 of the Standard Specifications.

TYPE III TEMPORARY TAPE FOR WET CONDITIONS

Effective: February 1, 2007

Revised: February 1, 2011

Description. This work shall consist of furnishing, installing, and maintaining Type III Temporary Pavement Marking Tape for Wet Conditions.

Materials. Materials shall be according to the following.

Item	Article/Section
(a)	Pavement Marking Tape 1095.06

Initial minimum reflectance values under dry and wet conditions shall be as specified in Article 1095.06. The marking tape shall maintain its reflective properties when submerged in water. The wet reflective properties will be verified by a visual inspection method performed by the Department. The surface of the material shall provide an average skid resistance of 45 BPN when tested according to ASTM E 303.

CONSTRUCTION REQUIREMENTS

Type III Temporary Tape for Wet Conditions shall meet the requirements of Article 703.03 and 703.05. Application shall follow manufacturer's recommendations.

Method of Measurement. This work will be measured for payment in place, in feet (meters).

Basis of Payment. This work will be paid for at the contract unit price per foot (meter) for WET REFLECTIVE TEMPORARY TAPE TYPE III of the line width specified, and at the contract unit price per square foot (square meter) for WET REFLECTIVE TEMPORARY TAPE TYPE III, LETTERS AND SYMBOLS.

CHANGEABLE MESSAGE SIGNS

This work consists of furnishing, placing, and maintaining changeable message sign(s) according to the Standard Specifications and the following:

All signs must be in place and operational for a minimum of 7 calendar days prior to beginning of the work and subsequent traffic stages. Each sign shall state the day work will begin and delays are possible. The exact message will be approved by the Engineer. The Contractor may be required to relocate each sign multiple times during the contract at his or her expense. The exact location of the placement of these signs shall be determined in the field by the Engineer.

The furnishing, placing, and maintaining of portable changeable message sign(s) shall be paid for per calendar day as CHANGEABLE MESSAGE SIGN, SPECIAL.

This contract requires 4 changeable message signs

TRAFFIC CONTROL AND PROTECTION, STANDARD BLR 22 (SPECIAL)

Description. This work shall include furnishing, installing, maintaining, replacing, relocating, and removing all traffic control devices used for the purpose of regulating, warning, or directing traffic on local roadways. Traffic control and protection shall be provided as called for in the plans, applicable Highway Standards, Standards and Supplemental Specifications, these Special Provisions, or as directed by the Engineer.

Suitable Access: Properties located northwest and southwest of the Well House along Missouri Avenue and 2nd Street shall have suitable access (minimum 12' wide and aggregate surface) at all times during construction of this project. Estimated quantities of Aggregate for Temporary Access have been included in the plans for this purpose. The Engineer will determine the amount and when to place the aggregate. The Contractor shall begin placement of the aggregate within 2 hours of notice to proceed from the Engineer or he/she will be liable for liquidated damages in accordance with Article 108.09 of the Standard Specifications. Additional drums, signs, barricades, and concrete barriers may be required to guide this traffic and protect existing Illinois Department of Transportation facilities.

Method of Measurement. All traffic control and protection on local roadways will be measured on a lump sum basis for furnishing, installing, maintaining, replacing, relocating, and removing traffic control devices required in the plans and these Special Provisions.

Basis of Payment.

- (a) This work will be paid for at the contract lump sum price for TRAFFIC CONTROL AND PROTECTION, STANDARD BLR 22 (SPECIAL). This price shall be payment in full for all labor, materials, transportation, handling, and incidental work necessary to furnish, install, maintain, replace, relocate, and remove all local roadway traffic control devices required in the plans and specifications.

In the event the sum total value of all the work items for which traffic control and protection is required is increased or decreased by more than ten percent (10%), the contract bid price for TRAFFIC CONTROL AND PROTECTION, STANDARD BLR 22 (SPECIAL) will be adjusted as follows:

$$\text{Adjusted contract price} = .25P + .75P [1 \pm (X - 0.1)]$$

Where: "P" is the bid unit price for Traffic Control and Protection

Where: "X" =	$\frac{\text{Difference between original and final sum total value of all work items for which traffic control and protection is required}}{\text{Original sum total value of all work items for which traffic control and protection is required.}}$
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The value of the work items used in calculating the increase and decrease will include only items that have been added to or deducted from the contract under Article 104.02 of the Standard Specifications and only items which require use of Traffic Control and Protection.

Aggregate for temporary access will be paid for separately.

REINFORCEMENT BARS

Minimum clearances for reinforcement bars shall be as specified in the ACI-318-08 (Building Code Requirements for Structural Concrete).

CONCRETE COLLAR

Description. This work shall consist of furnishing a concrete collar to complete the blind service connection of proposed storm sewer pipes into the existing 90" diameter sump sewer pipe as shown in the plans.

Materials. Concrete Collar shall be constructed of Class SI Concrete in accordance with Section 503 of the Standard Specifications.

Reinforcement bars shall conform to Section 508 of the Standard Specifications.

Construction. Refer to the drainage detail and cross-section provided with the plans for the construction of the concrete collar. An excavated trench will be required for the installation of the proposed storm sewer pipe. A hole will need to be drilled in the existing 90" sump pipe to provide the service connection. The hole will be created by drilling a series of small holes around the perimeter of the opening. All concrete that falls into the hole of the 90" pipe needs to be removed at no additional cost to the Department. Any excessive damages to the 90" pipe resulting from the drilling and storm sewer installation process shall be repaired by the Contractor at no additional cost to the Department.

The cost of excavation, reinforcement bars, wire mesh, anchor bolts, and concrete needed for construction are included in the cost of CONCRETE COLLAR.

Method of Measurement. This work will be measured for payment in cubic yards.

Basis of Payment. This work will be paid for at the contract unit price per cubic yards for CONCRETE COLLAR.

WATER VALVES

Description. This work shall consist of furnishing and installing water valves in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois and the Illinois American Water company standards and as shown in the plans. In case of conflict, the stricter standard shall apply.

Provide valves with clockwise closing direction.

Gate valves:

1. Valves 4-inch to 12-inch size:
 - a. Design in accordance with AWWA C509 (cast iron body), or AWWA C515 (ductile iron body) bronze fitted, modified wedge disc, resilient wedge and seat type with non-rising stem and O-ring packing.
2. Provide mechanical joint ends, and a cutting-in sleeve or similar sliding/make-up piece, for valves installed in vaults as indicated on the Plans.
3. Acceptable valve manufacturers:
 - a. Mueller No. A-2370-20;
 - b. Or approved equal.

Butterfly valves:

1. Valves greater than 12-inch size:
2. Design in accordance with AWWA C504 for pressure Class 150B, cast iron body, rubber-seated, tight closing type suitable for buried service.
3. Provide mechanical joint ends, and a cutting-in sleeve or similar sliding/make-up piece, for valves installed in vaults.
 - a. Provide restrained type joints for all mechanical joint end valves.
4. Use valve shaft of either 18-8 or Type 304 stainless steel. Extend valve shaft through the valve disc and body into the operator.
5. Provide each valve with a fully enclosed, sealed, grease-packed integral geared manual operator with a 2-inch square operating nut.
6. Acceptable butterfly valve manufacturers:
 - a. Mueller Linesal III,
 - b. Or approved equal.

Basis of Payment. This work will be paid for at the contract unit price per each for WATER VALVES of the diameter specified.

SLOPE WALL

This work shall consist of all labor, material and equipment to construct the concrete slope wall and toewalls at the locations and to the elevations and dimensions as shown on the plans and in accordance with Section 511 of the Standard Specifications and as directed by the Engineer.

Materials. Hydrophilic rubber waterstop shall be according to the following minimum requirements:

Swelling Capacity:	190%
Hydrostatic Resistance:	231 ft (70 m)
Wet / Dry Cycling:	25 Cycles unaffected
Tensile Strength:	83 psi (ASTM D412)
Elongation:	275% (ASTM D412)
Shore A Hardness:	32 (ASTM D2240)
Density:	1.14 g/cm ³ (ASTM D792)

General. All joints and joints adjacent to inlet and outlet structures shall be sealed with a hydrophilic rubber waterstop. The hydrophilic rubber waterstop shall be installed in accordance with the manufacturer's directions.

The slopewall thickness shall be increased as detailed in the plans in order to obtain the required coverage on the hydrophilic rubber waterstop.

Basis of Payment. The cost of all work to construct the concrete slopewall will be paid for at the contract unit price per square foot for SLOPE WALL, of the thickness specified. The unit price shall include the hydrophilic rubber waterstop and additional concrete at the joints.

DOMESTIC METER VAULTS

This item includes furnishing all labor and materials necessary to furnish and install a water meter and concrete vault in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois and the Illinois American Water company standards and as shown in the plans. In case of conflict, the stricter standard shall apply.

Materials. Materials for the concrete meter vault shall be in accordance with Article 602.02 of the Standard Specifications for Road and Bridge Construction.

Basis of Payment. This work will be paid for at the contract unit price per each for DOMESTIC METER VAULTS.

PIPE DRAINS

This work shall consist of constructing pipe drains and clean outs in accordance with Section 601 of the Standard Specifications.

Materials. Materials shall be Polyvinyl Chloride (PVC) Pipe or Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior.

All joints and fittings shall be assembled with solvent cement or gaskets.

Clean outs will be constructed as shown in the plans.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for PIPE DRAINS of the diameter specified. The unit price shall include all cleanout fittings and materials.

PORTLAND CEMENT CONCRETE PAVEMENT 8" (SPECIAL)

This work shall be in accordance with Local Roads "Special Provision for Portland Cement Concrete Pavement (Special)" LR 420, Effective May 12, 1964 and Revised January 2, 2007.

BOLLARDS

Description. This work shall consist of furnishing and installing exterior bollards with concrete footings as shown on the Plans and as directed by the Engineer.

General. The bollards shall be constructed of concrete filled schedule 80 steel pipe. The Portland cement concrete used for the bollard footings and to fill the inside of the pipe shall be in accordance with Article 1020 of the Standard Specifications. Grout installed for the top "cap" of the pipe shall be in accordance with Article 1020 of the Standard Specifications.

The steel reinforcement bars installed for the footings shall be in accordance with Article 1006.10(a) of the Standard Specifications.

The bollard footings shall be the drilled shaft type and shall be constructed according to Section 516. The submittal requirements as stated in Article 516.04 shall not apply.

The bollards shall be painted with one coat of primer and two coats of yellow paint. Cleaning of the painting surfaces shall be in accordance with Article 851.03 of the Standard Specifications.

Method of Measurement. Each exterior bollard installed with a concrete footing will be measured for payment. Bollards inside new or existing buildings will not be measured for payment.

Basis of Payment. This work will be paid for at the Contract unit price each for BOLLARDS.

DRAINAGE STRUCTURES TO BE CLEANED

Description. Drainage Structures to be Cleaned shall consist of all work required to clean all catch basins, manholes, inlets, and pump station sump pits as shown on the plans.

Execution.

Cleaning:

- A. All drainage structures shall be cleaned by removing all soil sediment, waste and other debris.
- B. Soil sediment and debris shall not be discharged to drainage channels, existing storm sewers, or sanitary sewers.
- C. The use of a truck mounted vacuum and containment system to remove, transport and dispose of soil sediment, waste and other debris shall be required for proper removal and disposal of waste by Contractor.
- D. The Engineer shall conduct a visual inspection of the drainage structure to be cleaned upon completion of the material removal.

Basis of Payment. This work will be paid for at the contract unit price each for DRAINAGE STRUCTURES TO BE CLEANED.

SANITARY SEWER

This item includes furnishing all labor and materials necessary to furnish and install sanitary sewer in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois and the Metro East Sanitary District standards. In case of conflict, the stricter standard shall apply. Sanitary sewer pipe shall be PVC DR-35 conforming to ASTM D3034.

Method of Measurement. Measurement for this work will be per foot as measured from the sanitary sewer manhole outside the Well House Building to the connection to the existing sewer main.

The sanitary sewer from the Well House Building to the sanitary sewer manhole will not be measured for payment and will be included in the pump station general work.

Basis of Payment. This work will be paid for at the contract unit price per foot for SANITARY SEWER of the diameter specified.

STEEL CASING PIPE

Description. The work shall be in accordance with Section 561 and shall consist of steel casing pipe complete in place by trenching, augering and jacking or pneumatic ramming methods; including providing both jacking and receiving pits; tight sheeting to protect adjacent utilities, roadways and property, or to provide protection to the public; protection, repair or replacement of utilities; traffic control; fencing of work site to provide protection to public; excavation; removal and disposal of waste excavated materials; bracing; dewatering, including erosion and sedimentation control methods and devices to provide protection to environment from all pumping operations; providing and jacking or ramming of casing pipe; grouting of voids between casing and casing excavation; installing carrier pipe; supporting carrier pipe within the casing with casing spacers; end seals; testing; backfilling with compacted granular backfill; cleanup; and finish grading.

Provide new steel casing pipe conforming to ASTM A139 Grade A with continuous field-welded butt joints in accordance with AWWA C206, minimum yield strength of 35,000 psi, and the following minimum wall thickness of 0.375" for a 36" diameter casing.

The Contractor is not required to use augering and jacking methods if the Contractor believes the specified casing size is not large enough to allow man-entry to remove obstructions. Casing pipes may be rammed at the Contractor's option.

Removal and replacement of casing to avoid obstructions, achieve correct slope, elevation, and bearing will be done at no additional cost to the Contract. Installation of short lengths of casing and carrier pipe because of limited working room will be done at no additional cost to the Contract.

Casing spacers shall consist of molded high density polyethylene, 304 stainless steel, or 14 gauge (minimum) hot rolled and pickled steel, with a minimum 10 mil of fusion bonded PVC coating on the steel bands, and a minimum 0.090-inch PVC liner on the steel bands. Bolts, washers, and nuts shall be 304 stainless steel. Runners shall be glass reinforced or glass filled high density reinforced plastic. The casing spacers shall be restrained in all directions with one spacer on each side of, and a maximum of 12 inches from, each joint and a minimum of one spacer between the joints, with additional spacers as recommended by casing spacer manufacturer. The acceptable products are PSI, Advance, Cascade, or an approved equal. End seals shall be rubber end seals made specifically for the purpose of sealing around carrier pipes and the outside of the steel casing pipes.

Casing void pressure grout to fill voids outside the casing pipe shall consist of a clean dry concrete mix, composed of one part Portland cement and 10 parts of sand and gravel by volume, or other mix approved by the Engineer. Alternatively, the Contractor may use a low density cellular concrete grout with a minimum net density of 45 pounds per cubic foot, a minimum compressive strength of 160 pounds per square inch at 28 days. Acceptable products for low density grout are Mearl Geofoam Liquid Concentrate, or an approved equal. Provide and install a 17-pound magnesium type anode at each end of the casing, with welded connections between the anode lead and the casing pipe.

Method of Measurement. The work will be measured in lineal feet for the length of the casing pipe.

Basis of Payment. The work will be paid for at the Contract Unit Price per foot for STEEL CASINGS or STEEL CASING PIPE, AUGERED AND JACKED of the diameter specified. The work does not include the high density polyethylene pipe, which will be paid for as HIGH DENSITY POLYETHYLENE PIPE of the size indicated on the Drawings.

VIDEO INSPECTION OF STORM SEWER

Description. Video Inspection of Storm Sewer shall consist of all work required to clean and inspect storm sewer culverts, storm sewer piping, utility accesses, and other storm sewer structures.

Equipment. The following is a list of criteria for the video recording equipment:

Camera:

- High-Resolution color with adjustable iris focus.

- Pan and tilt capabilities.

- Integral lighting suitable to provide proper illumination and a clear video image of the entire periphery of the pipe.

- Capable of operating in 100% humidity conditions.

- Produce a high quality video image.

Provide closed-circuit video inspection equipment capable of displaying on-screen footage of distance measured to within 1% of actual distance.

Record the inspection in color in the recording media specified by the Engineer. Forward the recording to the Engineer.

Inspection Procedure. The Contractor should notify the Engineer at least 24 hours prior to performing the cleaning and inspection work.

The storm sewer inspection should begin with a visual examination of the sewer to assess the level of soil, sediment, and other debris that needs removed. If the pipe is 100% free of grit, the video inspection may begin; otherwise, the pipe must be jetted (cleaned) with a high-pressure hose.

Conduct the video inspection of all existing storm sewer pipes, as shown on the plans, when the visual inspection and cleaning is complete. If unacceptable debris is present and the mobile camera cannot pass through the pipe, the Contractor shall continue cleaning operations until debris is removed to the satisfaction of the Engineer.

Each pipe segment should be inspected between manholes or access points in a continuous single run. The video camera should be centered in the pipe during inspection, and the camera speed should not exceed 30 feet per minute.

Method of Measurement. Video Inspection of Storm Sewer shall be measured for payment for in feet. This measurement for payment will be based on cleaning and inspecting storm sewer from center of structure to center of structure. Initial visual inspections, final inspections, and storm sewer jetting and cleaning shall be considered incidental to VIDEO INSPECTION OF STORM SEWER.

Basis of Payment. This work will be paid for at the contract unit price per foot for VIDEO INSPECTION OF STORM SEWER.

DRILLED WELL, HORIZONTAL WELL

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers construction of horizontal collector well, which includes construction of caisson, concrete dead-man, lateral projections, and step and constant rate pumping tests. The location of the caisson shall be as indicated on the drawings.

1.2 GENERAL

- A. The work shall include the installation of a Horizontal Collector Well. It is located near Missouri Avenue in East St. Louis, IL. Design conditions for the well are as indicated herein:
- B. The caisson (shaft) of the well shall have an inside diameter of 16 feet. The outside diameter of the caisson shall be determined by the Contractor's design, but no less than 20 feet. Lateral screens shall be radially projected from within the caisson through a stainless steel port assembly and terminated within the caisson with a full ported stainless steel gate valve.
- C. The Contractor shall provide all equipment, personnel, materials, and services to satisfactorily complete this work in accordance with these specifications. All materials utilized shall be new unless otherwise specifically provided for in the specifications. All workmanship and materials shall meet or exceed the industry standards usually applied to such work.

- D. The Contractor shall provide acceptable erosion control for the site, complying with all requirements of the State of Illinois to prevent harmful materials, construction debris, and excessive suspended solids from leaving the construction site.
- E. The requirements specified herein shall be considered the minimum requirements for construction of the well. The Contractor shall be responsible for satisfying any State regulations otherwise exceeding these specifications.
- F. The Contractor's on-site representative shall possess all required licenses and obtain all well construction permits.
- G. The Contractor shall employ certified welders for each material to be welded.
- H. All components (e.g. structural caisson) shall be designed by a professional structural engineer licensed in the State of Illinois, and all submittal drawings shall be signed and sealed by a professional structural engineer licensed in the State of Illinois.
- I. The Contractor shall be responsible for all structural and geotechnical design parameters of the caisson. The caisson shall be capable of supporting the superimposed loads from the pump house structure consisting of the following service level forces.

Load Case	Reactions			
	Gravity Load (kips)	Horizontal Load (kips)	Overturning Moment (East-West) (kip-ft) ¹	Overturning Moment (North-South) (kip-ft) ¹
Dead	1000	-	4200	6900
Live	325	-	700	325
Snow	20	-	35	135
Seismic	-	82 ³	-	-
Wind	-	45 ³	-	-

- J. Reaction Notes:
 1. Overturning moment shall be taken from the top of the caisson elevation as specified herein.
 2. Overturning moment is for each orthogonal direction and the caisson shall be designed for the resultant moment from combining each horizontal moment.
 3. Horizontal force and moment shall be assumed for any horizontal direction.

- K. The top of the caisson shall be finished flush within 1/4" ± of the finished elevation as indicated herein with a keyway for continuation by Others. Dowels with mechanical connections located at the top of the caisson shall be of sufficient size, quantity, and length to provide for the transfer of loads from the pump house above to the top of the caisson below. If dowels larger than size #8 are required, Contractor shall notify Engineer immediately in writing.
- L. The caisson should be constructed as detailed on the plans to support the concrete superstructure.
- M. Vertical wells at the general site have been in operation for about 20 years. During this period water quality information has been obtained. It is believed this water quality information is indicative of the groundwater water quality that the proposed horizontal collector well will produce. The key water characteristics previously experienced in the groundwater are 10 mg/L iron, 75 mg/L chloride, 1,100 mg/L Total Dissolved Solids, 800 mg/L Total Hardness, and a pH range of 7-8. More specific information is available upon request. The water has been observed to be corrosive to metals and creates depositions on surfaces it contacts.

1.3 PROFESSIONAL LIABILITY INSURANCE

- A. Contractor or Contractor's consultant shall provide professional liability insurance in accordance with Section 107.27 of the Standard Specifications.

1.4 DRAWING AND DATA

- A. Complete drawings and specifications covering materials to be furnished, and dimensions, sizes, and thicknesses of members shall be submitted in accordance with the Submittals section. Additional items to be furnished shall include:
 - 1. Method of measuring and controlling plumbness during the sinking of the caisson.
 - 2. Details pertaining to the lateral installation, including lateral pipe, slotting, packer, digging head, seals, valves, and other items necessary to indicate the proposed Work.
 - 3. Current certificates for each welder to be employed on the project.
 - 4. Complete details of lateral pipe welding.
 - 5. Pump curves for the pumps utilized during the pump testing.
 - 6. Erosion control plan.

1.5 TECHNICAL PROPOSALS

- A. Each horizontal collector well supplier shall submit a Technical Submittal at the time of bid. The submittal shall include:
1. Summary of the proposed work.
 2. Work Experience. List of at least five but not more than 10 projects of similar scope, including number of wells, diameter of wells, length of screen, and capacity. Location and completion date are also to be stated. The name and phone numbers of end users are to be provided for each listed project. The person(s) responsible for directly supervising the construction of the caisson, sinking of the caisson, and projection/development of laterals is to be identified for each completed project.
 3. List of equipment to be used in constructing the wells.
 4. Organizational chart showing the project team for drilling, development, and testing of the wells. Resumes and a work experience history of each individual identified in the project team.
 5. Schedule for drilling, developing, and testing the wells. The schedule shall be shown in a bar, or Gantt, chart form, with activities shown in increments of weeks.
 6. Description of the procedures to be used in construction and sinking of the caisson, installation of laterals, development of the laterals, and performance testing of each well.
 7. Listing of the materials to be provided, such as caisson diameter (inner and outer), total linear feet of caisson, length of screen, length of blank section, number of ports, etc., and the type of joints to be used on the lateral screens.
 8. Description of the proposed lateral design, including number, length, type of laterals and proposed centerline of laterals. Provide rationale for design, including screen entrance, approach, and in-line velocities along with anticipated yield under assumed summer and winter conditions.
 9. Specific identification of any subconsultants (excluding surveyors) who will be utilized for this project. If subconsultants will be utilized, the resumes of the specific individuals, as well as a work experience history of their firms, including three references with specific contacts and telephone numbers.
 10. Description of the as-built information which will be provided to the Engineer.

11. Specifics of any exceptions that are taken to items listed in this document.
12. Within 7 days of the Notice of Award, Contractor shall submit proposed concrete mix designs.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The horizontal collector well shall be designed for the following minimum operating conditions and requirements unless otherwise noted.

	<u>HCW 14-1</u>
Minimum Capacity, gpm	
Winter Conditions	6600
Summer Conditions	6600
Water Temperature, deg F	45-60
Elevations, msl	
Well House Floor Slab, MSL	421
Top of Caisson	
Existing Grade	417 +/-
Approximate top of Bedrock, MSL	296 +/-
Avg. Static Groundwater Level *	
Summer	380 +/-
Winter	380 +/-
Lateral Centerline, MSL	307
Top of Plug, MSL	303
Minimum Caisson Inside Diameter, ft	16
Min Number of Ports	7
Min Number of Laterals	7
Min Total Length of all Laterals, including blank pipe sections, ft	1400
Min Inside Diameter, in	12
Max Entrance Velocity, ft/mon (at lateral screen openings, assuming screen 50% blocked)	2

*Assumes existing dewatering system in operation

2.2 MATERIALS

- A. Concrete – As specified in Section 503 of the Standard Specifications.
- B. Reinforcement – As specified in Section 508 of the Standard Specifications.
- C. Stainless Steel – All stainless steel shall be 316L except screens that shall be 304L.
- D. Stainless Steel Pipe, Schedule 40S – All metal wetted by the process water shall be 316L stainless steel.

1. Lateral Pipe – ASTM A312 or ASTM A778, Grade TP3164L.

2. Fittings

- a. Buttwelding – ASTM A774, wrought stainless steel, Grade TP316L, with beveled ends and Schedule 40S wall thickness.
- b. Flanged – Flanged ASTM A774, wrought stainless steel, Grade TP316L, with angle face rings and stainless steel backing flanges.

3. Backing Flanges – AISI Type 316L stainless steel plate, with ANSI/ASME B16.5, Class 150 diameter and drilling; bolt holes shall be enlarged to accept bolt insulating sleeves; with the following thickness:

<u>Nominal Pipe Size</u> inches	<u>Flange Thickness</u> inches
10 – 14	5/8
16 – 18	3/4
20 – 30	1
36	1-1/4

4. Flange Bolts and Nuts – ASTM A307, AISI Type 316L stainless steel, length such that, after installation, bolts will project 1/8 to 3/8 inch beyond outer face of nut.

E. Insulated Flanges

- 1. Gaskets – PIS “Linebacker, Type E”, full faced,
- 2. Insulating and sealing flange gasket. 1/8 inch thick Pyrox G-10 glass reinforced epoxy retainer with teflon quad-ring seal. Inside diameter shall be 1/8 inch less than inside diameter of flange.
- 3. Sleeve – Pyrox G-10 insulated sleeve, 1/32 inch thick, for each flange bolt.

4. Washers
 - a. Insulating – Two flat Pyrox G-10 insulating washers, 1/8 inch thick, for each flange bolt.
 - b. Metal – Two flat AISI Type 316L stainless steel washers, 1/8 inch thick, for each flange bolt. OD shall not be larger than OD of insulating washer.
5. Primer – Tapecoat “TC Coldprime”.
6. Void Space Sealer – Tape “Flangecoat”.
7. Transparent Temporary Tape – Tapecoat “CT 10/40W”, 2 inches wide.
8. Conformable Watertight Coating – Tapecoat “Moldable Sealmant”
- F. Lateral Screens – Type 316L stainless steel, wire wrapped.
- G. Teflon Thread Sealer – Paste type; Hercules "Real-tuff", John Crane "JC-30", or Permatex "Thread Sealant with Teflon", NSF approved.
- H. Teflon Tread Tape – Hercules "Tape Dope" or John Crane "Thred-Tape", NSF approved.
- I. Anti-Seize Thread Lubricant – Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize", NSF approved.

2.3 PORTS

- A. The ports for the well laterals shall be fabricated of Type 316L stainless steel. The flanges shall be threaded for standard studs. Port assemblies shall be in accordance with the Contractor's design and acceptable to the Engineer. Unused ports shall be furnished with blind flanges. Where valves are to be installed, flanges shall be furnished with insulating flanges to isolate dissimilar metals.

2.4 VALVES

- A. Valves shall be bonneted 316L stainless steel, resilient seat, gate. The gate valves shall be installed on each lateral to isolate that lateral. Valves shall have full pipe diameter openings and shall conform to the requirements of AWWA C509 or C520-10 with NSF approved interior and exterior coatings. Bolt holes shall be enlarged as required to accept bolt insulating sleeves. The valve actuators shall be fitted with a 2 inch wrench nut located on top of the valve. All wetted surfaces shall be 316L stainless steel or rubber/ecastomeric component involving the operator assembly.

2.5 LATERAL PIPE

- A. Lateral pipe shall be 304L stainless steel as indicated in the materials list.
- B. Threaded Joints.
 - 1. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
 - 2. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads.
- C. Flanged Joints
 - 1. Flanged joints between valves and stainless steel flanges shall use insulated flange kits as specified in the materials section. Insulated flange kits shall be installed in accordance with the manufacturer's recommendations. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.
- D. Welded Joints
 - 1. Welding shall conform to the specifications and recommendations in the "Code for Pressure Piping", ANSI B31.1.

2.6 Screen

- A. Screens shall be 304L Stainless steel and of continuous slot, wedge wire-wound construction, with flush joint connections and have a collapse strength of greater than 275 psi and a minimum inside diameter as specified in Paragraph 2-1.
- B. Screens shall be sized to provide the specified well capacity in accordance with the manufacturer's design, pipe-size type, with flush joint connections. Screens shall be adequate to provide the specified minimum capacities with an average entrance velocity through the screen openings of 2.0 feet per minute or less assuming a screen blockage of 50 percent.

- C. The number, length, orientation, and slot openings of the lateral screens shall be determined by the Contractor to produce the specified yield. The Contractor will provide the Owner (IDOT) results of any analysis and documentation used to determine screen and gravel pack sizing and shall also provide a description of the methodology to be used to make this determination. The Contractor shall employ a qualified hydrogeologist acceptable to the Owner to perform this analysis.
- D. Actual screen slot sizes shall be determined based upon selected sieve analyses of samples collected at five-foot intervals during lateral pipe projection and subject to the approval of the Engineer and owner prior to installation.
- E. Screen projection pipe shall be sized to install the screen. Pipe shall be of sufficient strength to withstand the stresses of projection into and withdrawal from the aquifer.

2.7 Caisson Access Port

- A. A floor hatch shall be installed as indicated on the Drawings to allow access to the caisson interior.

2.8 Vent Wall Fitting

- A. A wall fitting shall be installed near the top of the caisson to allow connection of the caisson vent piping. The size and location of the wall fitting shall be as indicated on the Drawings. The wall fitting shall be ductile iron.

PART 3 - EXECUTION

3.1 Hydraulic Interval Testing

- A. Prior to construction of the caisson, hydraulic interval testing should be performed. Contractor shall perform a test boring to the underlying bedrock at the location and conduct hydraulic interval testing to determine the hydraulic conductivity at selected intervals. Based on the results of the testing, Contractor and Engineer shall confirm the depth of the lateral screen projections. Contractor shall be responsible for all costs associated with the testing.
- B. The intervals to be tested will be selected by the Contractor based on the drilling and sampling results and shall be acceptable to the Engineer. Upon reaching the total completion depth of each test boring, the casing will be pulled back to the bottom of the interval to be tested, and the screen will be installed in the selected interval using the pull back method.

- C. Development of the test interval will be accomplished by pumping, bailing and/or air lifting until the water produced is visibly clear and contains little or no sediment. Development time shall be approximately two (2) hours for comparability. Response of the well to development pumping shall be noted so that pumping rates for the hydraulic interval testing can be estimated. The test boring will be equipped with a temporary pump capable of pumping a minimum of 100 gallons per minute (gpm). Suitable equipment such as an in-line flow meter or free- discharge orifice will be used to accurately determine the pumping rate. The selected interval will be pumped for a minimum of two (2) hours. The pumping period will be divided into four (4) steps of at least thirty (30) minutes duration. During each step, the pumping will be maintained at a constant rate. The pumping rate will be varied between steps so that the steps are run at approximately 25%, 50%, 75% and 90% of the maximum achievable pumping rate. The pumping rate should be adjusted and stabilized as quickly as possible between steps. During testing, a water sample may be collected for analysis by the Engineer for quality monitoring of pH, iron, hardness, conductivity and temperature.
- D. Depths to water shall be measured to the nearest 0.01 foot in the test boring prior to and during the pumping period. The elapsed time of pumping to the nearest minute and the pumping rate associated with each water level measurement will be recorded. During each step of the pumping period water level measurements in the test boring will be made on at least the following schedule:

	<u>Minimum Frequency</u>	<u>Period</u>
Pumping	1 minute	First 7 minutes
	2 minutes	Next 8 minutes
	5 minutes	Next 15 minutes

- E. At the end of the test-pumping period, water levels in the test boring will be monitored for a minimum of 30 minutes of recovery on the same schedule specified for the pumping period. Following completion of test drilling and hydraulic interval sampling, the test borings shall be properly abandoned.

3.2 Caisson Construction

- A. The caisson shall be built by the open caisson method or other methods acceptable to the Engineer. The open caisson method entails constructing a portion (lifts) of the reinforced concrete caisson above grade and, after the forms have been removed, excavating soil from the interior of the caisson, thus allowing it to sink under its own weight. With the aid of a dead man and hydraulic ram system to pull the caisson into the ground. The entire deadman shall be backfilled with structural backfill as required in the earthwork section. For any subsurface disturbance adjacent to the caisson, a minimum 6- inch wide seal of bentonite chips shall be placed around the caisson for the entire depth of the disturbance.(AD1-B.3.2) Care shall be taken to keep the caisson plumb during sinking. The deviation from plumb shall not exceed 12 inches in 100 feet. Any correction of caisson deviation, and any construction and associated costs resulting from relocation of appurtenances inside the caisson, including but not limited to pumps, motors, power supply, piping, controls, valves, valve stems, etc., caused by caisson's lack of plumbness, shall be at the Contractor's expense.
- B. When the cutting edge of the caisson has been sunk to the depth determined by the Contractor and the top of the specified level, the Contractor shall clean the cutting shoe bevel area and install plug reinforcing beams. The top of plug elevation shall be as specified with the plug depth and thickness as determined by the Contractor. The plug concrete shall be placed by tremie for underwater placement of concrete. After the plug has attained the minimum 7 day compressive strength required for structural concrete, the Contractor shall dewater the caisson. All loose material shall be removed to sound surface at the plug prior to its placing. The surface of the plug shall have a wood float finish.
- C. The interior of the caisson shall be cleaned of all debris, materials, and equipment and left washed clean prior to performance testing.

3.3 Screen Installation

- A. Lateral screens shall be installed at an elevation and in the orientation to produce the specified yield of each well. Installation of lateral screens shall proceed initially by jacking blank projection pipe into the aquifer radially from the central caisson to the required distance from the caisson wall or to refusal or an indication of excessive jacking pressure. After the blank pipe has been projected, lateral screens shall be inserted into the projection pipe, gravel pack placed and then the projection pipe shall be withdrawn.
- B. Each line of lateral screen shall be completed with 10 feet of blank pipe extending from the inside wall of the caisson. The blank pipe shall conform to the requirements specified for stainless steel lateral pipe.

- C. Any lateral terminated less than 50 feet from the interior caisson wall will be considered ineffective and shall be closed with a blind flange and abandoned; its length shall not be counted in computing the total aggregate screen length required to be installed to meet Contractor's design.
- D. Maximum variance from horizontal shall be 2.5 feet per 100 foot of lateral in either direction.
- E. The Contractor shall provide during projection suitable means to effect removal of aquifer material equal to the minimum of the volume of the pipe projected. All water and material provided during this operation shall be directed into the retention basin which is a part of this project.
- F. At the conclusion of lateral installation, all installation equipment and appurtenances shall be removed from the interior of the screen pipe and the control valve shall be affixed to the interior end and shall be closed to await development.
- G. Method of joining sections of screen and of connecting lateral pipe to port openings shall be of Contractor design and approved by the Engineer.
- H. The contractor shall identify and avoid any pier, piling, or well that may interfere with the lateral.
- I. It is desired for a minimum of 1400L.F. of screen to be installed.

3.4 Well Development

- A. Each lateral screen shall be developed by hydraulically isolating the screen in sections not to exceed 6 feet in length. Development shall be by jetting, compressed air, flushing, or by a combination of these methods. Alternative methods may be utilized, subject to review and acceptance by the Engineer.
- B. Development shall be continued until one of the following conditions can be demonstrated, and each line shall be tested individually.
 - 1. Sand production from each screen line is less than 3 ppm at a flow rate equivalent to at least the Contractor's design rate (gpm/ft) times the total length of that line.
 - 2. Sand production from all screen lines combined is less than 2 ppm during pumping of the collector well at a discharge rate of 7000 gpm.
 - 3. Sand production from each isolated section of the screen has reached stability and cannot be improved by further development.
- C. To demonstrate compliance with the above conditions, sand production shall be measured by a centrifugal sand separating device, or Rossum Sand Tester, attached to the discharge line and flow rates shall be measured using either a flow meter or free discharge orifice.

- D. For a free discharge orifice, the orifices shall be constructed and operated in accordance with ASTM D5716. If multiple discharge pipes are used, the Contractor shall monitor flow on each discharge. The discharge pipe must extend a distance of at least 10 pipe diameters back of the orifice plate. Exactly 24 inches from the orifice plate, or three pipe diameters, whichever is greater, the pipe wall shall be tapped midway between the top and bottom with a 1/8 or 1/4 inch hole. No burrs shall be inside the pipe. The tap shall be fitted with a nipple that does not protrude inside the pipe. The nipple shall be fitted with a transparent flexible tube attached to an accurate scale set to measure the pressure head above the center line of the pipe.
- E. During construction and development of the well, the Contractor shall be required to convey the water to a detention basin as indicated on the Drawings at no additional cost to the Owner. The method of disposal shall be in accordance with all applicable rules and regulations and shall be acceptable to the Engineer. The Contractor shall furnish all labor, materials, and equipment for constructing temporary pipelines as required, the general arrangement of which shall be acceptable to Engineer and Owner. Furthermore, the Contractor shall pump clarified water after settling through the new 24" HDPE discharge main to the point of discharge near Bowman Avenue. All temporary pumps and piping connections are the responsibility of the Contractor.
- F. All required test equipment shall be furnished by the Contractor. The Engineer shall make the final determination of whether or not development of the well has attained these objectives, and is therefore complete.

3.5 Completion Of Development

- A. Upon completion of all well development and disinfection activities, Contractor shall close all lateral isolation valves and fully drain the caisson. Contractor shall clean and remove any residual material remaining in the caisson to the acceptance of the Engineer. Prior to leaving the site, Contractor shall construct a temporary cover deck on the top of the caisson to prevent potential access and entry of rainwater into the caisson. The deck shall be constructed of dimensional lumber and plywood and covered with a heavy duty tarp securely fastened all around. Fabrication of the deck shall be to the acceptance of the Engineer.

3.6 Pumping Tests

- A. Pumping tests shall be conducted to determine the installed capacity of each well. A step rate method pumping test shall be conducted to determine well efficiency and the optimum rate of pumping for the constant rate test; a constant rate method pumping test shall be conducted to determine well efficiency and to confirm capacity.

- B. Due to the volume of water requiring discharge during the pumping tests, it will be unacceptable to discharge near the well site. The pumping tests will not be performed until following completion of the Well House. Contractor shall re-mobilize following the construction of the well house to perform the testing. Pump testing will be performed using the actual pumping units and flow measurement devices to be installed with the work by Others. The timing of the pumping tests is described further in Section 01310 and shall be coordinated with the Owner and Engineer.
- C. At the time Contractor re-mobilizes to perform the pumping test, all lateral isolation valves will be open and the caisson will be flooded.
- D. The Contractor shall be required to pump the wells during the tests for the full specified period without shutdown. Water level measurements shall be made in the horizontal collector well and at monitoring wells, both existing and new to be installed as specified herein, during the test at intervals and in the manner directed by the Engineer.
- E. After drawdown has substantially stabilized, the Contractor shall measure the velocity of the flow and water temperature from each lateral using remote measuring equipment.
- F. The Contractor shall furnish any necessary equipment to conduct the specified pump tests. All measurements of drawdown shall be made with an electric tapeline and shall be accurate within plus or minus 1/8 inch.
- G. A tap will be provided in the pump discharge piping for Contractor's use in obtaining samples for sand content in the raw water.
- H. All power costs for operation of the pumps during the testing will be furnished by the Owner. The power costs for any additional pumping testing required due to an aborted test or other reason due to the Contractor's inability to meet the performance shall be paid by the Contractor.
- I. Step Rate Method.
 - 1. Prior to starting the step rate pumping test, the well shall be allowed to recover from any previous pumping activities for at least 10 hours. The step rate method pumping test period shall be 8 hours pumping and 2 hours recovery time. To confirm compliance with specified sand content requirements (2 ppm or less), a sand test as specified in Paragraph 3-3 shall be conducted at the end of each step. If the average of these four tests is greater than 2.0 ppm, additional development will be required. Contractor will be responsible to re-mobilize crews and equipment as necessary to perform the additional development.

2. The step rate method shall be a step drawdown type pumping test in which pumping rates shall be as follows:

	<u>Period</u>	<u>Rate (gpm)</u>
	2 hours	1000
	2 hours	3000
	2 hours	5000
	2 hours	7000
	<u>Minimum Frequency</u>	<u>Period</u>
Pumping	5 minutes	First 60 minutes
	30 minutes	Next 60 minutes
	5 minutes	Next 60 minutes
	30 minutes	Next 60 minutes
	5 minutes	Next 60 minutes
	30 minutes	Next 60 minutes
	5 minutes	Next 60 minutes
	30 minutes	Next 60 minutes
Recovery	5 minutes	Next 60 minutes
	30 minutes	Next 60 minutes

3. The pumping rate shall also be measured and recorded at the same frequency listed above.
4. Optimum rate of pumping for each well shall be determined from the results of the step rate method pumping tests.

J. Constant Rate Method

1. Following the step rate method pumping test, each well shall be allowed to recover for at least 24 hours before the constant rate method pumping test is started. The constant rate method pumping test period shall be 72 hours pumping time and 24 hours recovery time. To confirm compliance with specified sand content requirements (2 ppm or less), a sand test as specified in Paragraph 3-3 shall be conducted at elapsed times of 1 hour, 6 hours, 12 hours, 24 hours and 48 hours during the constant rate test. If the average of these five tests is greater than 2.0 ppm, additional development will be required. Contractor will be responsible to re-mobilize crews and equipment as necessary to perform the additional development.
2. The optimum rate of pumping determined by the Contractor from the step rate method pumping tests shall be used for the constant rate method pumping tests up to a maximum of 7000 gpm.

3. The drawdown shall be measured in the horizontal well and in each of the associated monitoring wells as follows:

	<u>Frequency</u>	<u>Period</u>
Pumping	1 minute	First 15 minutes
	5 minutes	Next 45 minutes
	15 minutes	Next 60 minutes
	30 minutes	Next 120 minutes
	60 minutes	Next 68 hours
Recovery	Frequency and period shall be measured to the above drawdown schedule for a period of 24 hours. However, if the Engineer determines that the recovery level has stabilized to the natural static water level, measurements may be discontinued.	

4. The pumping rate shall also be measured and recorded at the same frequency listed above. The corresponding level in the Mississippi River shall also be measured and recorded.

K. Test Report

1. The Contractor shall furnish to the Engineer copies of the field data, calculations and graphs plotted to logarithmic scale of the step and constant rate pump tests performed for each well. A preliminary copy of the report shall be submitted in accordance with the Submittals section. Upon acceptance of the preliminary report, five hard copies and two electronic copies of the report shall be furnished.

L. Aborted Test

1. Failure of pump operation for a period longer than 2 percent of the elapsed pumping time shall require suspension of the test until the water level in the pumped well has recovered to its original level. Once the water level has recovered, the test must be restarted.
2. Recovery shall be considered "complete" after the well has been allowed to rest for a period at least equal to the elapsed pumping time of the aborted test, except that if any three successive water level measurements spaced at least 20 minutes apart show no further rise in the water level in the pumped well, the test may be resumed immediately. The Engineer shall make the determination as to whether this latter condition exists.

3.7 EROSION AND POLLUTION CONTROL

- A. During construction and well tests, the Contractor shall comply with any State or Federal regulatory requirements and employ techniques to prevent harmful materials, construction debris, and excessive suspended solids from exiting the site.
- B. Under no circumstances should discharges be made to the surface surrounding the caisson.
- C. The Contractor shall submit his proposed methods prior to the start of well construction and shall address the following:
 - 1. Diversion of sand, silt, and debris removed from the bottom of the caisson and pumped discharges carrying these materials, to prevent erosion and runoff of solids and debris.
 - 2. Protection of the site from surface erosion during construction.
 - 3. Disposal of waste construction materials, including concrete wash.
 - 4. Disposal of other potential contaminants that would otherwise be dumped, sprayed, or placed near or disposed of onsite.
- D. Certain portions of the project will be completed prior to construction of the horizontal collector well to aid the Contractor in removing spoil and water during the construction and testing of the horizontal collector well. This work includes the detention basin and HDPE transmission main. It is intended that all spoil and water from the construction and testing operation will be directly pumped into the detention basin adjacent to the collector site, the solids will be allowed to settle, and the clarified water will be pumped through the HDPE main to the point of discharge near Bowman Avenue by a temporary pump provided and operated by the Contractor. All facilities necessary to complete this approach not provided as a part of the completed project shall be provided by the Contractor and removed by the Contractor when the collector is completed. Any spoil accumulated in the detention basin during this operation will be removed and properly disposed of by the Contractor. The site around the caisson will be excavated to the limits shown on the plans to allow for caisson construction and to promote site drainage during construction.

3.8 Warrantee

- A. Because the performance of the horizontal collector well cannot be determined during the normal 1 year warrantee period and significant costs are at stake, the Contractor shall provide an extended warrantee on the performance of the collector well.

- B. CONTRACTOR guarantees that for the period commencing on the date of the Substantial Completion of the collector well and continuing until the end of three (3) years following the Substantial Completion of the collector well (the "Guarantee Period"), the collector well will achieve a continuous flow rate of 6600 gallons per minute (gpm) for a period of 24 hours (the "Performance Guarantee") with the pumping level at least 10 feet above the elevation of the center of laterals. As soon as practicable after performance testing of the collector well and as a condition to achievement of Substantial Completion of the collector well, CONTRACTOR shall submit a performance testing report fully documenting the results of the performance testing and demonstrating achievement of the Performance Guarantee. If the collector well fails to achieve the Performance Guarantee during the initial performance test, CONTRACTOR shall take whatever action he determines is necessary to correct and achieve the Performance Guarantee.

Notwithstanding anything to the contrary:

The Performance Guarantee covers only the collector well's ability to yield 6600 gpm for 24 hours as defined above and does not cover any other item, i.e. pumps, piping, controls, meters, etc.). If, during the Guarantee Period, ILDOT provides notice to CONTRACTOR that the collector well fails to satisfy the Performance Guarantee, then CONTRACTOR shall have a reasonable opportunity and time to inspect such claimed failure.

- 1.) If CONTRACTOR determines that there is no failure to achieve the Performance Guarantee, based upon application of the Performance Test Procedures specified above, CONTRACTOR shall be entitled to compensation at its standard rates for the call-out.
- 2.) If there is a failure to achieve the Performance Guarantee, CONTRACTOR shall promptly at its own cost and expense, take such actions with regards to the well as are reasonable and practicable to achieve the Performance Guarantee. The timing of the work to be completed with respect to any such remediation or repair shall be subject to ILDOT's approval, such approval not to be unreasonably withheld or delayed. Notwithstanding the foregoing, if the collector well fails to satisfy the Performance Guarantee during the Guarantee Period, and such failure endangers property or materially and adversely affects the operation of ILDOT's facilities, CONTRACTOR shall correct the failure as soon as is practicable.

Following completion of any remediation work, pursuant to paragraph 3 above, to remedy a failure to achieve the Performance Guarantee during the Guarantee Period, CONTRACTOR shall conduct a performance test with the existing equipment (pumps meters, piping) of the collector well in accordance with approved Test Procedures to verify achievement of the Performance Guarantee. Such performance test shall be conducted at a time mutually agreed between ILDOT and CONTRACTOR. CONTRACTOR will be responsible for his costs and expenses associated with any follow-up performance test conducted due to a failure to achieve the Performance Guarantee. With respect to remediation work pursuant to paragraph 2 above, CONTRACTOR shall continue to perform engineering, equipment and/or construction services until the [collector well] is operating at a level that achieves the Performance Guarantee. The Performance Guarantee excludes defects or damage caused by abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, CONTRACTOR's subcontractors and suppliers, or any other individual or entity for whom CONTRACTOR is responsible. Under no circumstances shall the CONTRACTOR'S liability extend beyond its costs and efforts to correct the deficiency in meeting the Performance Guarantee.

Once CONTRACTOR has successfully conducted a performance test that achieves the Performance Guarantee, CONTRACTOR will submit to ILDOT a notice of Performance Guarantee achievement, stating that the Performance Guarantee has been met, including a detailed report. ILDOT shall have thirty (30) days to review CONTRACTOR'S notice and respond with any comments or objections to the notice, otherwise, the Performance Guarantee will be deemed to have been achieved during the applicable period.

Method of Measurement. This work will be measured for payment as follows:

- a. Construction of the caisson, concrete dead-man, demobilization, and related work will be measured for payment on an each basis.
- b. Construction of the horizontal (lateral) wells will be measured for payment in feet measured from the inside wall of the caisson to the end of the screens.

Basis of Payment.

Caisson construction and related work shall be paid for at the contract unit price per each for DRILLED WELL, which shall be payment in full for the work described herein.

Horizontal wells will be paid for at the contract unit price per foot for HORIZONTAL WELL, which shall be payment in full for all underground work outside of the caisson as described herein.

DOWNSPOUT CONNECTION

This work shall consist of constructing downspout connections from the Well House Building downspouts to the proposed pipe drains in accordance with Section 601 of the Standard Specifications, as directed by the Engineer, and specified herein.

Materials. Materials shall be Polyvinyl Chloride (PVC) Pipe or Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior.

Building anchor materials shall be according to applicable articles of Section 1006 of the Standard Specifications.

All joints and fittings shall be assembled with solvent cement or gaskets.

Basis of Payment. This work will be paid for at the contract unit price per each for DOWNSPOUT CONNECTION.

SANITARY SEWER CONNECTION

This item includes furnishing all labor and materials necessary to connect the proposed 4" sanitary sewer from the new Well House Building to the existing sanitary sewer system. This work shall conform to the Standard Specifications for Water and Sewer Main Construction in Illinois and the Metro East Sanitary District standards. In case of conflict, the stricter standard shall apply.

Basis of Payment: This work will be paid for at the contract unit price per each for SANITARY SEWER CONNECTION.

RECORDER WELL

Description. This item consists of furnishing all materials, labor, tools, and equipment necessary for the construction of new recorder wells at the locations as indicated on the Plans, as directed by the Engineer, and as specified herein.

Casings. The casing for the recorder well shall be Schedule 80S, stainless steel not less than 8 inch outside diameter by 0.5 inch wall thickness, extending from the top of the screen to the elevation indicated on the Plans. Steel casings shall be fabricated from Type 304 L stainless steel and shall be manufactured in accordance with ASTM A312. Joints shall be welded and shall be watertight.

Screens. The well screen shall be manufactured by a firm regularly engaged in the manufacturer of well screens. Screens shall be fabricated from Type 304 L stainless steel. The outside diameter of the screen shall not be less than 8 inches. The vertical height of the screen shall be indicated on the Plans, unless otherwise directed by the Engineer.

The screen or members and elements thereof shall be of adequate strength and thickness to meet the required service conditions. The screen shall be wire wound continuous slot. The width of screen openings shall be 50 slot for the recorder well. The screen open area shall be 238 in² per foot of screen. All members and elements between slots shall be of adequate section and strength to safely withstand all loads and stresses to which they may be subjected. The screens shall have sufficient strength to safely support vertically the load imposed thereon by the casing. Screen sections shall be fabricated by the welding of all joints and points of contact of the assembled parts. All joints between screen sections shall be securely welded by continuous weld meeting the approval of the Engineer.

The end of the screen shall be tightly sealed by means of a stainless plate not less than 3/8 inch nominal thickness, attached to the screen by means of a continuous weld around its entire circumference. This plate will serve the dual purpose of closing the bottom of the recorder well and of providing a support for the casing and screen assembly.

Gravel. All materials used for the gravel wall around the inner well casing shall be clean, well-rounded particles of 95% siliceous material which has been thoroughly cleaned of all silt, dust, and other foreign matter. The filter gravel as herein specified shall be uniformly graded between 2.25 mm to 3.75 mm and no more than 5% by weight should fall outside the upper and lower limits specified. The Contractor will provide signed certification that states the gravel is composed of not less than 95 percent silica and meets the gradation requirements of this special provision. Contractor will need to sample every super sack or every 5,000 lbs of proposed gravel pack two weeks prior to drilling to verify the proposed gravel pack meets the special provisions. A representative of the Department will be present to witness the gravel sampling. Each super sack will have its own sieve analysis performed on the proposed gravel pack. Once the sieve analysis has been completed by an independent lab the results will be turned into the department for approval. Any super sacks not meeting the specifications will be rejected. Contractor will then have to replace the super sack with new and test again. The cost for testing will be included in this pay item.

Recorder Well Construction. The recorder well shall be constructed by using a Pier Rig method and/or Rotary Reverse method. If Reverse Rotary is used no pit will be allowed to be dug. A portable pit or tank will be allowed. A trench for the portable tank or pit will be allowed to be dug from the proposed well to the portable pit or tank. If a trench is used it must be lined. All cuttings will remain on site and will be graded out. The drilled hole shall be 1.5 feet in diameter. The Contractor shall provide a continuous and sufficient supply of water so that the drilled hole will be kept full of water at all times during the entire drilling operation.

No use of drilling mud or other Bentonite-type drilling additives shall be used in the drilling process, unless otherwise permitted by the Engineer.

The Contractor shall be prepared to use temporary casing or other approved means to keep the hole open during construction. Temporary casing used during the drilling shall be removed and recovered by the Contractor. Should the drilling water become heavy with fines and mud, the Engineer will require the Contractor to pump the drilling fluid to waste and refill with clean water.

After the drilling is complete, the casing and screen shall be installed in the drilled hole. Care shall be taken that the closed end of the well screen shall have a uniform bearing on the bottom of the hole. The bottom of the casing shall be centered concentrically plumb in the hole. Centering guides designed to hold the screen in the center of the borehole shall be installed as shown on the Plans. The screen and casing shall be no more than 5 inches in 100 feet out of plumb. The casing (including the screen sections) shall extend from the bottom of the well to the elevation indicated on the Plans.

Gravel shall be placed in annular space between the casing and the side of the drilled hole from the bottom of the well up to the elevation indicated on the Plans. Gravel shall be placed with a tremie in one continuous operation. The outside diameter of the gravel wall shall be not less than 1.5 feet and the horizontal thickness of the gravel pack shall not be less than 6 inches. During the placement of the gravel, the elevation of the bottom of the tremie pipe shall be so controlled that at no time shall the bottom of the pipe be more than 5 feet above the top of the gravel already deposited in the well. All operations of handling and placing the gravel shall be regulated to prevent the segregation of sizes of gravel particles. The water used to wash the mixture down the tremie pipe shall contain a chlorine concentration of 400 ppm, obtained by the addition of sodium hypochlorite.

The annular space between the casing and the 1.5 foot drilled hole directly above the gravel pack shall be filled with a 3 foot Bentonite layer and then the remaining annular space between the casing and the drilled hole wall shall be filled with cement grout as indicated on the Plans. The grout shall be mixed 1 bag of cement to 6 gallons of water with 1% Bentonite added to reduce shrinkage. Grout shall be placed with a tremie similar to the gravel pack, when placed below water level. No water from drilling of the new well will be allowed on the roadway pavement. Cost for this will be incidental to the project.

Battery Powered Recorder. The water level recorder shall be battery powered and variable speed. The recorder shall include the following:

- 4" copper float.
- 4 oz. counterweight.
- 1:10 English gage scale gearing
- 18 inch pulley for beaded line.
- 60 ft. beaded float line w/ 6 in. bead spacing.
- 2 end hooks.

Contractor's Responsibility. The Contractor shall be responsible for performing all of the work in strict accordance with these specifications. If evidence indicates that the screen or casing in the well is broken or that the well is not constructed in accordance with the specifications to the satisfaction of the Engineer, the Engineer may order that proper changes be made by the Contractor, or in the event that proper changes cannot be made, the Engineer may order the Contractor to abandon such well without cost to the Department and to drill a new well.

Drawings and Data. Complete specifications, data, and catalog cuts and Plans covering the fabricated items furnished under this section shall be submitted in accordance with the Standard Specifications.

Method of Measurement: Each new recorder well installed complete in accordance with this provision will be measured for payment on an each basis.

Basis of Payment: This work will be paid for at the contract unit price per each for RECORDER WELL.

HIGH DENSITY POLYETHYLENE PIPE

This work shall consist of furnishing and installing High Density Polyethylene (HDPE) pipe for deep well pump systems as shown in the plans, as directed by the Engineer in accordance with Section 550 and 561 of the Standard Specifications, and as herein specified.

Materials.

- A. Pipe shall be DR 17 and manufactured from a PE 4710 resin which meets ASTM D 3350 with a minimum cell classification of 445574C. Pipe shall be manufactured to the dimensions of ASTM F 714. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Pipe shall have a minimum pressure rating of:
- | | |
|---------|---------|
| DR 7 | 336 psi |
| DR 9 | 252 psi |
| DR 11 | 202 psi |
| DR 13.5 | 161 psi |
| DR 15.5 | 139 psi |
| DR 17 | 126 psi |
| DR 21 | 101 psi |
| DR 26 | 81 psi |
| DR 32.5 | 64 psi |
- B. Butt Fusion Fittings - Fittings shall be made from HDPE pipe resin meeting ASTM D 3350 with a minimum cell classification of 445574C. Molded butt fusion fittings shall have a manufacturing standard of ASTM D 3261. Fabricated fittings must have the same pressure rating as the pipe; a DR less than the pipe shall be used. Fabricated fittings are to be manufactured using a Data Logger to record temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the Quality Control records.
- C. Electrofusion Fittings - Fittings shall be made from resin or pipe meeting ASTM D 3350 with a minimum cell classification of 445574C. Electrofusion Fittings shall meet the manufacturing standard of ASTM F 1055. Fittings shall have the same pressure rating as the pipe or higher unless otherwise specified on the plans.
- D. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be made from materials containing resin that meets ASTM D 3350 with a minimum cell classification of 445574C.
- E. Plain End Terminations – All plain end terminations (clean outs) shall be made using 304L or 316L stainless steel stiffeners.

- F. Repair Clamps - The full circle repair clamp shall have an 18-8 Type 304 stainless steel band. It shall be a minimum of 7.5" in width (5" minimum width for the 221). The lugs shall be made of high strength ductile iron per ASTM A536 GR80-55-06 and have a fusion bonded Flexi Coat epoxy coating. The lugs shall be attached to the band by hemming the band and sliding it into the lug slot. The slot shall be cast into the lug base. The lug shall have a friction fit with the band, preventing it from sliding off, yet allowing for easy removal and reattachment in case of installing the clamp in restricted spaces.

The gasket shall be made of Nitrile (Buna N) specially compounded to resist water, oil, acids, alkalis, most (aliphatic) hydrocarbon fluids, and many other chemicals. The temperature range of the gasket shall be -20°F thru +180°F. The gasket must have a bridge plate that helps the end of the clamp band to seal across the gap. The bridge plate shall be made of quarter-hard 304 stainless steel. It shall be recessed and bonded into the gasket. The gasket shall have a gridded pattern. The gasket shall be tapered on the ends and overlap for range capability.

All bolts shall be at least 5/8" x 6" high strength low alloy per ANSI A21.11 and B18.10. At least one 5/8" x 6 7/8" bolt with a taller nut shall be furnished to help facilitate installation of clamps up thru 4.50" O.D. Heavy semi-finished nuts meeting ASTM A563 shall be provided with the bolts. Multiband clamps shall have all closed lugs except for one set of open and closed lugs to allow for easy opening and installation of the clamp.

- G. Manually Operated Pinch Valves – 14" Diameter and Larger

1. Submittals

- a. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, flow data, and pressure rating.
- b. Upon request, provide shop drawings that clearly identify the valve dimensions, including all supplied accessories.

2. Quality Assurance

- a. Supplier shall have at least ten (10) years experience in the manufacture of pinch style valves, and shall provide references and a list of installations upon request.

3. Manually Operated Pinch Valves – 14” Diameter and Larger
 - a. Valve shall have a ductile iron body, mechanical pinch type with flange joint ends. The valve length shall be as given in ISA S75.08 or no longer than twice the nominal valve port diameter. The flanges shall be drilled and tapped to mate with ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges. Body shall be epoxy coated for additional corrosion protection.
 - b. The sleeve trim shall be one piece construction with integral flanges drilled to be retained by the flange bolts. The sleeve trim shall be reinforced with calendared nylon or calendared polyester fabric to match service conditions. The sleeve trim shall be connected to the pinch bar by tabs imbedded in the sleeve trim-reinforcing ply. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim.
 - c. The fixed lower pinch bar shall be set to pre-pinch the sleeve so that there is no reduction to the total flow when the valve is in the open position.
 - d. The solid steel mechanism shall be single acting, closing the sleeve trim from the top only. The mechanism shall be supported in the valve body. There shall be no cast parts in the operating mechanism. The pinch mechanism shall be adjustable for stroke without removing the valve from the line. ACME threads shall be used on the valve mechanism.
 - e. A torque tube shall be fitted to the body of the valve via a mounting plate. The tube shall extend from the valve to above grade level, providing protection for the operating stem and sealing the opening in the top body half. Valve shall be operated by turning a non-rising stem, contained within the torque tube, and connected to the pinch mechanism. Bevel gear operators shall be provided on all valves over 8" size, and on smaller sizes as specified on the purchase order. Torque tube shall be epoxy coated for additional corrosion protection. Valves shall be manufactured in the USA.
 - f. The handwheel shall be constructed of welded, tubular steel and be connected to the bevel gear operator by means of a single retaining bolt. The handwheel shall be fitted with a lubrication fitting to allow lubrication of the stem.
4. Function
 - a. Rotating the handle clockwise lowers a pinch bar above the sleeve. Turning the handle counter-clockwise separates the two pinch bars to open the valve

5. Manufacturer
 - a. All valves shall be of the Series 52-H as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106, Clarkson, Wen or approved equal.
 6. Installation
 - a. Valve shall be installed in accordance with manufacturers written Installation and Operation Manual and approved submittals
 7. Manufacturer's Customer Service
 - a. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.
 - b. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.
- H. Manually Operated Pinch Valves – 12" Diameter and Smaller
1. Submittals
 - a. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, sleeve trim design, elastomer characteristics, flow data, and pressure ratings.
 - b. Upon request, provide shop drawings that clearly identify the valve dimensions including all supplied accessories.
 2. Quality Assurance
 - a. Supplier shall have at least ten (10) years experience in the manufacture of pinch style valves, and shall provide references and a list of installations upon request.

3. Manually Operated Pinch Valves – Up to 12” Diameter
 - a. Valves are to be of the full cast metal body, mechanical pinch type with flange joint ends on both the body and the sleeve trim. The valve shall have face-to-face dimensions of standard gate valves, in accordance with ANSI B16.10 up to 12” size. They shall be rated for operating pressure up to 150 psi. The flanges shall be drilled to mate with ANSI B16.1, Class 125/ANSI B16.5, and Class 150 flanges.
 - b. The sleeve trim shall be one piece construction with integral flanges drilled to be retained by the flange bolts. The sleeve trim shall be reinforced with calendared nylon or calendared polyester fabric to match service conditions. The sleeve trim shall be connected to the pinch bar by tabs imbedded in the sleeve trim-reinforcing ply. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim. To promote laminar flow. The interior surface of the sleeve shall be smooth. Sleeves manufactured with interior arches or folds shall not be permitted.
 - c. For full port and reduced port sleeves, the port areas shall be 100% of the full pipe area at the valve ends. For Cone and Variable Orifice sleeves the inlet port area shall be 100% of the full pipe area, reducing to a smaller port at the outlet.
 - d. The steel mechanism shall be double acting with pinching of the sleeve trim occurring equally from two sides. ACME threads shall be used on all valve mechanisms. There shall be no cast parts in the operating mechanism. To prevent pitting, corrosion, seizing or jamming. The pinching mechanism and side-rails shall be fully enclosed within the valve body. Side-rails that slide through bushings or protrude through the valve body shall not be permitted. The stem shall be non-rising and have a non-rising handwheel. The handwheel shall be constructed of welded, tubular steel and be connected to the stem by means of a single retaining bolt. The handwheel shall be fitted with a lubrication fitting to allow lubrication of the stem. A valve position indicator rod shall pass through the center of the stem, retaining bolt, and handwheel to provide visual position indication. Bevel gear operators shall be provided on all valves over 8” size. Lifting eyelets shall be provided on the top of the valve body where applicable.

4. Function
 - a. Rotating the handle clockwise lowers a pinch bar above the sleeve, while raising a pinch bar below the sleeve simultaneously, pinching the sleeve closed at the center of the valve. Turning the handle counter-clockwise separated the two pinch bars to open the valve.
 5. Manufacturer
 - a. All valves shall be of the Series 75 as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106 or approved equal.
 6. Installation
 - a. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.
 7. Manufacturer's Customer Service
 - a. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valves.
 - b. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valves.
-
- I. Portland Cement Concrete shall be in accordance with Section 1020 of the Standard Specifications.
 - J. Reinforcement bars shall be in accordance with Section 1006.10 of the Standard Specifications.

Construction Requirements.

During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced.

Force mains shall be bedded and backfilled with compacted FA1 or FA2 to the limits shown on the plans. The remainder of the trench shall be backfilled with suitable material meeting the approval of the Engineer.

Trench backfill will be required according to Section 208 of the Standard Specifications.

Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe supplier. The butt fusion joining will produce a joint with weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

Mechanical joining will be used where the butt fusion method cannot be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a ductile iron back-up ring.

Hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

Butt Fusion Operator and Equipment. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion welds made by that individual. The employer is responsible for documenting all qualification and training records of that individual. The owner of fusion equipment is responsible for all maintenance records of fusion equipment. Employer of the fusion machine operator to have in-house safety program, established for at least 2 years with verifiable information in regard to schedules and history of safety meetings.

A fusion procedure that follows the guidelines of ASTM F 2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings must be documented on company letterhead. A record or certificate of training for the fusion operator must be provided that documents training to the fundamentals of ASTM F 2620.

All HDPE fusion equipment operators shall be qualified to perform pipe joining. Fusion equipment operators shall have current, formal training on all fusion equipment employed on the project. Training received more than two years prior to operation with no evidence of activity within the past 6 months shall not be considered current.

Butt fusion equipment must be serviced prior to use for this project. The machine must be environmentally friendly and in satisfactory working order. The hydraulic system must be leak free. The pressure gauge must be checked for accuracy and the thermometer checked.

A fusion data recorder shall be used to record all fusion welds. The device shall record the following variables of each fused joint:

- a. Heater surface temperature immediately before inserting the heater plate. Alternatively, the heater plate may be measured with a pyrometer and entered into the weld record.
- b. Gauge pressure during the initial heat cycle
- c. Gauge pressure and elapsed time during the heat-soak cycle
- d. Heater removal (dwell) time
- e. Gauge pressure and elapsed time during the fusing/cool cycle
- f. Drag pressure
- g. Pipe diameter and wall thickness
- h. Type of HDPE material (Specification and Classification) and manufacturer
- i. Fusion Machine Identification

The device shall record the operator, a unique operator ID number, the date and time of each weld. Records showing the device is up to date on all required calibration should be available for presentation when requested. All fusion welds should be traceable to the report with an indentation weld stamp (operator/weld ID) or by permanent paint marker/pen next to fusion weld.

Thrust Blocks. Thrust blocking will be required at all bends greater than 10 degrees and at locations recommended by the manufacturer. Thrust blocks shall be constructed of Class SI Concrete.

Thrust Restraints. Thrust restraints will be required at locations shown in the plans and at locations recommended by the manufacturer. Thrust restraints shall resist a 20 degree Fahrenheit change in pipe temperature. Thrust restraints shall be constructed of Class SI Concrete.

Testing. The force mains shall be tested for hydrostatic pressure and leakage as specified in Article 51.04 of the Standard Specifications. Water from the deep well system may be used for testing. Disinfection of the force mains will not be required.

Tracer Tape. Conductive metallic tracer tape shall be installed 1.5 ft. above each force main. Tape shall be 3 inch wide, aluminum core, 13 microns thick encased in a protective inert plastic jacket. Tensile strength shall be a minimum of 5000 psi. Tape shall be color coded in accordance with APWA uniform color code.

Pipe, valves, and fittings shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

Basis of Payment. This work will be paid for at the contract unit price per linear foot for HIGH DENSITY POLYETHYLENE PIPE of the diameter specified, which price shall include all excavation, sheeting or shoring, backfill, thrust blocking, thrust restraints, valves, repair clamps, tees, labor, materials, equipment and incidentals necessary to complete the installations as herein specified. No deductions or additions will be made for installations on the pipe bridge or in casings.

LOCATING DEEP WELL FORCE MAIN

This work shall consist of determining the exact location and depth of the deepwell force mains owned and maintained by the Department at the locations of the proposed Cleanout Vaults shown on the plans and locations where force mains will cross, prior to the construction of Cleanout Vaults, to protect them from damage and to obtain necessary information for required Cleanout Vault height dimension.

Any prints of the force main location or any information shown on the plans for existing underground force mains owned and operated by the Department are intended to show general alignment only, and are not intended to show exact locations of the force mains. The Contractor shall be responsible for determining the exact location of any such existing underground force mains prior to any excavation or penetration relative to the construction work.

The Contractor shall take whatever precautions necessary to protect the force main from damage during location and construction operations. In the event that the pipe is damaged, the Contractor shall immediately repair the damaged section of force main in a manner satisfactory to the Engineer.

In the event the repairs are not made by the Contractor, the Contractor shall reimburse the Department for such repairs within 60 days of receiving written notification of said damage. Otherwise, the cost of such repairs will be deducted from monies due or which will become due the Contractor under the terms of the contract.

Basis of Payment. This work will be paid for at the contract unit price for each location to LOCATING DEEP WELL FORCE MAIN which price shall include locating each force main, measuring the depth and protecting it from damage during location and construction operations.

POROUS GRANULAR BACKFILL (SPECIAL)

Description. This work shall consist of furnishing, and placing Porous Granular Backfill (Special) material as detailed on the plans, and in according to Section 502.10 except as modified herein.

Materials. The gradation of the porous granular material shall be CA 11 in accordance with Articles 1003 and 1004.

Construction. The Porous Granular Backfill (special) shall be installed according to Section 502.10.

Basis of Payment. This work will be paid for at the contract unit price per Cubic Yard POROUS GRANULAR BACKFILL (SPECIAL).

PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL

Description. This work shall consist of constructing portland cement concrete sidewalk dowelled into adjacent concrete structures as shown on the plans. This work shall be completed in accordance with applicable portions of Sections 420 and 424 of the IDOT Standard Specifications.

Basis of Payment. Payment for PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH, SPECIAL will be made at the Contract unit price per square foot, complete in place and shall include all dowel bars, concrete stoops, and expansion joints.

GUTTER REMOVAL (SPECIAL)

Description. Gutter removal (Special) shall consist of all work required to sawcut, dispose and remove the existing concrete curb, gutter, and paved shoulder for the construction of new modified gutter sections that will accommodate the proposed drainage inlets in accordance with the specification shown on the plans, or established by the Engineer. This work shall conform to the requirements of Section 440 of the IDOT Standard Specifications.

Construction. The existing gutter and portions of shoulder shall be saw cut full width to the length shown on the plans, or as established by the Engineer. Any damage done to the existing pavement or appurtenance to remain in place shall be repaired or removed and replaced as directed by the Engineer at no additional cost to the Department.

Any excavation made behind the existing gutter for the removal shall be replaced. The excavated space shall be filled with material satisfactory to the Engineer, and placed according to Section 205 at no additional cost to the Department.

If the Engineer determines that existing sections of guardrail need to be removed for gutter removal and replacement work, these sections shall be stored away and re-assembled upon the completion of the project. This work shall be incidental to the gutter and pavement removal operations.

Method of Measurement. Gutter Removal (Special) will be measured for payment in feet along the flow line of the existing gutter to be removed.

The area of existing paved shoulder to be removed will not be measured for separately, but shall be considered as included in the unit price for GUTTER REMOVAL (SPECIAL)

Basis of Payment. This work will be paid for at the contract unit price per foot for GUTTER REMOVAL (SPECIAL).

REMOVE AND REPLACE CONCRETE HEADWALL FOR PIPE UNDERDRAINS

This work shall consist of the removal and reinstallation of concrete headwalls and connected underdrains due to conflicts with the installation of the proposed force main in accordance with applicable portions of Section 601 of the Standard Specifications and as directed by the Engineer.

Basis of Payment. This work will be paid for at the contract unit price per each for REMOVAL AND REPLACE CONCRETE HEADWALL FOR PIPE UNDERDRAINS.

If existing concrete headwalls are damaged, new concrete headwalls shall be provided as directed by the Engineer. This will be paid for separately at the contract unit price per each for CONCRETE HEADWALLS FOR PIPE DRAINS.

MANHOLES, TYPE A, 7' – DIA., TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE

Description. This work shall consist of constructing manholes with restrictor plates as shown on the plans with the necessary cast iron frames and grates. This work shall be completed in accordance with applicable portions of Section 602 of the IDOT Standard Specifications. Structure dimensions and details shall be as shown on the Plans.

Basis of Payment. Payment for MANHOLES, TYPE A, 7'-DIAMETER, TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE will be made at the Contract unit price per each, complete in place and accepted, and payment as specified, in accordance with Article 602.16 of the IDOT Standard Specifications except that the pay item MANHOLES, TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE shall be added.

Payment for MANHOLES, TYPE A, 7' -DIAMETER, TYPE 1 FRAME, CLOSED LID, RESTRICTOR PLATE shall include all labor, equipment and materials necessary to complete the structure as shown in the plans including all pre-cast sections, pre-cast lids, cast iron frames and lids, restrictor plates, and hardware.

MANHOLES, SANITARY

Description. This work shall consist of furnishing and installing sanitary manholes of the size Indicated on the plans with the required frame and grate in accordance with Sections 550 and 602 of the IDOT Standard Specifications for Road & Bridge Construction, and Section 32 of the Standard Specifications for Water & Sewer Construction in Illinois, except as modified herein.

General Requirements: Sanitary manholes shall be constructed using precast reinforced concrete sections in accordance with Article 602.07, except that joints between precast sections and pipe to manhole connections shall include watertight flexible gaskets or rubber gaskets. Preformed flexible gaskets shall conform to the requirements of ASTM C 990. Rubber gaskets shall conform to the requirements of ASTM C 443. Pipe to manhole connections shall conform to the requirements of ASTM C 923. Dimensions of manholes and precast sections shall conform to the latest revision of one of the following Highway Standards (as applicable based on manhole diameter): Highway Standards 602401, 602406, and 602411.

Trenches resulting from the installation of sanitary manholes shall be backfilled according to the applicable requirements of Article 550.07 and Article 602.12.

Method of Measurement. Construction of sanitary manholes shall be measured for payment as an each item.

Basis of Payment. This work will be paid for at the contract unit price per each for MANHOLES, SANITARY of the specified size, with the specified frame(s) and grate(s), which price includes all labor, material, and equipment necessary to complete the work specified herein. Preformed flexible gaskets or rubber gaskets used at the joints between precast sections will also be included in the unit cost of this item.

If trench backfill is required, it will be paid for separately.

FRAMES AND LIDS, SPECIAL

Description. This work shall consist of furnishing and installing access doors for the force main clean out vaults in accordance with the specifications shown on the plans, and in Section 602 if the Standard Specifications.

Materials. See Article 602.02 if the Standard Specifications.

Covers shall open to 90 degrees and lock automatically in that position. A handle shall be provided to release the cover for closing.

Hinges shall be of heavy forged brass with stainless steel pins. A stainless steel snap lock with removable handle shall be provided. A 1.5 in. drainage coupling shall be provided at location shown on the plans. Pentahead recessed bolt lock (2 each) and pentahead tee wrench required.

Provide factory finished units. Finish shall be mill finish with bituminous coating applied to exterior of frame.

The manufacturer shall provide material certifications and shall certify access doors to meet AASHTO H-20 loading.

Basis of Payment. This work will be paid for at the contract unit price per each for FRAMES AND LIDS, SPECIAL.

CONCRETE GUTTER, TYPE B (SPECIAL)

Description. This work shall consist of constructing new curb and gutter with modified gutter flag sections to accommodate the proposed drainage structures as shown in the plans.

Materials. Materials shall be according to the following:

<u>Item</u>	<u>Article/Section</u>
Portland Cement Concrete	1020
Reinforcement Bars and Fabric	1006.10
Prefomed Expansion Joint Fillers	1051
Protective Coat	1023
Dowel Bars	1006.11
Polysulfide Joint Sealant	1050.03
Grout	1024.01
Synthetic Fibers	LIST
Polyurethane Joint Sealant	1050.04

Equipment. Equipment shall be according to the following:

<u>Item</u>	<u>Article/Section</u>
Forms	1103.05

Construction. The excavation, form set-up, and placement of concrete shall conform to Articles 606.04, 606.05, and 606.06 of the IDOT Standard Specifications, respectively.

Before construction begins, the existing paved shoulder, curb, and gutter elevations depicted in the plans should be field verified. The Engineer may adjust the elevations in the gutter and inlet design to accommodate the field conditions, if necessary.

Longitudinal construction, transverse contraction, and transverse expansion joints shall be constructed according to the applicable portions of Article 420.05 of the IDOT Standard Specifications. See the Special Provision for Concrete Gutter, Curb, Median, and Paved Ditch for the revised note on sealing transverse contraction and longitudinal construction joints.

The proposed concrete gutter and modified gutter flag sections shall be poured monolithically, and tied to the existing shoulder pavement as shown in the drainage detail plan. The finished gutter grades shall continue to convey runoff to the existing low point (sag) at Station 124+12.

The exposed concrete surfaces shall be finished smooth and even, and given a light brush finish while the concrete is still workable. See the Special Provision for Concrete Gutter, Curb, Median, and Paved Ditch for the revised note on removing forms and repairing minor defects.

Protective coat, if required by The Engineer, shall be applied according to Article 420.18 of the IDOT Standard Specifications.

After the concrete has obtained the specified strength, the space behind the new gutter section shall be backfilled to the required elevation with suitable material (preferably the existing riprap), compacted, and neatly graded. If sections of existing guardrail panels had to be removed to accommodate the gutter construction, the panels can be reattached at this time.

Method of Measurement. The concrete gutter will be measured for payment in feet along the flow line of the proposed gutter section. This measurement will include the length across the proposed drainage castings that are incorporated into the proposed gutter construction.

The area of proposed shoulder pavement beyond the gutter flow line (also known as the modified gutter flag or gutter transition) will not be measured for separately as an area of pavement. The cost of the gutter transition areas is included in CONCRETE GUTTER, TYPE B (SPECIAL).

Tie Bars between existing pavement and new concrete gutter, including all labor and materials required for installation and testing, will not be paid for separately, but shall be considered as included in the unit bid price for CONCRETE GUTTER, TYPE B (SPECIAL).

Basis of Payment. This work will be paid for at the contract unit price per foot for CONCRETE GUTTER, TYPE B (SPECIAL).

Protective Coat, if required, will be paid for at the contract unit price per square yard (SY) for PROTECTIVE COAT.

Excavation of unsuitable material and backfilling of suitable material, if required in the performance of the work, shall be paid for according to Section 202 of the IDOT Standard Specifications.

CHAIN LINK FENCE, 8' (SPECIAL) AND CHAIN LINK GATES (SPECIAL)

This work shall consist of furnishing, erecting, and installing chain link fence, gates, and accessories in accordance with Section 664 of the Standard Specifications, at locations shown in the plans, and as directed by the Engineer.

The chain link fence and gates shall have three strands of barbed wire across the top of the fence.

Height of the fence and gates shall be measured to the top of the chain link fabric.

Size, type and number of gates are shown on the plans.

Method of Measurement. Chain link fence (special) will be measured for payment in feet along the top of the fence from center to center of end posts, excluding the length occupied by gates.

No additional compensation shall be given to the Contractor, if the size or depth of the fence post excavation exceeds the dimensions in the plans or Highway Standard.

Removal of pavement, curb and gutter, or other roadway improvements that interfere with the construction of the fence as shown in the plans and standards shall not be measured for payment, but will be included in the costs of the fence or gates.

Basis of Payment: This work will be paid for at the contract unit price per foot for CHAIN LINK FENCE, (SPECIAL), of the height specified, and at the contract unit price per each for CHAIN LINK GATES (SPECIAL).

STORM SEWER, DUCTILE IRON

This item includes furnishing all labor and materials necessary to furnish and install ductile iron storm sewers in accordance with Section 550 of the Standard Specifications and a specified herein.

Materials. Ductile Iron pipe shall be Class 52, centrifugally cast, cement lined, meeting the requirements of AWWA C 150, C 151 and C 104. Joints shall meet the requirements of AWWA C 111.

Joints for Ductile Iron pipe shall be mechanical joints (AWWA C 111 and C 600) or push-on joints (AWWA C 111 and C 600).

Basis of Payment. This work will be paid for at the contract unit price per foot for STORM SEWERS, DUCTILE IRON of the type and diameter specified which price shall include all excavation, sheeting or shoring, backfill, thrust blocking, valves, repair couplings, tees, labor, materials, equipment and incidentals necessary to complete the installations as herein specified.

CATCH BASINS, TYPE A, 5' DIAMETER, TYPE 22 FRAME AND GRATE (SPECIAL)

Description. Catch Basins, Type A, 5' Diameter, Type 22 Frame and Grate (Special) shall consist of all work required install the catch basins with frames and grates in accordance with the specifications shown on the plans, and in Section 602 if the IDOT Standard Specifications.

Materials. See Article 602.02 if the IDOT Std. Specifications.

Construction. Refer to the drainage plan and profile, drainage detail, and cross section plans for the construction and installation of the catch basin with frame and grate.

The grate shown in the drainage detail is a non-standard sloped Type 22 double grate with a slope of 9.375%. If the grate cannot be custom made with the slope, then a standard Type 22 grate could be used with the 9.375% slope being provided by shimming the grate with recycled rubber riser rings or HDPE plastic adjusting rings.

The Type 22 frame and grate shall be installed with the long side (4 feet) sitting perpendicular to the flow line of the gutter, and the short side (2 feet) sitting along the flow line of the gutter. The grates will have to be placed in their respective frames in accordance with the drainage detail to maximize flow interception capacity.

If the Engineer determines that existing sections of guardrail need to be removed for catch basin installation work, these sections shall be stored away and re-assembled upon the completion of the project. This work shall be incidental to the catch basin installation work, and will not be paid for separately.

Basis of Payment. This work will be paid for at the contract unit price per each for CATCH BASINS, TYPE A, 5' DIAMETER, TYPE 22 FRAME AND GRATE (SPECIAL).

PUMP STATION GENERAL WORK

Description:

This work shall include all work necessary to construct the new Well House Building and rehabilitate the Existing Pump Station building as shown in the plans and specified herein.

The Pump Station General Work Equipment shall include, but not be limited to, the following:

1. **Demolition** of portions of the existing Pump Station Building as shown in the plans and as described in Section 024100 of this Special Provision.
2. **Cast in place concrete** within the footprint of the new Well House Building and the Existing Pump Station that is not paid for separately as a unit cost as shown in the plans and as described in Section 033000 of this Special Provision.
3. **Precast concrete hollow core planks**, connection plates, brackets, hangers, grouting, and related items as shown in the plans and as described in Section 034113 of this Special Provision.
4. **Unit Masonry**, concrete masonry units (CMU's), brick, mortar, stone coping, grout, wall reinforcement, and related items as shown in the plans and as described in Section 042000 of this Special Provision.
5. **Structural steel framing**, including structural shapes, channels and angles, hollow structural sections, structural pipe, structural plates and bars, bolts, connectors, anchors and related items as shown in the plans and as described in Section 051200 of this Special Provision.
6. **Steel roof deck**, including formed steel cant strips, eave strips, valley strips, framing for openings up to and including [18] inches, bearing plates and angles, and accessories as shown in the plans and as described in Section 053123 of this Special Provision.
7. **Cold-formed metal framing**, including hatch framing and bracing as shown in the plans and as described in Section 054000 of this Special Provision.
8. **Metal fabrications**, including shop-fabricated metal items, loose steel lintels, channel door frames, interior bollards and accessories as shown in the plans and as described in Section 055000 of this Special Provision.
9. **Metal ladders** and accessories as shown in the plans and as described in Section 055100 of this Special Provision.
10. **Handrails, railings**, and accessories as shown in the plans and as described in Section 055200 of this Special Provision.
11. **Rough carpentry**, rooftop equipment bases, support curbs, wood blocking, nailers, and related work as shown in the plans and as described in Section 061000 of this Special Provision.
12. **Thermal insulation** including perimeter insulation under slabs-on-grade, perimeter foundation wall insulation, concealed building insulation, and related work as shown in the plans and as described in Section 072100 of this Special Provision.

13. **Foamed-in-place masonry wall insulation** and related work as shown in the plans and as described in Section 0721119 of this Special Provision.
14. **Ethylene propylene diene monomer (epdm) roofing**, adhered membrane roofing system, rubber pavers, and related work as shown in the plans and as described in Section 075323 of this Special Provision.
15. **Sheet metal flashing and trim**, formed roof drainage sheet metal fabrications and accessories as shown in the plans and as described in Section 076200 of this Special Provision.
16. **Pre-manufactured roof accessories** such as roof curbs, roof hatches, and related work as shown in the plans and as described in Section 077200 of this Special Provision.
17. **Joint sealants** for vertical surfaces, interior joints in vertical surfaces and horizontal traffic and nontraffic surfaces as shown in the plans and as described in Section 079200 of this Special Provision.
18. **Hollow metal doors and frames** and related work as shown in the plans and as described in Section 081113 of this Special Provision.
19. **Fiberglass doors and frames** and related work as shown in the plans and as described in Section 082200 of this Special Provision.
20. **Floor access doors**, portable guard rail enclosure systems and accessories as shown in the plans and as described in Section 083100 of this Special Provision.
21. Manually operated **overhead coiling doors** and accessories as shown in the plans and as described in Section 083323 of this Special Provision.
22. Manually operated **sectional doors** and accessories as shown in the plans and as described in Section 083613 of this Special Provision.
23. **Door hardware** and accessories as shown in the plans and as described in Section 087100 of this Special Provision.
24. **Glass glazing** and related work as shown in the plans and as described in Section 088100 of this Special Provision.
25. Surface preparation and painting of interior and exterior surfaces with **high performance coatings** as shown in the plans and as described in Section 099600 of this Special Provision.
26. **Plaques** and accessories as shown in the plans and as described in Section 101400 of this Special Provision.
27. **Toilet Accessories** as shown in the plans and as described in Section 102813 of this Special Provision.

28. **Fire Extinguishers** and accessories as shown in the plans and as described in Section 104416 of this Special Provision.
29. **Control room furniture**, including desk, chairs, bulletin board, clock, and first aid kit as shown in the plans and as described in Section 125500 of this Special Provision.
30. **Overhead cranes, hoists, and trolleys** and related work as shown in the plans and as described in Section 412200 of this Special Provision.

024100 DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work includes demolition inside the Existing Pump Station Building footprint and as shown on demolition drawings and as required to permit rehabilitation of the existing building.
- B. Any fixtures, cabinetry, windows, doors/frames, plumbing fixtures, HVA/C equipment or electrical fixtures not designated for reuse in the renovated building or addition shall be offered to the DEPARTMENT for salvage and storage. Items not retained by DEPARTMENT shall be removed from site by Contractor.

PART 2 – EXECUTION

2.1 Cutting and Patching

- A. No structural members shall be removed, cut or otherwise modified without approval and any such work shall be done in a manner as directed by the ENGINEER. For structural modifications not shown on the plans, the Contractor shall hire a licensed Structural Engineer in the STATE of Illinois to analyze Contractor's proposed modifications and seal drawings. Then the DEPARTMENT will review for approval.
- B. Cutting of concrete slabs, walls and members shall be performed without over-cutting at corners or elsewhere.
- C. Cutting and patching shall be performed in a neat and workmanlike manner, consistent with the best practices of the appropriate trade. All patching shall be done in a manner consistent with the building material being patched.
- D. All cutting, fitting or patching of the Work that may be required to make the several parts thereof join shall be provided in accordance with the Contract Documents. Restoration shall be performed by competent workmen skilled in the trade.

- E. All cutting and patching required to install improperly timed work or to remove samples of installed materials for testing shall be provided.
- F. Except when the cutting or removal of existing construction is specified or indicated, any cutting or demolition which may affect the structural stability of the Work or existing facilities shall not be undertaken without the ENGINEER's concurrence. For structural modifications not shown on the plans, see 1.2.1 of this Section.
- G. Shoring, bracing, supports, and protective devices necessary to safeguard all work during cutting and patching operations shall be provided.
- H. All materials shall be cut and removed to the extent shown or as required to complete the Work. Materials shall be removed in a careful manner with no damage to adjacent facilities. Materials which are not salvageable from the site shall be removed.
- I. All work affected by demolition, cutting operations, and equipment removal shall be patched, repaired or restored with new materials or with salvaged materials acceptable to the ENGINEER to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished. Affected surfaces shall match adjacent surfaces and provide uniform appearance. Unnecessary gaps, holes, openings and depressions shall be filled with suitable patching material.

2.2 Job Conditions and Workmanship

- A. Contractor is advised that demolition will be an on-going procedure with portions of the work required at various times as general construction work progresses.
- B. Keep material wetted to minimize dust. Exercise care so that wetting procedures do not damage existing building structure/contents to remain intact.
- D. Contractor shall be responsible for removal and disposal of all debris promptly as work progresses; retaining and temporarily storing on site only that material designated, as noted above, for reuse and for the DEPARTMENT's salvage.

2.2 Existing Conditions/Inspection

- A. During demolition procedures, this contractor shall take all precautions to protect against personal and public injuries. Erect safety walkways where necessary. Provide dust protection barriers to prevent dust infiltration into occupied areas of existing building.
- B. Obtain all necessary demolition permits, land fill disposal permits, etc. necessary for proper and authorized execution of the work.

End Section 024100

033000 CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Unless otherwise indicated, concrete material and work shall be in conformance with the requirements of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, adopted January 1, 2012.

1.2 SUBMITTALS

- A. Submit under provisions of Section 1A and Standard Specifications.

1.3 QUALITY ASSURANCE

- A. Under provisions of Standard Specifications.
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Section 7 - Lightweight Concrete.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms shall conform to the requirements of Section 503 "Concrete Structures" of the Standard Specifications.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: AASHTO A 706, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: AASHTO M55, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."
- D. Minimum clearances for reinforcement bars shall be as specified in the ACI-318-08 (Building Code Requirements for Structural Concrete).

2.3 CONCRETE MATERIALS

- A. Materials shall meet the requirements of Section 508 and Section 1006.10 of the Standard Specifications.

2.4 CONCRETE MIXTURES

- A. Normal-weight Concrete
 - 1. Normal-weight concrete mixtures shall meet the requirements of Section 1020 of the Standard Specifications.
 - 2. Minimum 14 days Compressive Strength of 3,500 psi
- B. Light-weight Concrete
 - 1. Light-weight Concrete mixtures shall meet the requirements of ACI 301.
 - 2. Minimum Compressive Strength: 3500 psi at 28 days.
 - 3. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
 - 4. Slump Limit: 4 inches, plus or minus 1 inch.
 - 5. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch.
- C. Rapid Hardening Concrete
 - 1. Rapid hardening concrete shall meet the requirements of Section 1018 of the Standard Specifications.

2.5 Waterstops

A. Preformed Strip Type

1. Materials
 - a. Hydrophilic type waterstop manufactured solely for the purpose of preventing water from traveling through construction joints.
 - b. Provide adhesive as recommended by manufacturer.
2. Install on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
3. Waterstop to be continuous with splices in accordance with manufacturer's instructions.
4. Work concrete under waterstops by hand to avoid the formation of air and rock pockets.

2.6 Epoxy Grout

1. Grouting of anchor bolts and bars shall meet the requirements of Section 584 of the Standard Specifications.
2. Where new concrete is doweled to existing work or anchors or bars are being placed into new and existing concrete, drill and epoxy concrete using an epoxy adhesive.
3. Epoxy Grout shall be a hybrid epoxy adhesive.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, removal, and maintain formwork according to Section 503 of the Standard Specification.
- B. Chamfer exterior corners and edges of permanently exposed concrete - 3/4".

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

- A. Place and fasten reinforcement in accordance to Section 508 of the Standard Specifications.
- B. All ends of existing reinforcement bars exposed from saw cutting shall be coated with an epoxy bonding agent. Application shall be in strict conformity with the manufacturer's recommendations and shall follow Section 503 of the Standard Specifications.

3.4 JOINTS

- 1. Concrete joints shall be made per Section 503 of the Standard Specifications.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items.
- B. Concrete placing and consolidating shall comply with Section 503 and Section 1020 of the Standard Specifications.
- C. All concrete shall be cured for a minimum of 7 days, per Section 1020.13 of the Standard Specifications.
- D. Existing concrete surfaces in contact with new concrete shall be coated with an epoxy bonding agent. Application shall be in strict conformity with the manufacturer's recommendations and shall follow Section 503 of the Standard Specifications. This work shall be included in the Contract unit price for CLASS SI CONCRETE (MISCELLANEOUS).

3.6 FINISHING FORMED SURFACES

- A. Concrete surfaces shall be finished according with Section 503 of the Standard Specifications.

3.7 FIELD QUALITY CONTROL

- A. The Contractor shall engage a qualified testing agency to perform testing and to submit reports. The minimum qualifications of the testing agency shall include ASTM E329 laboratory validation from a nationally recognized quality validation agency. The agency shall also meet the requirements of ASTM C1077.

B. Inspections:

1. Steel reinforcement placement.
2. Steel Reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 10 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure four standard cylinder specimens for each composite sample.
 - b. Field cure one of the standard cylinder specimens when the temperature during the first 7 days of cure will reach 90 deg F or will be below 32 deg F.
7. Compression Strength Tests: ASTM C 39/C 39M; test one of the three laboratory-cured specimens and the field cured specimen, if any, at 7 days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 033000

034113 PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. Roof planks.
 2. Connection plates brackets and hangers.
 3. Grouting plank joint keys.

1.2 DESIGN REQUIREMENTS

- A. Design components to withstand dead loads and live loads in restrained condition:
 1. Roof Assembly: 50 psf superimposed dead load; 50 psf live load.
 2. Concentrated loads as indicated on Drawings.
 3. Concrete topping shall be composite.
- B. Maximum Allowable Deflection:
 1. Roof Planks: 1/480 of span (live load); 1/360 of span (total load).

1.3 SUBMITTALS

- A. Shop Drawings: Indicate plank layout, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers, fire ratings.
- C. Design Data: Indicate calculations for loadings and stresses of planks, prestressing; signed and sealed by licensed Structural engineer.

- D. Fabricator's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

- A. Design planks in accordance with requirements of:
 - 1. PCI MNL-120 - Design Handbook.
 - 2. PCI MNL-126 - Manual for the Design of Hollow Core Slabs.
 - 3. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete.
 - 4. ACI 318.
 - 5. ACI 301.
- B. Design connections in accordance with PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.
- C. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- D. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum three years documented experience, and that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's Plant Certification program at time of bidding and is designated a PCI-certified plant as follows:
 - a. Group C, Category C2 - Prestressed Hollowcore and Repetitively Produced Products.
- B. Erector: Company specializing in erecting Work of this section with three years documented experience and approved by fabricator.
- C. Design planks under direct supervision of a Structural Engineer experienced in design of this Work and licensed in the state where this project is located.
- D. Welder: Qualified within previous 12 months for types of welds indicated, in accordance with AWS D1.1 and AWS D1.4.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- B. Mark each member with date of production and final position in structure.

1.7 COORDINATION

- A. Coordinate roof opening locations, prior to installation.
- B. Coordinate location of hanger tabs and devices for mechanical and electrical work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete Materials: ACI 301
- B. Tensioning Steel Tendons: ASTM A416/A416M Grade 270, of diameter appropriate to member design.
- C. Deformed Reinforcement: ASTM A615 Grade 60, steel bars.
- D. Non-Shrink Grout: Non-metallic, minimum compressive strength of 8000 psi at 28 days.
- E. Cement Grout: Minimum compressive strength of 4000 psi at 28 days.
 - 1. Shall be a mixture of not less than one part Portland Concrete to three parts fine sand, and the consistency shall be such that joints can be completely filled but without seepage over adjacent surfaces.
- F. Bearing Strips
 - 1. Plastic: multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.

2.2 ACCESSORIES

- A. Connecting and Supporting Devices: Plates, angles, and inserts: ASTM A36 carbon steel.
- B. Core Hole End Plugs: Cardboard insert with stiff concrete fill, foamed-in-place insulation, or glass fiber insulation.
- C. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lb dead load, predrilled to receive hanger.

- D. Anchorage Devices for Mechanical and Electrical Equipment Hangers as indicated in Drawings.
- E. Sill Seal: Glass fiber strips.

2.3 FABRICATION

- A. Planks: Plant cast, prestressed, hollow core; fabricated in accordance with PCI MNL-126 and ACI 318.
- B. Dimensions as indicated on Drawings.
- C. Weld reinforcing in accordance with AWS D1.4.
- D. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- E. Fabricate openings required by other sections, at locations indicated.
- F. Cut exposed ends flush or as indicated on Drawings.
- G. Plant Finish: PCI MNL-116.
 - 1. Roof Members: Standard Grade.
- H. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.

2.4 FABRICATION TOLERANCES

- A. Tolerances: Conform to PCI MNL-126.

2.5 SOURCE QUALITY CONTROL AND TESTS

- A. Test and analyze stressing tendons in accordance with ASTM A416.
- B. Test and analyze concrete in accordance with PCI MNL-116 and ACI 318.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions are ready to receive Work and field measurements are taken as indicated on Drawings and Shop Drawings.

- B. Verify supporting structure is ready to receive work.

3.2 PREPARATION

- A. Prepare support devices for erection procedure and temporary bracing.

3.3 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints, as erection progresses.
- C. Maintain temporary bracing in place until final connections are made. Protect members from staining.
- D. Install sill seal at bearing ends of planks as indicated on Shop Drawings.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.
- G. Secure units in place. Perform welding in accordance with AWS D1.1.
- H. Tape seal underside or install sealant backer rod in plank joints to prevent grout leakage.
- I. Grout longitudinal keys as indicated on Drawings.
- J. Make plank-to-plank joints smooth using grout, troweled smooth. Transition differential elevation of adjoining planks with grout to maximum slope of 1 in 12.

3.4 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-126 and PCI MNL-120 - Design Handbook.
- B. Exposed Joint Dimension: 3/4 inch plus or minus 1/4 inch for members 0 to 40 feet in length, plus or minus 3/4 inch for members 41 to 61 feet in length, and plus or minus 1 inch for 61 feet plus members.

3.5 FIELD QUALITY CONTROL

- A. The Contractor shall engage a qualified testing and inspecting agency to perform field special structural inspections in accordance with the applicable International Building Code and to submit reports to the Engineer.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 034113

042000 UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Face brick.
 - 3. Natural limestone coping.
- B. Products installed but not furnished in this Section include:
 - 1. Steel lintels specified in Division 05 Section "Metal Fabrications"

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for each type and color of exposed masonry units and limestone copings.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- D. Shop Drawings: For reinforcing steel, detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Store masonry units above ground on level platforms which allow air circulation under the stacked units.
- D. Cover and protect against wetting prior to use.
- E. All masonry units shall be delivered to mason undamaged. Cracked or broken, block with spalled edges or corner, or otherwise defective block shall be rejected by contractor upon delivery and shall not be used in the work.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions. All external corners, sills and jambs shall be bullnosed.
- B. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2400 psi.
 - 2. Weight Classification: Light weight.
 - 3. Color: Natural Grey. Curing: Steam or autocaved. No air cured blocks.
 - 4. Concrete masonry units for exterior exposure shall be fabricated with integral water repellent additive.
- C. Fire-rated concrete masonry units: ANSI/UL 263, Classification B-4, 4-hour rated as necessary to meet U.L. U901. Refer to drawings for location.

2.2 MASONRY LINTELS

- A. Masonry Lintels: Made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

2.3 BRICK

- A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBS.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
 5. Size: Modular
 6. Color & Finish: Match Existing Pump Station

2.4 LIMESTONE

- A. Limestone: Comply with ASTM C568.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Stone – Cut Indiana Oolitic Limestone, select grade, grade color, smooth finish.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S or quicklime complying with ASTM C5.
- C. Aggregate for Mortar: ASTM C 144.
 - 1. For joints less than $\frac{1}{4}$ inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- D. Aggregate for Grout: ASTM C 404.
- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- F. Water: Potable.

2.6 MIXING

- A. Mortar:
 - 1. Provide mortar type "S" with Concrete Masonry Units and type "N" for face brick in accordance with ASTM C270.
 - 2. Proportions:
 - a. For type "N" mortar, provide one part Portland cement to one part hydrated lime and 6 parts sand by volume.
 - b. For type "S" mortar, provide one part Portland cement to $\frac{1}{2}$ part hydrated lime and $4 \frac{1}{2}$ parts sand by volume.
 - 3. Mechanically mix in a batch mixer for not less than three minutes, using only sufficient water to produce a mortar which is spreadable and of a workable consistency.
 - 4. Retemper mortar with water as required to maintain high plasticity.
 - a. On mortar boards, retemper only by adding water within a basin formed with mortar, and by working the mortar into the water.
 - b. Discard and do not use mortar which is unused after $2 \frac{1}{2}$ hours following initial mixing.
 - 5. Use of pre-mixed mortar is not approved.

- B. Grout:
1. Provide "fine grout" or "course grout" as required, and in accordance with ASTM C476.
 2. Proportions:
 - a. For "fine grout," provide one part Portland cement to 2 ¼ parts minimum to 3 parts maximum of damp loose sand, with sufficient water to achieve fluid consistency.
 - b. For "course grout," provide one part Portland cement to 3 parts maximum of damp loose sand to two parts coarse aggregate, with sufficient water to achieve fluid consistency.
 3. "Fluid consistency" is interpreted as meaning as fluid as possible for pouring intimately in place without segregation.
- C. Use "fine grout" where the grout space is less than 2" in its least dimension.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951, mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
1. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 2. Single-Wythe Masonry: Truss and/or ladder type; plain steel; galvanized finish 3/16 inch side rods with 3/16 inch cross ties.
- C. Multiwythe Masonry:
1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.
 2. Tab type, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
 3. Adjustable (two-piece) type, with one side rod at each face shell of backing wythe and with ties that extend into facing wythe. Ties engage eyes or slots in reinforcement and extend at least halfway through facing wythe but with at least 5/8 inch cover on outside face.

4. Truss and/or Ladder type reinforcing with U-shaped anchors welded every 16 inches on center and extending into the cavity of the two wythe wall; plain steel; galvanized finish; 3/16 inch side rods with 3/16 inch cross ties and 3/16 inch anchors; complete with 3/16 inch rectangular hooked box tie.
- D. Cavity backup wall horizontal reinforcing:
1. Truss and/or Ladder type reinforcing with U-shaped extending into the cavity of the two wythe wall; plain steel; hot dip galvanized, after fabrication, finish; 3/16 inch side rods with cross ties and 3/16 inch anchors; complete with 3/16 inch rectangular hooded box tie. The u-shaped anchor shall have a restraint bar and other device attached to it to prevent transverse movement of the two wythes.
- E. Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch-diameter, hot-dip galvanized, carbon-steel continuous wire.

2.8 TIES AND ANCHORS

- A. Materials:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M. Galvanized
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least $\frac{5}{8}$ inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Wire: Fabricate from [3/16 inch-] [$\frac{1}{4}$ inch-] diameter, hot-dip galvanized steel wire.

- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped $\frac{1}{4}$ inch- diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch- diameter, hot-dip galvanized steel wire.
 3. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch-thick, steel sheet, galvanized after fabrication.
- E. Partition Top anchors: 0.097-inch- thick metal plate with $\frac{3}{8}$ inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars $1\frac{1}{2}$ inches wide by $\frac{1}{4}$ inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- G. Adjustable Masonry-Veneer Anchors
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
 - a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and slotted holes for inserting connector section.
 - b. Connector Section: Rib-stiffened, sheet metal bent plate; sheet metal clip; or wire tie and rigid extruded vinyl clip designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least $\frac{5}{8}$ inch cover on outside face.
 - c. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch-thick, steel sheet, galvanized after fabrication.
 - d. Fabricate wire connector sections from 0.188-inch-diameter, hot-dip galvanized, carbon-steel wire.

2.9 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated.
 1. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and $\frac{1}{2}$ inch out from wall, with outer edge bent down 30 degrees and hemmed.
 2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for $\frac{3}{4}$ inch and down into joint $\frac{3}{8}$ inch to form a stop for retaining sealant backer rod.
 3. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:
 1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following, unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth $\frac{1}{8}$ inch less than depth of outer wythe, in color selected from manufacturer's standard.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Provide one of the following configurations:
 - a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep.

2.11 INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV or X, closed-cell product extruded with an integral skin.

2.12 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains from new masonry without damaging masonry. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.13 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.14 STONE FABRICATION

- A. Cut stone to produce pieces of thickness, size and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.
- B. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
 - 1. Finish for copings: Smooth.
 - a. Finish exposed ends of copings same as front and back faces.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

- D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than $\frac{1}{8}$ inch in 10 feet, $\frac{1}{4}$ inch in 20 feet, or $\frac{1}{2}$ inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than $\frac{1}{8}$ inch in 10 feet, $\frac{1}{4}$ inch in 20 feet, or $\frac{1}{2}$ inch maximum.

3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and concrete masonry units as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.4 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 36 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
- B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.
- C. Collar Joints in Clay Tile Masonry: After each course is laid, fill the vertical, longitudinal joint between wythes solidly with mortar at exterior walls, except cavity walls, and interior walls and partitions.
- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide individual metal ties not more than 8 inches o.c.
 - 2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.
 - 3. Provide rigid metal anchors not more than 24 inches o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.5 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 36 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
 3. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit insulation between wall ties and other confining obstructions, with edges butted tightly. Press units firmly against inside wythe of masonry.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install in mortar with a minimum cover of $\frac{5}{8}$ inch on exterior side of walls, $\frac{1}{2}$ inch elsewhere. Lap reinforcement a minimum of 6 inches.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
1. Provide an open space not less than ½ inch in width between masonry and structural member, unless otherwise indicated.
 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
1. Fasten seismic anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners.
 2. Embed [tie sections] [connector sections and continuous wire] in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing, unless noted otherwise.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 32 inches o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

- B. Install flashing as follows, unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as recommended by flashing manufacturer.
 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing $\frac{1}{2}$ inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing $\frac{1}{2}$ inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches o.c., unless otherwise indicated.
 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent product to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports in accordance with the applicable International building Code. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 7806. Test mortar for compressive strength.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.12 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Protect adjacent surfaces from contact with cleaner.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
 - 2. Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 042000

051200 STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural shapes.
 - 2. Channels and angles.
 - 3. Hollow structural sections.
 - 4. Structural pipe.
 - 5. Structural plates and bars.
 - 6. Bolts, connectors, and anchors.
 - 7. Grout.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate sizes, spacing, and locations of structural members, openings, connections, cambers, loads, and welded connections.
- B. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.
- C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Structural Steel: AISC 303 and AISC 360.
 - 2. High Strength Bolted Connections: RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- B. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.4 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on Drawings, Shop Drawings and as instructed by the manufacturer.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992.
- B. Channels and Angles: ASTM A36.
- C. Structural Pipe: ASTM A53, Grade B.
- D. Structural Plates and Bars: ASTM A36.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Bolts: Heavy hex, structural type.
 - 1. ASTM A325; Type 1, plain, or Type 3.
 - 2. Finish: Mechanically galvanized
- B. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Mechanically galvanized
- C. Washers: ASTM F436; Type 1, circular
 - 1. Finish: Mechanically galvanized
- D. Compressible-Washer-Type Direct Tension Indicators: ASTM F959; Type 325.
 - 1. Finish: Mechanically galvanized.
- E. Clevis: ASTM A668
 - 1. Finish: Hot dip galvanized
- F. Turnbuckle: ASTM F1154
 - 1. Finish: Hot dip galvanized
- G. Mastic: ASTM C647

- H. Tension Control Assemblies: ASTM F1852; Type 1, twist off type; complete with washers and heavy hex nuts.
 - 1. Finish: Mechanically galvanized
- I. Shear Connectors: ASTM A108; Grades 1015 through 1020, headed, unfinished and in accordance with AWS D1.1; Type B.
- J. Anchor Rods: ASTM F1554; Grade 36, weldable.
 - 1. Shape: Straight with threaded and nutted bottom.
- K. Threaded Rods: ASTM A36
 - 1. Finish: Mechanically galvanized

2.3 ALUMINUM

- A. Structural Shapes
 - 1. Shall meet ASTM B308 Specification.
 - 2. Minimum yield strength of 32,000 psi (Alloy 6061-T6)

2.4 STAINLESS STEEL

- A. Structural Shapes
 - 1. Shall meet ASTM A276, Type 304L or 316L
 - 2. Minimum yield strength of 30,000 psi
- B. Bolts and Anchors
 - 1. Shall meet ASTM F593
- C. Nuts
 - 1. Shall meet ASTM F594

2.5 WELDING MATERIALS

- A. Welding Materials: AWS D1.1; type required for materials being welded.

2.6 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

2.7 FINISHES

- A. All structural steel shall be hot dipped galvanized per ASTM A123 or ASTM A153.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or SSPC Paint 20 Type II Organic.

2.8 ACCESSORIES

- A. Grout for base plates shall be prepacked, non-metallic, non-gaseous, and non-shrink per CRD C621 and ASTM C1107 at fluid consistency (Flow Cone) of 20-30 seconds. 28 day compressive strength = 7000 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify bearing surfaces are at correct elevation.
- B. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; torque to required resistance, tighten to snug tight for bearing type connections.

- D. Do not field cut or alter structural members without approval of Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

- A. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- B. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- C. Moist cure grout.
- D. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.
- E. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From Alignment: 1/4 inch.

3.6 FIELD QUALITY CONTROL

- A. Owner shall engage a qualified inspecting agency to perform field special structural inspections in accordance with the applicable International Building Code and to submit reports.
 - 1. Inspect steel framing to verify compliance of bracing, stiffening, member locations, member sizes, and proper application of joint details at each connection.
 - 2. Bolted Connections: Inspect in accordance with AISC 303.
 - a. Verify high-strength bolts, nuts and washers material.
 - b. Visually inspect all bolted connections.
 - c. Verify tightening of high strength bolts in slip-critical connections.
 - d. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
 - 3. Welding:
 - a. Verify weld filler materials.
 - b. Inspect welds according to AWS D1.1.
- B. Provide free access to Work and cooperate with appointed agency.

- C. Correct defective members, bolted connections and welds.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 051200

053123 STEEL ROOF DECK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel roof deck and accessories.
2. Formed steel cant strips, eave strips, and valley strips.
3. Framing for openings up to and including [18] inches.
4. Bearing plates and angles.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- B. Product Data: Deck profile characteristics and dimensions, structural properties, and finishes.
- C. Manufacturer's installation instructions.
- D. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- E. Welders Certificates: Certify welders employed on Work, verifying AWS qualification within previous 12 months.

1.3 QUALITY ASSURANCE

- A. Perform Work according to ASCE 3 for composite decks.

1.4 QUALIFICATIONS

- A. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Store deck on dry wood sleepers; slope for positive drainage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Steel: ASTM A653, Grade 33 Structural Quality; with G60 galvanized coating.
- B. Bearing Plates and Angles: ASTM A36 steel.
- C. Welding Materials: AWS D1.1.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic

2.2 ACCESSORIES

- A. Sump Pans, Sump Plates, Valley Strips, and Eave Strips: Fabricated of metal of same type and finish as deck.

2.3 FABRICATION

- A. Ribbed Metal Deck: Sheet steel, galvanized configured as follows:
 - 1. Minimum Metal Thickness Excluding Finish: 0.036"
 - 2. Height of 'V' Rib shall be 1 ½".
 - 3. Side Joints: lapped or lock seam
 - 4. Type: 1.5B20 (Typical Roof Deck)
- B. Related Deck Accessories: Metal closure strips, cover plates, cant strips, thickness to match deck thickness, galvanized sheet steel; of profile and size as indicated on drawings.
- C. Roof Sump Pan: Fabricate of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- D. Cant Strips: Formed sheet steel, gage thickness to match deck thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.

- E. Fasteners: Galvanized hardened steel, self tapping.
- F. Weld Washers: Mild steel, uncoated, 1 inch outside diameter, 16 gage thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Erect metal deck according to SDI Manual.
- B. Bear deck on masonry, concrete, or wood support surfaces with [6] inch minimum bearing. Align and level.
- C. Bear deck on steel supports with 3 inch minimum bearing. Align and level.
- D. Fasten deck to steel support members at ends and intermediate supports with fusion welds through weld washers or mechanical fasteners at 12 inches o.c. maximum, parallel with deck flute and at transverse flute as indicated on the drawings.
- E. Weld according to AWS D1.1.
- F. Fasten male/female side laps at spacing indicated on the drawings.
- G. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld or mechanically attach to deck at each flute.
- H. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Fusion weld or mechanically attach at 12 inches o.c. maximum.
- I. Install wet concrete stops at roof edge upturned to top surface of slab to contain wet concrete. Install stops of sufficient strength to remain stationary under wet concrete without distortion.
- J. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- K. Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.
- L. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- M. Place metal cant strips in position and fusion weld or mechanically attach.
- O. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

3.2 FIELD QUALITY CONTROL

- A. Owner shall engage a qualified inspecting agency to perform field special structural inspections in accordance with the applicable International Building Code and to submit reports.
 - 1. Inspect deck size, gage, location and fastening.
 - 2. Inspect welds according to AWS D1.1.
- B. Provide free access to Work and cooperate with appointed agency.
- C. Correct defective decking and connections.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 053123

054000 COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hatch framing and bracing.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of related work.
- B. Product Data: Describe materials and finish, product criteria, and limitations.
- C. Field Quality Control Submittals: Contractor furnished special structural inspection reports.

1.3 QUALITY ASSURANCE

- A. Furnish framing materials in accordance with SSMA - Product Technical Information.

PART 2 - PRODUCTS

2.1 FRAMING COMPONENTS

- A. Steel Sheet: ASTM A240
 - 1. Grade: 304 Stainless Steel
- B. Studs: Stainless Steel sheet, formed to shapes.

2.2 ACCESSORIES

- A. Bracing, Furring, Bridging, Plates, Gussets, Clips: Formed sheet steel, thickness determined by performance requirements specified; same finish as framing members.
- B. Screws: Stainless steel, self drilling, self tapping.
- C. Anchorage Devices: Power actuated and Drilled expansion bolts.
- D. Welding: In accordance with AWS D1.1 and AWS D1.3.
- E. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or Type II Organic.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate surfaces and building framing components are ready to receive work.

3.2 ERECTION OF STUDS

- A. Align layout as shown on detail drawings. Secure in place with fasteners or by welding, as called out on the drawings.
- B. Touch-up field welds and damaged surfaces with primer to match shop coating.

3.3 TOLERANCES

- A. Maximum Variation from Indicated Position: [1/8] inch.
- B. Maximum Variation of Member from Plane: [1/8] inch.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 054000

055000 METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Shop-fabricated metal items.
 - 2. Loose steel lintels.
 - 3. Channel door frames.
 - 4. Interior Bollards

1.2 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.3 QUALITY ASSURANCE

- A. Finish joints according to NOMMA Guideline 1.

1.4 QUALIFICATIONS

- A. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept metal fabrications on-Site in labeled shipments. Inspect for damage.
- B. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 LINTELS

- A. Steel sections, size and configuration as indicated on Drawings, length to allow 8 in minimum bearing on both sides of opening.
 - 1. Interior and Exterior Locations: Galvanized

2.2 DOOR FRAMES

- A. Door Frames: Steel channel sections, size indicated on drawings, with jamb anchors suitable for building into masonry, attachment to concrete and/or attachment to steel framing, minimum 4 anchors per jamb; galvanized for exterior locations, prime paint, one coat for interior locations.

2.3 INTERIOR BOLLARDS

- A. Bollards:
 - 1. Pipe: ASTM A53, Grade B, Schedule 40, galvanized.
 - 2. Nuts: ASTM A563, heavy-hex type. Finish: Mechanically galvanized
 - 3. Washers: ASTM F436; Type 1. Finish: Mechanically galvanized.

2.4 Touch-Up Primer for Galvanized Surfaces:

- A. SSPC Paint 20 Type I Inorganic or SSPC Paint 20 Type II Organic.

2.5 ANCHORS

- A. Anchor Rods: ASTM F1554; Grade 33, weldable.
 - 1. Shape: Straight with threaded and nutted bottom.
 - 2. Furnish with nut and washer; galvanized.
- B. Epoxy Adhesive Anchors:
 - 1. Threaded Rod: Type 316 stainless steel.

2.6 MATERIALS

- A. Steel: According to Section 051200 – Structural Steel Framing.

2.7 FABRICATION

- A. Fit and shop assemble items in largest practical sections for delivery to Site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Fabrication Tolerances:
 - 1. Squareness: 1/8 in maximum difference in diagonal measurements.
 - 2. Maximum Offset between Faces: 1/16 in.
 - 3. Maximum Misalignment of Adjacent Members: 1/16 in.
 - 4. Maximum Bow: 1/8 inch in 48 in.
 - 5. Maximum Deviation from Plane: 1/16 inch in 48 in.

2.8 FINISHES

- A. Steel:
 - 1. Prepare surfaces to be primed according to SSPC SP 3.
 - 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
 - 3. Prime paint items with one coat except where galvanizing is specified.
 - 4. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.
 - 5. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153.
 - 6. Sheet Steel: Galvanized.

7. Bolts: Unfinished for interior applications, Hot-dip galvanized or Mechanically galvanized for exterior applications.
8. Nuts: Unfinished for interior applications, Hot-dip galvanized or Mechanically galvanized for exterior applications.
9. Washers: Unfinished for interior applications, Hot-dip galvanized or Mechanically galvanized for exterior applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field weld components indicated on Drawings and Shop Drawings. Do not weld exterior units that have been hot-dip galvanized after fabrication.
- B. Obtain approval of Architect/Engineer prior to Site cutting or making adjustments not scheduled.

3.2 FIELD QUALITY CONTROL

- A. Inspect welds according to AWS D1.1.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 055000

055100 METAL LADDERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. Ladders.

1.2 SUBMITTALS

A. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

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

1.3 QUALITY ASSURANCE

A. Design ladder in accordance with OSHA Standards, ANSI A14.3, and applicable Building Codes.

B. Perform railing work according to ASTM E985.

C. Finish joints according to NOMMA Guideline 1.

D. Welders and Welding Procedures: AWS D.1

1.4 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 Ladder System

A. Rails

1. 2 ½" x 3/8" Bar.

a. Spacing

- 1) Minimum clear distance between rails to be 18".

2. 2 ½" x ½" Bar

a. Spacing

- 1) Minimum clear distance between rails to be 24".

B. Brackets for wall supports

1. 18" Ladder
 - a. Provide 3/8" by 4" long bent plate bracket welded to side rails with punched holes for 5/8" diameter anchors.
2. 24" Ladder
 - a. Provide 1/2" by 4" long bent plate bracket welded to side rails with punched holes for 5/8" diameter anchors.

C. Brackets for floor supports

1. Provide 5/16" angle brackets welded to rails with punched holes for 5/8" expansion anchors.

D. Rungs

1. 18" Ladder
 - a. Minimum 3/4" diameter solid extruded, with integral serrated non-slip finish on all sides.
 - b. Minimum distance from centerline of rung to wall or any obstruction shall be 7".
 - c. Maximum rung spacing shall be 12".
 - 1) Top rung shall be level with landing or platform.
 - 2) Spacing of bottom rung from grade or platform may vary, but shall not exceed 14".
2. 24" Ladder
 - a. Minimum 1" diameter solid extruded, with integral serrated non-slip finish on all sides.
 - b. Minimum distance from centerline of rung to wall or any obstruction shall be 7".
 - c. Maximum rung spacing shall be 12".
 - 1) Top rung shall be level with landing or platform.
 - 2) Spacing of bottom rung from grade or platform may vary, but shall not exceed 14".

E. Ladder Safety Extension Post

1. Telescoping tubular steel section that automatically locks at variable heights.
2. Pre-assembled with all hardware necessary for mounting to ladder.
3. Finish
 - a. Hot dipped galvanized

F. Self closing safety gate

1. Constructed out of same material of as ladder.
2. Meets or exceeds OSHA 1910 requirements.
3. Width of the gate, as shown on drawings.
4. Hinges
 - a. Size as recommended by manufacturer.
 - b. Minimum thickness: 0.32"
 - c. Bolted or welded to gate and ladder jamb post.
 - d. Permanently lubricated ball bearings.
5. Stop plates
 - a. Provide stop plate of sufficient size and thickness to stop the gate at full open swing without damage to the plate or post connection.
 - b. Minimum thickness: 0.25"
 - c. Weld plate to vertical posts with continuous fillet welds and grind smooth.

2.2 Materials

- A. Rods and Bars: ASTM A36
- B. Structural Plates: ASTM A36.
- C. Bolts: ASTM A325, Type 1
 1. Finish: Mechanically galvanized
- D. Nuts: ASTM A563, heavy-hex type.
 1. Finish: Mechanically galvanized

- E. Washers:
 - 1. ASTM F436; Type 1.
 - a. Finish: Mechanically galvanized.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. All ladders shall be hot dipped galvanized after fabrication per ASTM A123.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or SSPC Paint 20 Type II Organic.

2.3 FABRICATION

- A. Fit and shop-assemble components in largest practical sections, for delivery to Site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Continuously seal joined pieces by continuous welds.
- D. Ladder side rails shall be welded with full penetration butt welds.
- E. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- F. 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.
- G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FINISHES

- A. Hot dip galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.
- B. Verify that concealed blocking and reinforcement is installed and correctly located to receive wall-mounted ladders.

3.2 PREPARATION

- A. Clean and strip galvanized steel items to bare metal where Site welding is required. Site welding is not permitted unless shown otherwise or as approved.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Install anchors, plates, angles, hangers, and struts required for connecting ladders to structure.
- C. Field-weld components indicated on Drawings and Shop Drawings. Perform field welding according to AWS D1.1.
- D. Field-bolt and -weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.
- F. Obtain approval of Engineer prior to Site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not galvanized.
- H. Install ladder safety extension post in accordance with manufacturer's instructions.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- B. Maximum Offset from Alignment: 1/4 inch.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 055100

055200 HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Handrails

1.2 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

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

C. Qualifications Statements:

1. Submit qualifications for fabricator and erector.
2. Submit manufacturer's approval of fabricator and erector.

1.3 QUALITY ASSURANCE

A. Perform Work for structural aluminum according to AA ADM 1 and AA ASM 35.

B. Perform Work of this Section according to ASTM E985.

C. Finish joints according to NOMMA Guideline 1.

1.4 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Railing System:

1. Hollow Structural Sections: ASTM A500, Grade B
2. Pipe: ASTM A53, Grade B, Schedule 40
3. Rails and Posts: 1-1/2 inch diameter steel pipe; welded joints.
4. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast or machined steel.
5. Safety Chain: 1/4" Grade 30
6. Bolts: ASTM A325, Type 1. Finish: Mechanically galvanized.
7. Nuts: ASTM A563, heavy-hex type. Finish: Mechanically galvanized
8. Washers: ASTM F436; Type 1. Finish: Mechanically galvanized.
9. Adjustable brackets and flanges, Prepare backing plate for mounting in wall construction.
10. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
11. Splice Connectors: Steel concealed spigots, welding collars, or threaded collars.
12. All exterior handrails, toe plates, and safety chains shall be hot dipped galvanized after fabrication per ASTM A123
13. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or SSPC Paint 20 Type II Organic.

2.2 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site.
- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.

- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- G. Interior Components: Continuously seal joined pieces by continuous welds.
- H. 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.
- I. Accurately form components to each other and to building structure.
- J. Accommodate expansion and contraction of members and building movement without damage to connections or members.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean and strip galvanized steel items to bare metal where Site welding is required. Site welding is not permitted unless shown otherwise or as approved.
- B. Supply items required to be cast into concrete, embedded in masonry and placed in partitions with setting templates to appropriate Sections.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors, plates or angles.
- C. Field-weld anchors as indicated on Drawings and Shop Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- B. Maximum Offset from Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 055200

055300 METAL GRATINGS AND FLOOR PLATE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Grated floors

1.2 SUBMITTALS

- A. Product Data: Submit span and deflection tables.
- B. Shop Drawings: Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.
- E. Manufacturer's Instructions: Submit special requirements of openings and perimeter framing.

1.3 QUALITY ASSURANCE

- A. Perform Work according to metal bar grating standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual, NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual", and NAAMM MBG 534, "Metal Bar Grating Engineering Design Manual."
- B. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

1.4 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Structural Performance of Gratings: Provide gratings capable of withstanding the effects of gravity loads and the following loads within stress limits and under conditions indicated:
 - 1. Floor Live Load: Uniform load of 200 lb./sq. ft. minimum
 - 2. Elevated Platforms: Uniform load of 100 lbf/sq. ft.
- B. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

- C. Maximum Allowable Deflection under Live Load: 1/240 of span; size components for span as indicated on the drawings.
- D. Maximum Spacing between Bars: 1-3/16 inch.

2.2 MATERIALS

- A. Aluminum for Pressure Locking: ASTM B221, Alloy 6061-T6 or 6063-T6 extruded aluminum alloy, of I-bar shape.
 - 1. Crossbars and frames: ASTM B211, Alloy 6061-T6 or 6063-T6 extruded aluminum alloy.
- B. Hot Rolled Steel Diamond Tread Floor Plate
 - 1. Shall meet ASTM A786 Specifications.
 - 2. Minimum yield strength 36 ksi (ASTM A36 steel)
- C. Welding Materials: AWS D1.2, type as required for materials being welded.

2.3 FABRICATION

- A. Fabricate grates and plates to accommodate design loads and to size indicated in Drawings.
- B. Attach joints of intersecting metal sections as indicated in Shop Drawings.
- C. Fabricate support framing for openings
 - 1. Grating Frame: 2 ¼" by 2 ¼" with continuous anchor.
 - a. Grating frame shall use ¼" x 1" optional anchor.
- D. I-Bar: 3/16-by-2-inch size, spaced 1-3/16 inches o.c. (19-SG Series)
- E. Crossbar: Spaced 4 inches o.c.
- F. Removable Panels: With recessed handles.

2.4 FINISHES

- A. Prepare surfaces to be primed according to SSPC Manual and SSPC SP 6 "Commercial Blast Cleaning".
- B. Aluminum: Mill Clear anodized, NAAMM, AA-M12C22A41 finish (A-31 ½ hour Clear Anodizing).

- C. Diamond Plates shall be hot dipped galvanized per ASTM 123 or A153
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or SSPC Paint 20 Type II Organic.

2.5 ACCESSORIES

- A. Fasteners, Saddle Clips, Flange Blocks, and J-hooks: Stainless steel.
- B. Perimeter Closure: Same material as grating.
- C. Edge Banding: at edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that opening sizes and dimensional tolerances are acceptable.
- B. Verify that supports and anchors are correctly positioned.

3.2 INSTALLATION

- A. Place frames in correct position, plumb and level.
- B. Mechanically cut galvanized finish surfaces. Do not flame cut.
- C. Anchor by bolting through saddle clips.
- D. Set perimeter closure flush with top of grating and surrounding construction.
- E. Secure to prevent movement.

3.3 TOLERANCES

- A. Conform to NAAMM MBG 531 and NAAMM MBG 532.

3.4 CLEANING

- A. Clean welds and damaged coatings and apply one coat of touchup primer.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 055300

061000 ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking and nailers.

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

PART 2 - PRODUCTS

2.1 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA C2 [, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWA C31 with inorganic boron (SBX)].
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat [all rough carpentry, unless otherwise indicated.] [items indicated on Drawings, and the following:]
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood blocking and similar concealed members in contact with masonry or concrete.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWWA C20 lumber.
 - 1. Use Exterior type for exterior locations and where indicated.
 - 2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 - 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content of any species.

2.4 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than ½ inch nominal thickness.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel if indicated.
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 061000

072100 THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter insulation under slabs-on-grade.
 - 2. Perimeter foundation wall insulation.
 - 3. Concealed building insulation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type X, 1.30 lb/cu. ft. with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.3 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 072100

072119 FOAMED-IN-PLACE MASONRY WALL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of insulation work is shown on drawings and indicated by provisions of this section.
- B. Applications of insulation specified in this section include the following:
 - 1. Foamed-In-Place for thermal, sound and fire resistance values.

1.2 SUBMITTALS

- A. Product and technical presentation as provided by the manufacturer.
- B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values, fire performance and sound abatement characteristics.
- C. Material Safety Data Sheet: Submit Material Safety Data Sheet complying with OSHA Hazard Communication Standard, 29 CFR 1910 1200.

1.3 QUALITY ASSURANCE

- A. Manufacturing Standards: Provide insulation produced by a single and approved manufacturer. The product must come from the manufacturer pre-mixed to ensure consistency.
- B. Installer Qualifications for Foamed-In-Place Masonry Insulation: Engage an experienced dealer/applicator who has been trained and licensed by the product manufacturer and which has not less than three years direct experience in the installation of the product used.
- C. Warranty: Upon request, a one year product and installation warranty will be issued by both the manufacturer and installer.
- D. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by a testing agency acceptable to authorities having jurisdiction.

Product must be classified by Underwriters Laboratory ® (“UL”) as to Surface Burning Characteristics

Fire Resistance Ratings:	ASTM E-119
Surface Burning Characteristics:	ASTM E-84
Combustion Characteristics:	ASTM E-136

PART 2 - PRODUCTS

2.1 INSULATING MATERIALS

- A. General: Provide insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Foamed-In-Place Insulation: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation.
 - 1. Surface Burning Characteristics: Maximum flame spread, smoke developed and fuel contributed of 0, 5 and 0 respectively.
 - 2. Combustion Characteristics: Must be noncombustible, Class A building material.
 - 3. Thermal Values: "R" Value of 4.91/inch @ 32 degrees F mean; ASTM C-177.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 072119

075323 ETHYLENE PROPYLENE DIENE MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes adhered membrane roofing system and rubber pavers.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples: For each product included in membrane roofing system.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Source Limitations: Obtain components for membrane roofing system from same manufacturer as roofing membrane.

1.4 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's total system warranty form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Warranty Period: 55 mph, 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EPDM ROOFING MEMBRANE

- A. EPDM Roofing Membrane: ASTM D 4637, Type II, scrim or fabric internally reinforced uniform, flexible sheet made from EPDM, and as follows:
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: Black.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
- B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Seaming Material: Single-component butyl splicing adhesive and splice cleaner
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- F. Miscellaneous Accessories: Provide lap sealant, water cutoff mastic, metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
 - 1. Refer to drawings – insulation to be mechanically fastened to metal deck of existing well house. Insulation will be fully adhered to concrete deck of new pump house.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.4 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- B. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
- C. Cover Board: ASTM C 1289, Type II, Grade 2, high density polyiso, 1/2 inch thick.

2.5 PREFINISHED METAL ROOF EDGE

- A. Anchor bar roof edge fascia system consisting of heavy .100" thick extruded aluminum bar, corrosion resistant stainless steel fasteners, and snap-on 24 ga. prefinished fascia cover.

2.6 ROOF PAVERS

- A. Lightweight Rubber Roof Pavers: Interlocking, lightweight rubber units of same manufacturer as membrane, and as follows:
 - 1. Size: 2' x 2' x 2" thick
 - 2. Weight: 6 lbs./sq. ft.
 - 3. Color: Black

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

- E. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a cold fluid-applied adhesive.

- F. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

- G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Loosely butt cover boards together and fasten to roof deck.
 - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.2 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- E. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
- F. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- G. Roof-Paver Ballast: Install lightweight rubber roof pavers according to manufacturer's written instructions.

3.3 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.4 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 075323

076200 SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed roof drainage sheet metal fabrications.
 - 2. Formed low-slope roof sheet metal fabrications (shop-built roof hatches at Existing Pump Station Building).
- B. Related work specified elsewhere:
 - 1. Through-wall flashings specified in 042000 Unit Masonry

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
- C. Samples: For each exposed product and for each finish specified.
- D. Maintenance data.
- E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.4 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finishes:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
 - 2. Color: As selected by Owner from manufacturer's full range.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; 2D (dull, cold rolled) finish.
- D. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
 - 3. Color: As selected by Architect from manufacturer's full range.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.4 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 - 1. Hanger Style: Stirrup.
 - 2. Fabricate from the following materials:
 - a. Pre-finished Galvanized Steel: 0.022 inch thick.
- C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond parapet wall into field of roof. Fabricate from the following material:
 - 1. Pre-finished Galvanized Steel: 0.028 inch thick.
- D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
 - 1. Pre-finished Galvanized Steel: 0.024 inch thick.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Penetration Flashing: Refer to drawings for fabrication details of shop-built roof hatches at Existing Pump Station Building. Fabricate from the following materials:
 - 1. Stainless Steel: Type 304, 0.0785 inch thick (14 ga.)

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

- D. Fastener Sizes: Use fasteners of sizes that will penetrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
- F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.2 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
- D. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, parapet and under roofing membrane.
- E. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper discharge.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 076200

077200 PRE-MANUFACTURED ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Roof curbs.
2. Roof hatches.

1.2 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples: For each type of exposed factory-applied color finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. **Prepainted, Metallic-Coated Steel Sheet:** Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
1. **Galvanized Steel Sheet:** ASTM A 653/A 653M, G90 coated.
 2. **Aluminum-Zinc Alloy-Coated Steel Sheet:** ASTM A 792/A 792M, Class AZ50 coated.
 3. **Exposed Finishes:** High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a. **Fluoropolymer 2-Coat System:** Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in AAMA 2604.
- B. **Aluminum Sheet:** ASTM B 209, alloy and temper recommended by manufacturer for type of use and finish. Coil-coat finish as follows:
1. **Factory-Prime Coating:** Where painting after installation is indicated, provide pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat; with a minimum dry film thickness of 0.2 mil (0.005 mm).
 2. **Class II, Clear Anodic Finish:** AA-M12C22A31 (Mechanical Finish: Nonspecular as fabricated; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 3. **Baked-Enamel Finish:** AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a. **Organic Coating:** Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.
 - b. **Color and Gloss:** As selected by Owner from manufacturer's full range.

4. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturer's written instructions.

a. Color and Gloss: As selected by Owner from manufacturer's full range.

C. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use, mill finished.

D. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.

E. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.

F. Steel Tube: ASTM A 500, round tube, baked-enamel finished.

G. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.

H. Galvanized Steel Pipe: ASTM A 53/A 53M.

2.2 MISCELLANEOUS MATERIALS

A. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, 1 inch (25 mm) thick.

B. Glass-Fiber Board Insulation: ASTM C 726, 1 inch (25 mm) thick.

C. Polyisocyanurate Board Insulation: ASTM C 1289, 1 inch (25 mm) thick.

D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Polyethylene Sheet: 6-mil- (0.15-mm-) thick, polyethylene sheet complying with ASTM D 4397.

- G. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- H. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- K. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- L. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 PRE-MANUFACTURED ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 - 1. Material: Galvanized steel sheet, 0.052 inch (1.32 mm) thick.
 - 2. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.
 - 3. Material: Stainless-steel sheet, 0.078 inch (1.98 mm) thick.
 - a. Finish: Baked enamel High-performance organic coating.
 - b. Finish: Clear anodic.
 - 4. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 5. Factory install wood nailers at tops of curbs.

6. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
7. Factory insulate curbs with 1-1/2-inch- (38-mm-) thick, cellulosic or glass-fiber board insulation.
8. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches, unless otherwise indicated.

2.4 PRE-MANUFACTURED ROOF HATCHES

- A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.
1. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. (1.9-kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loads.
 2. Type and Size: Single-leaf lid, 30 by 48 inches (refer to drawings for location)
 3. Type and Size: Double-leaf lid, 48 by 96 inches (refer to drawings for quantity and location).
 4. Curb and Lid Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.
 - a. Finish: High-performance organic coating.
 5. Insulation: Manufacturer's standard Cellulosic-fiber, Glass-fiber, or Polyisocyanurate board.
 6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
 7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
 8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 9. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.

10. Hardware: Spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
 - a. Provide 2-point latch on covers larger than 84 inches (2130 mm).
11. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.
 - a. Height: 42 inches (1060 mm) above finished roof deck.
 - b. Material and Finish: Steel tube, baked enameled.
 - c. Diameter: Pipe with 1-5/8-inch (41-mm) OD tube.
12. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.
 - a. Test Load: Per OSHA 29 CFR
 - b. Height: 42 inches (1060 mm) above finished roof deck.
 - c. Pipe or Tube: 1-1/4-inch (31-mm) ID galvanized pipe or 1-5/8-inch (41-mm) OD galvanized tube.
 - d. Flat Bar: 2-inch- (50-mm-) high by 3/8-inch- (9-mm-) thick galvanized steel.
 - e. Chain Passway Enclosure: Galvanized proof coil chain with quick link on fixed end.
 - f. Pipe Ends and Tops: Covered or plugged with weather-resistant material.
 - g. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
 - h. Fabricate joints that will be exposed to weather in a watertight manner.
 - i. Close exposed ends of handrail and railing members with prefabricated end fittings.
 - j. Fasteners: Manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Roof Curb Installation:
 - 1. Set roof curb so top surface of roof curb is level.
- F. Roof Hatch Installation:
 - 1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
 - 2. Attach safety railing system to roof hatch curb.
 - 3. Attach ladder safety post according to manufacturer's written instructions.

3.3 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 077233

079200 JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
 - 1. Exterior joints in vertical surfaces.
 - 2. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 3. Interior joints in horizontal traffic surfaces.
- B. See Division 08 Section "Glazing" for glazing sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

- D. Single-Component Neutral- and Basic-Curing Silicone Sealant:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 100/50.
 3. Use Related to Exposure: NT (nontraffic).
 4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
- E. Single-Component Neutral-Curing Silicone Sealant:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 25.
 3. Use Related to Exposure: NT (nontraffic).
 4. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
- F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 25.
 3. Use Related to Exposure: NT (nontraffic).
 4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
- G. Single-Component Nonsag Urethane Sealant:
1. Type and Grade: S (single component) and NS (nonsag).
 2. Class: 25.
 3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

H. Multicomponent Nonsag Immersible Urethane Sealant:

1. Type and Grade: M (multicomponent) and P (pourable).
2. Class: 50.
3. Uses Related to Exposure: NT (nontraffic) and I (immersible), Class 1.
4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

I. Single-Component Pourable Urethane Sealant:

1. Type and Grade: S (single component) and P (pourable).
2. Class: 25.
3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

2.3 SOLVENT-RELEASE JOINT SEALANTS

- A. Pigmented Narrow-Joint Sealant: Manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type [C (closed-cell material with a surface skin)] [O (open-cell material)] [B (bicellular material with a surface skin)] [or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated], and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26°F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete and stone.
 - 1. Joint Sealant: Single-component nonsag urethane sealant.
- B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.
 - 1. Joint Sealant: Single-component nonsag urethane sealant
- C. Joint-Sealant Application: Exterior perimeter joints between masonry and frames of doors and louvers.
 - 1. Joint Sealant: Single-component nonsag urethane sealant
- D. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
 - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant
- E. Joint-Sealant Application: Interior perimeter joints of exterior openings.
 - 1. Joint Sealant: Single-component nonsag polysulfide sealant
- F. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant

- G. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
 - 1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant
- H. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors.
 - 1. Joint Sealant: Latex sealant.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 079200

081113 HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

- B. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- E. Mineral-Fiber Insulation: ASTM C 665, Type I.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.2 STANDARD HOLLOW METAL DOORS

- A. General: Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush)
 - a. Width: 1-3/4 inches.
- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.3 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8.
- B. Interior Frames: Fabricated from cold-rolled steel sheet
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.6 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb from 60 to 90 inches high.
 - 6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.
 - a. Single-Door Frames: Three door silencers.
- C. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.

2.7 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: ANSI/SDI A250.10.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Install door silencers in frames before grouting.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - e. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 081113

082200 FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Standards for manufacturing, machining, finishing and installation of heavy-duty insulated fiberglass reinforced polymer doors and fiberglass reinforced polymer frames unless more specifically described under other section(s).

1.2 SUBMITTALS

- A. Shop Drawings
 - 1. Shop and erection drawings of all fabricated and milled items.

1.3 QUALITY ASSURANCE

- A. Provide doors and frames meeting or exceeding the minimum standards as set forth by the following organizations unless standards are modified or exceeded by this specification:
 - 1. Composite Fabricators Association (CFA).
 - 2. Composites Institute
- B. All doors and frames shall be the products of the same manufacturer to insure uniformity of quality and appearance throughout the project.
- C. The top of each door shall bear a bar code label from the manufacturer indicating the door serial number, date(s) of manufacture, size and type.
- D. The door manufacturer shall provide a Certification of Compliance with this specification signed by an authorized company representative.

1.4 DELIVERY AND STORAGE

- A. Deliver all materials to job site and store in a manner to prevent damage.

1.5 WARRANTY

- A. To include (10) years free from defects in material and workmanship from date of shipment.
- B. Lifetime from corrosion provided that door panels and frames have not been compromised.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. Door Core
 - 1. Cores shall be injected, closed cell, polystyrene foam with a density of 4 pounds per square foot. Foam shall be injected into the door cavity while the door is in a press. Foam shall be allowed to cure in place prior to door being removed from the press. The use of drop in foam cores shall be prohibited.
- B. Door Stiles, Rails and Stiffeners
 - 1. Stiles and rails shall be tubular fiberglass members and manufactured by the pultrusion process. Outside dimensions shall conform to hardware reinforcement requirements and overall door thickness of 1.75 inches. Vertical stiffeners shall be minimum 6" o.c. Resin and reinforcement selection shall be compatible with door facing material.

C. Door Face Skins

1. Door face skins shall consist of a Fiberglass Laminate manufactured by the Resin Transfer Molding (RTM) process. Skin thickness shall be 0.125 inches.
 - a. Gel Coat and resin selection: Gel coat and resin shall be selected to withstand the installed environment. Both UV and corrosion resistance shall be considered paramount.
 - b. Reinforcements shall be either type "A" or "C" glass. The use of "E" glass roving shall be strictly prohibited.
 - c. Face skin shall be fused to stiles, rails, and stiffeners using two-part 100 percent reactive urethane adhesive, and then cured under pressure until completely bonded.

D. Fiberglass Frames

1. Constructed of 0.1875 inch thick Fiberglass pultrusions:
 - a. Jamb depths and faces as indicated by drawing details and/or door and frame schedule on drawings.
 - b. Provide frames with mitered corners, resin welded and ground smooth unless specifically noted otherwise.
 - c. Reinforcing:
 - 1) Corner Reinforcement: 4"x4"x5-3/8"x1/4" pultruded fiberglass angle.
 - 2) Strike Reinforcement: 1-1/2" x 8" x 3/4" thick polymer material.
 - 3) Closer Reinforcement: 1-1/8"x18"x1/4" polymer bonded to frame.
 - 4) Provide adequate reinforcings for other hardware as required in approved finish hardware schedule.
2. Provide proper type base and jamb anchors for all frames.
 - a. Provide standard rubber silencers, 3 per strike jamb and 2 per head jamb for pairs.
3. Removable mullion: Provide full depth removable mullion of matching construction for Door #106. Set screws shall be on interior for security.

2.2 ACCESSORIES

- A. Provide all required accessories for proper assembly and installation, including but not limited to, stainless steel screws, clips, washers, bolts, anchors, splice plates, spacers, and similar items, whether specifically mentioned herein or not.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Fabricate all doors, frames and accessories in strict accordance with this specification and Door Manufacturer's manufacturing specifications.

3.2 MACHINING AND FITTING

- A. All fiberglass doors shall be machined by the manufacturer or authorized manufacturer for cutouts, hinges, locks, closures and all hardware requiring routing and mortising. Doors shall be sized to allow 0.125 inches of clearance at top and each side and 5/8 inch clearance at bottom (unless specified otherwise).

3.3 INSTALLATION OF HARDWARE

- A. Contractor shall install hardware according to approved hardware schedule for proper locations.
- B. Install with full threaded screw furnished by hardware manufacturer.
- C. Drill proper size pilot holes for all screws.
- D. Securely anchor hardware in correct position and proper alignment.
- E. Adjust hardware and door for proper function and smooth operation, proper latching, without force or excessive clearance.

3.4 FIELD FINISHING

- A. Doors and frames are furnished with a polyurethane primer. Contractor shall apply finish paint as recommended by manufacturer that is compatible with the primer coat.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 082200

083100 FLOOR ACCESS DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide factory-fabricated floor access doors – refer to drawings for sizes and locations.
 - 1. Provide portable guard rail enclosure systems – total of two (one for each building).

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 SURFACE MOUNT ACCESS DOOR

- A. Furnish and install where indicated on plans surface mount vault access door, size 4'-0" W x 3'-0" L. Length denotes hinge side. The floor access door shall be single leaf and pre-assembled from the manufacturer.
- B. Performance characteristics:
 - 1. Cover: Shall be reinforced to support a minimum live load of 105 psf (513kg/m²).
 - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - 3. Operation of the cover shall not be affected by temperature.
 - 4. Entire door, including all hardware components, shall be highly corrosion resistant. Please consult the manufacturer when doors are to be installed in unusually harsh environments or extremely corrosive conditions.
- C. Cover: Shall be 1/8" (3mm) aluminum diamond pattern.
- D. Frame: Shall be 1/4" x 3" x 3" (6mm x 76mm x 76mm) angle frame with internal mounting flange and 7/16" (11mm) diameter anchor holes.
- E. Gasket: A heavy extruded EPDM rubber gasket shall be permanently adhered to the cover.
- F. Hinges: Shall be heavy duty Type 316 stainless steel pintle hinges with 3/8" (10mm) Type 316 stainless steel hinge pins.
- G. Lifting Assistance: Manufacturer shall provide a gas strut lifting mechanism with a powder-coat finish to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.
- H. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

- I. Hardware:
 - 1. Cover shall be equipped with an aluminum hold open arm that automatically locks the cover in the open position
 - 2. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
 - 3. Hardware: Gas strut has a powder coat finish. All other hardware is type 316 stainless steel unless otherwise specified.
- J. Finishes: Factory finish shall be mill finish aluminum.

2.2 CAST-IN-PLACE ACCESS DOOR

- A. Furnish and install where indicated on plans vault access door, size 4'-0" W x 4'-0" L. Length denotes hinge side. The floor access door shall be double leaf and pre-assembled from the manufacturer.
- B. Performance characteristics:
 - 1. Covers: Shall be reinforced to support a minimum live load of 150 psf (732 kg/m²) with a maximum deflection of 1/150th of the span.
 - 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 - 3. Operation of the covers shall not be affected by temperature.
- C. Covers: Shall be 1/4" (6mm) aluminum diamond pattern plate.
- D. Frame: Shall be extruded aluminum with strap anchors bolted to the exterior.
- E. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of cover.
- F. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.
- G. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover.

H. Hardware:

1. Hinges: Cast steel cam-action hinges which pivot on torsion bars shall be provided.
 2. Covers shall be equipped with steel hold open arms that automatically lock each cover in the open position.
 3. Covers shall be fitted with the required number and size of torsion bars.
 4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the covers.
 5. Hardware: Shall be zinc plated and chromate sealed. Type 316 stainless steel hardware is available for installation in corrosive environments.
- I. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

2.3 PORTABLE GUARD RAIL SYSTEM

- A. Provide portable guard rail system meeting the requirements of OSHA CFR 1910.23 and 1926.502. System shall be free standing and non-penetrating, providing a minimum enclosure size of 6' x 6'. System shall consist of base plates, toe boards, 3'-6" high guard rail sections, rail mounted instruction tube with manual and Allen wrench, and self closing swing gate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
1. Test units for proper function and adjust until proper operation is achieved.
 2. Repair finishes damaged during installation.
 3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 083100

083323 OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of manually operated overhead coiling doors:

- 1. Insulated service doors.

1.2 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachment to other work.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

- 1. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Interlocking slats in a continuous length for width of door of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door.
 - 1. Aluminum Door Curtain Slats: ASTM B 209 or ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - 2. Slat type: Flat profile.
 - 3. Insulation: Manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
- B. Endlocks and Windlocks: Malleable-iron casings, secured to curtain slats to comply with wind load.
- C. Bottom Bar: Manufacturer's standard to suit type of curtain slats.
 - 1. Astragal: Replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; as a cushion bumper for interior door.
- D. Curtain Jamb Guides: Steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.
- E. Curtain Jamb Guides: Extruded aluminum with sufficient depth and strength to retain curtain, operate smoothly, and to withstand loading.
 - 1. Removable Posts and Jamb Guides: Manufacturer's standard.
- F. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
 - 1. Aluminum Hoods: Minimum 0.032 inch thick that matches slat aluminum.
 - 2. Shape: Square.

- G. Weatherseals: Replaceable, adjustable, continuous, compressible weatherstripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.
 - 1. Jamb Seals: Replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.
- H. Locking Device Assembly: Lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Full-disc cremone type, both jamb sides operable from inside only.
- I. Counterbalancing Mechanism: Adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
 - 1. Mounting Brackets: Cast iron or cold-rolled steel plate.
- J. Manual Door Operator: Chain hoist

2.2 FINISHES

- A. Aluminum Anodic Finish: Class II, clear anodic coating complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports
- B. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion, and with weathertight fit around entire perimeter.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 083323

083613 SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes manually operated sectional overhead doors.

1.2 SUBMITTALS

- A. Product Data: For each type and size of sectional overhead door and accessory.
- B. Shop Drawings: For special components and installations not detailed in manufacturer's product data.
- C. Samples: For each exposed finish.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
 - 2. Air Infiltration: Maximum Rate: 0.08 cfm at 15 mph.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 INSULATED ALUMINUM DOOR SECTIONS

- A. Construct door sections with extruded-aluminum shapes, complying with ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated. Join stiles and rails by welding or with concealed stainless-steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint. Provide reinforcement for hardware attachment.
- B. Fabricate panels of aluminum sheet not less than 0.040 inch thick, set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop. Insulate with manufacturer's standard polyisocyanurate or polystyrene insulation providing a minimum of R-7.5.
- C. Class II, Clear Anodic Finish.

2.2 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Weld or bolt to track supports.
 - 1. Provide tracks configured for the following lift types:
 - a. High-lift.
 - 2. Track Reinforcement and Supports: Galvanized steel supporting members to provide strength and rigidity during opening and closing of doors.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.
 - 1. Provide continuous flexible seals at door jambs for a weathertight installation.

2.3 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware to suit door type.
- B. Hinges: Heavy-duty galvanized steel hinges at each end stile and at each intermediate stile. Attach hinges to door sections through stiles and rails. Provide double-end hinges where required and for doors exceeding 16 feet in width.

- C. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races.
 - 1. Tire Material: Case-hardened steel.
- D. Locking device assembly with lock, dead bolt, operating handle, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Full-disc cremone type, both jamb sides operable from inside only.

2.4 COUNTERBALANCE MECHANISM

- A. Extension Spring: Oil-tempered wired springs with internal safety rods. Combine operation with a spring bumper in each horizontal track to cushion door at end of opening operation.
- B. Torsion Spring: Fabricated from oil-tempered-steel wire, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for a minimum of 10,000 cycles.
- C. Cable Drums: Cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft.
- D. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.
- F. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.5 MANUAL DOOR OPERATORS

- A. Chain-Hoist Operation: Side-mounted unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install door, track, and operating equipment complete with necessary hardware according to Shop Drawings, manufacturer's written instructions, and as specified.

3.2 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.
- B. Touch-up Painting: Immediately after welding galvanized track to track supports, clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 083613

087100 DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating and material of each door and frame.
 - 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
 - 3) Complete designations of every item required for each door or opening including name and manufacturer.
 - 4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Supplier, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1.4 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion, except as follows:
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
 - 1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

- A. Template Requirements: Provide only template-produced units.
- B. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Interior Hinges: Steel, with steel pin.
 - 2. Hinges for Fire-Rated Assemblies: Steel, with steel pin.
- C. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
 - 3. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.

2.4 CONTINUOUS HINGES

- A. Standard: BHMA A156.26, Grade 1
- B. Continuous, Gear-Type, Concealed Leaf (Butt Mount) Hinges: Extruded-aluminum, pinless, geared hinge leaves; joined by continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

2.5 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
 - 1. Levers: Lever trim shall return to within ½" of door.
 - 2. Dummy Trim: Match lever lock trim and escutcheons.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.
- E. Backset: 2-3/4 inches, unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.6 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function descriptions indicated in door hardware sets comply with the following:
 - 1. Mortise Locks: BHMA A156.13.
- B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1, Series 1000, Heavy-duty.

2.7 LOCK CYLINDERS

- A. High-Security Lock Cylinders: BHMA A156.30, Grade 1
 - 1. Key Control Level: Category A.
 - 2. Destructive Test Level: Category A.
 - 3. Surreptitious Entry Resistance Level: Category A.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Six.
 - 2. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.
- D. Construction Keying: Comply with the following:
 - 1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
 - 2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
 - a. Furnish permanent cores to Owner for installation.
- E. Manufacturer: Same manufacturer as for locks and latches.

2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.
 - 1. Existing System: Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver; permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."
 - 1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five master keys.

2.9 CLOSERS

- A. Accessibility Requirements: Comply with the following maximum opening-force requirements:
 - 1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - 2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- D. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

2.10 DOOR GASKETING/SILENCERS

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- F. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame. Provide for all frames not receiving weatherstripping or smoke gasketing.
- G. Door Sweeps: Gasket material held in place by flat metal housing or flange; surface mounted to face of door with screws.
 - 1. Gasket Material: Neoprene

2.11 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- D. Saddle Thresholds: Fluted top.

2.12 DRIP CAPS

- A. Standard: BHMA A156.22
- B. Clear anodized extruded aluminum, 2-1/2" projection. Furnish units in length to fit openings.

2.13 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

- C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel and FRP Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel and FRP Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- E. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.2 DOOR HARDWARE SETS

Door Hardware Set No. 1

Doors No. 101, 103, 105, 111 Exterior Singles; each to have the following:

No.	Item	Description	Finish
1	Hanging Device	Continuous Hinge	Clear
1	Securing Devices	Entrance Function Leverset	US26D
1	Closing Devices	Surface Closer	689
1	Miscellaneous Trim	Threshold	Alum
1	Miscellaneous Trim	Drip Cap	Clear
1	Seals	Weatherstripping	Set Black
1	Seals	Door Bottom	US26D

Door Hardware Set No. 2

Doors No. 106 Exterior Pair with Center Mullion; to have the following:

No.	Item	Description	Finish
2	Hanging Devices	Continuous Hinges	Clear
2	Securing Devices	Entrance Function Leverset	US26D
2	Closing Devices	Surface Closer	689
2	Miscellaneous Trim	Threshold	Alum
1	Miscellaneous Trim	Drip Cap	Clear
2	Seals	Weatherstripping	Set Black
2	Seals	Door Bottom	US26D

Door Hardware Set No. 3 – 3-HR RATING

Door No. 104; to have the following:

No.	Item	Description	Finish
3	Hanging Devices	Butt Hinges	US26D
1	Securing Device	Passage Leverset	US26D
1	Closing Device	Surface Closer	689
1	Miscellaneous Trim	Threshold	Alum
1	Seals	Fire Gasketing Set	Black
1	Seals	Door Bottom	US26D

Door Hardware Set No. 4

Doors No. 107 and 108; each to have the following:

No.	Item	Description	Finish
3	Hanging Devices	Butt Hinges	US26D
1	Securing Device	Passage Leverset	US26D
1	Closing Device	Surface Closer	689

Door Hardware Set No. 5
Door No. 109; to have the following:

<u>No.</u>	<u>Item</u>	<u>Description</u>	<u>Finish</u>
3	Hanging Devices	Butt Hinges	US26D
1	Securing Device	Privacy Leverset	US26D
1	Closing Devices	Surface Closer	689

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 083613

088100 GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Work includes:

1. Provide complete, in place, the glass and glazing not otherwise specified for the project, as shown, noted, or scheduled on the drawings and as specified herein.
2. Location of Glass Types Refer to interior elevations, details, door and frame schedules on the drawings for exact locations and types of glass required.

B. Related work:

1. Specified elsewhere:
 - a. Fiberglass Doors specified in Section 082200

1.2 SUBMITTALS

A. Product Data/Samples:

1. Submit for Engineer/Architect's approval: (minimum 5 copies required)
 - a. Manufacturer's data and catalog sheets clearly indicating all types of glass and glazing materials to be used.
2. Submit samples of each glass type for Engineer/Architect's approval.

1.3 QUALITY ASSURANCE

- A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified in the installation of specified materials and shall provide a fully qualified superintendent or foreman who shall be present at all times during execution of this work.
- B. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with pertinent recommendations contained in:
 - 1. Flat Glass Marketing Association (FGMA):
 - a. "Glazing Sealing Systems Manual".
 - b. "Glazing Manual".
 - 2. Sealed Insulating Glass Manufacturer's Association.

PART 2 - PRODUCTS

2.1 GLASS

- A. All glass shall be new, up to grade requirements. Provide type and thickness indicated on the drawings or as specified herein.
- B. Plate or Float Glass: Fed. Spec. DD G 451, Type I, Class 1, Quality q3.2. Where plate glass is called for, plate glass or float glass may be used.
- C. Tempered Glass: Fed Spec. DD G 1403 and ANSI Z97.1.
 - 1. For plate glass or float glass use Type I, Class 1, Quality q3.
 - 2. For heat absorbing glass, if required, use Type I, Class 2.

2.2 OTHER MATERIALS

- A. Glazing Compounds Permanent elastic material of proper consistency for specific application. Compounds shall maintain a flexible, watertight seal. Do not use putty.
- B. Glazing Gaskets, Resilient Glazing Seals Provide size and type as recommended by frame and glass manufacturers for a complete watertight seal.
- C. Accessories Provide all accessories, including but not limited to, glazing clips, setting blocks, shims, and similar items required for proper installation of all materials.

2.3 GLAZING SCHEDULE

- A. Refer to drawing interior elevations, details, door and frame schedules for locations of various glass types.

AS NOTED ON DRAWINGS	GLASS TYPE
PG	¼" thick Clear Polished <u>Plate Glass</u> or Architectural Float Glass
TG	Same as above, but <u>Tempered</u> .

PART 3 - EXECUTION

3.1 INSTALLATION, WORKMANSHIP

- A. Glass shall be installed by competent, qualified workmen/workwomen, as recommended in the Flat Glass Glazing Manual, and as specifically recommended by glass and frame manufacturers.
- B. All glazing ledges, beads, and stops shall be clean, dry, free from dust, foreign matter, mortar, oil, grease, and rust before glazing. Do no glazing until all such items have been thoroughly cleaned.
- C. Properly prime or otherwise prepare all glazing ledges, beads, and stops prior to installation of glass.
- D. Do all glazing at job site. Set all glass so there is equal bearing for entire width of pane using proper size setting blocks. Set all glass accurately so it fits frame or opening.
- E. Allow for proper expansion as recommended by manufacturer.
- F. Completely bed all glass in glazing compound or proper size glazing seals, free from rattle or leakage for watertight and weathertight installation.
- G. Use proper lubricants and tools as recommended by manufacturer for installation of glazing gaskets and seals.

3.2 REPLACEMENTS, CLEANING

- A. At conclusion of the work, examine all glass and glazing work. Remove and replace all cracked, broken, discolored, or otherwise defective glass and unacceptable glazing compound or glazing seals and gaskets.
- B. Thoroughly remove all excess glazing compound from glass and stops.
- C. Wash all glass surfaces, inside and outside.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 088100

099600 HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems.
- B. Work shall include painting of new and existing interior concrete, CMU, and interior/exterior structural/miscellaneous metal surfaces, existing metal doors and frames and new metal roof deck in Existing Pump Station and all new interior concrete, CMU, and interior/exterior metal surfaces of New Well House Building. Piping and electrical conduit shall be color coded with general color scheme as specified in this Section. Electrical conduits shall be painted the color of the wall/ceiling against which it is run. Conduits are not required to be painted if they are not running against a wall or ceiling. Natural or anodized aluminum surfaces shall not be painted. Surfaces and equipment which are provided with a factory final finish shall not be painted.

Interior surfaces below the fished first floor grade shall not be painted.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.3 QUALITY ASSURANCE

- A. Master Painters Institute (MPI) Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
4. Stains: VOC content of not more than 250 g/L.
5. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
6. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.

- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1, 1, 1-trichloroethane.
- y. Vinyl chloride.

C. Colors: As selected by Owner from manufacturer's full range

2.2 BLOCK FILLERS

A. Epoxy Block Filler: MPI #116.

- 1. VOC Content: Minimum E Range of E1.

2.3 INTERIOR PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

- 1. Environmental Characteristics:
 - a. VOC Content:
 - 1) Minimum E Range of E2.

2.4 METAL PRIMERS

A. Epoxy Zinc Primer: MPI #20.

- 1. VOC Content: Minimum E Range of E1.

B. Cold-Curing Epoxy Primer: MPI #101.

- 1. VOC Content: Minimum E Range of E1.

2.5 EPOXY COATINGS

A. Epoxy, Cold-Cured, Gloss: MPI #77.

- 1. VOC Content: Minimum E Range of E1.

B. High-Build Epoxy Marine Coating, Low Gloss: MPI #108.

- 1. VOC Content: Minimum E Range of E1.

C. Epoxy Deck Coating: MPI #82.

- 1. VOC Content: Minimum E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (CMU): 12 percent.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- E. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

- F. Steel Substrates: Remove rust and loose mill scale using methods recommended in writing by coating manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- E. Spray painting shall not be allowed.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 GENERAL COLOR SCHEME

- A. General color scheme shall be as follows:
1. Ceiling steel frame and metal deck – light gray
 2. Floors – light gray or equivalent
 3. Ceilings – white
 4. CMU and concrete walls – Tannery
 5. Interior steel frame and metal trim – light gray
 6. Exterior metal trim – light gray
 7. Exterior piping and appurtenances - Turbine blue
 8. Interior piping – turbine blue
 9. Electrical conduits – Match wall or ceiling running against
 10. Bollards – Yellow
 11. Hoist beams – Red
 12. Physical hazards – Yellow

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
1. High-Build Epoxy Coating System:
 - a. Prime Coat: Cold-curing epoxy primer (2.0-3.0 mils), MPI #101.
 - b. Intermediate Coat: High-build epoxy marine coating, low gloss (2.0-3.0 mils), MPI #108.
 - c. Topcoat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.
- B. Galvanized-Metal and Fiberglass Substrates:
1. Epoxy Coating System:
 - a. Prime Coat: Cold-curing epoxy primer (2.0-3.0 mils), MPI #101.
 - b. Intermediate Coat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.
 - c. Topcoat: Epoxy, cold-cured, gloss (4.0-6.0 mils), MPI #77.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy Coating System:

- a. Prime Coat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.
- b. Intermediate Coat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77.
- c. Topcoat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77.

B. Concrete Substrates, Horizontal Surfaces.

1. Concrete Floor Epoxy Non-Slip Coating System:

- a. Prime Coat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.
- b. Intermediate Coat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77 with silica sand to provide a non-skid surface.
- c. Topcoat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77.

C. CMU Substrates:

1. Epoxy Coating System:

- a. Prime Coat: Epoxy block filler (7.0-10.0 mils), MPI #116.
- b. Intermediate Coat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77.
- c. Topcoat: Epoxy, cold-cured, gloss (3.0-5.0 mils), MPI #77.

D. Steel Substrates:

1. High-Build Epoxy Coating System:

- a. Prime Coat: Epoxy zinc primer (4.0-6.0 mils), MPI#20.
- b. Intermediate Coat: High-build epoxy marine coating, low gloss (2.0-3.0 mils), MPI #108.
- c. Topcoat: High-build epoxy marine coating, low gloss (2.0-3.0 mils), MPI #108.

E. Galvanized-Metal and Fiberglass Substrates:

1. Epoxy Coating System:

- a. Prime Coat: Cold-curing epoxy primer (4.0-6.0 mils), MPI #101.
- b. Intermediate Coat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.
- c. Topcoat: Epoxy, cold-cured, gloss (2.0-3.0 mils), MPI #77.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 099600

101400 PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Bronze Plaque.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.

1.3 DEFINITIONS

A. NOT USED

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with local jurisdiction sign ordinances and apply for any required sign permits. Sign permit fees to be paid by the Contractor unless noted otherwise.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).

B. Bronze Plate: ASTM B 36/B 36M.

2.2 PLAQUE

- A. Cast Plaque: Provide castings free of pits, scale, sand holes, and other defects, as follows:
1. Plaque Material: Bronze as indicated.
 2. Background Texture: Manufacturer's standard pebble texture.
 3. Border Style: Raised flat band.
 4. Text: As indicated on drawings.
 5. Mounting: Rosettes and fasteners matching plaque finish for substrates encountered.

2.3 ACCESSORIES

- A. Anchors and Inserts: Provide stainless steel anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cast-Metal Plaque: Mount plaque using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.
1. Face Mounting: Mount plaques using exposed fasteners with rosettes attached through face of plaque into wall surface.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 101400

102813 TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work includes
1. Provide complete, in place, the toilet accessories for the project, as shown, noted, or scheduled on the drawings and as specified herein.

1.2 SUBMITTALS

A. Product Data/Samples

1. Submit for Engineer/Architect's approval: (minimum 5 copies required)
 - a. Manufacturer's catalog or data sheets on all specified products together with manufacturer's recommended installation instructions.

1.3 QUALITY ASSURANCE

- A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified and familiar with the assembly and recommended installation procedures for specified products.

PART 2 - PRODUCTS

2.1 GRAB BARS

- A. 1½" OD, Type 304 Stainless Steel, 18 gauge, smooth satin finish, concealed mounting type. Provide in lengths and configurations indicated on the drawings.

2.2 PAPER HOLDERS

- A. Surface mounted single roll type, Type 304 Stainless Steel, polished finish. Provide at each water closet location except those located within toilet compartments specified elsewhere.

2.3 MIRRORS

- A. Stainless steel mirror, concealed wall hangers slotted for concealed mounting with theft resistant devices. Provide type 304 stainless steel square corner channel frames with polished finish. Provide mirrors in sizes noted or indicated on the drawings.

2.4 PAPER TOWEL DISPENSER

- A. Surface mounted, stainless steel, roll-paper towel dispenser, accepts 9" standard core roll. Full-length stainless steel piano hinge, tumbler lock. Provide one per lavatory or wash fountain. Located as directed by Architect/Owner.

2.5 MISC. MATERIALS / ACCESSORIES

- A. Provide proper type anchoring devices for specific type wall construction or partition type involved for securing all items.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate as required with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this section, including proper wood backing in building partitions.
- B. Install each item in its proper location, firmly anchored into position, level and plumb, and in accordance with manufacturer's recommendations and proper installation templates.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 102813

104416 FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
 - 1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type 20A: 120B: C, UL-rated 20 pound nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated red baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 46 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 104416

125500 CONTROL ROOM FURNITURE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Control Room Desk
 - 2. Control Room Chairs
 - 3. Control Room Bulletin Board
 - 4. Accessories – Clock and First Aid Kit

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: ASTM A 569/A 569M, Type B, unless otherwise indicated.
- C. Steel Tubing: ASTM A 513, Type B, unless otherwise indicated; thickness indicated or required by structural loads.
- D. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

2.2 CONTROL ROOM FURNITURE

- A. Floor-Mounted Desk:
 - 1. Desk Top: Formed from 0.1406-inch- thick, stainless-steel sheet; with minimum 1½ inch flanged edges.
 - a. Size: Minimum 60 inches wide by 30 inches deep.
 - 2. Pedestal: Provide 2 storage shelves with sides and shelves formed from 0.1265-inch- thick steel sheet.
 - 3. Pencil Drawer:
 - 4. Legs: Formed from 1½ inch-square by 3/16-inch- thick steel tubing welded to desk top and mounting plate for an overall desk height of not less than 30 inches.
 - 5. Mounting Plate: Formed from ¼ inch- thick steel plate punched with 1 hole for floor anchorage; provide 1 mounting plate for each leg.
 - 6. Finish: Baked enamel grey in color.
- B. Stacking Chair (two required):
 - 1. Provide powder coated tubular steel frame with seat and back of contoured UV- protected high-density polyethylene plastic, 17" seat height, meets BIFMA standards and provide with manufacturer's 5-year limited warranty.

2.3 ACCESSORIES

A. Bulletin Board

1. Furnish and install one (1) two-panel bulletin board with glass doors as shown. Bulletin board panels shall be 1/4" cork mounted on hardboard. Doors shall have 1/4" glass and shall be continuously hinged with flat key tumbler locks. Overall dimensions shall be approximately 36" high, 48" long, 3" deep. See Drawing A101 for location.

B. First Aid Kit

1. Furnish and install two (2) first aid kit with brackets for wall mounting as directed by the Engineer. The kit shall be a Type III meeting the ANSI Z308.1-2003 requirements.

C. Clock

1. Clock shall be synchronous motor type, 12" face, 120 V. 60 Hz.

2.4 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention furnishings with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form edges and corners to be free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2 inch- wide hem on the concealed side; ease edges of metal plate to a radius of approximately 1/32 inch.

1. Fabricate detention furnishings with no more than 1/32 inch gap between component materials. Weld edges that cannot be crimped to meet tolerance so as to provide a seamless joint with no places for concealment of contraband.

E. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- F. Weld corners and seams continuously to comply with referenced AWS standard and the following:
 - 1. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
- H. Cut, reinforce, drill, and tap metal fabrications to receive hardware, security fasteners, and similar items.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.
- K. Attach drawer slides and shelves to furniture with security fasteners.

2.5 FINISHES

- A. Steel Finish: Baked-enamel finish with minimum dry film thickness of 1.2 mils.
- B. Stainless-Steel Finish: Intermediate Polish Finish, No. 3, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention furnishing connections before detention furnishing installation.
- B. Inspect built-in and cast-in anchor installations before installing detention furnishings to verify that anchor installations comply with requirements. Prepare inspection reports.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention furnishings to in-place construction. Include threaded fasteners for [concrete] [and] [masonry] inserts, security fasteners, and other connectors.

- D. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention furnishings. Set detention furnishings accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry or similar construction.
- F. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- G. Field Welding: Comply with the following requirements:
 - 1. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - 2. Fillet Welds: Minimum size of $\frac{1}{8}$ inch by $1\frac{1}{2}$ inches long spaced not greater than 12 inches o. c.
- H. Adjust doors and latches of detention lockers and cabinets to operate easily without binding. Verify that integral locking devices operate properly.
- I. Assemble detention furniture that requires field assembly with security fasteners, with no exposed fasteners on exposed faces and frames.
- J. Anchor furnishings [with security fasteners] [by welding] [as indicated on Drawings] to floors and walls at intervals required by expected loads, but not more than 12 inches o.c.
 - 1. Install anchors through backup reinforcing plates where necessary to avoid metal distortion.
 - 2. Use security fasteners with head styles appropriate for installation requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.
 - 3. Weld nuts onto cast-in-place anchors after installation so as to be nonremovable.
- K. Furnish and install one detention mattress for each detention bunk.
- L. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 125500

412200 OVERHEAD CRANES, HOISTS, AND TROLLEYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. 5 Ton overhead under hung bridge crane with electric motorized end trucks, electric motorized chain hoist/trolley, chain and hook, bridge and hoist controller, electrical panels, and accessories in the Well Room in the Well House Building.
- B. 2 Ton overhead under hung bridge crane with electric motorized end trucks, electric motorized chain hoist/trolley, chain and hook, bridge and hoist controller, electrical panels, and accessories in the Well Room in the Well House Building.
- C. 2 Ton, under hung bridge crane with electric motorized end trucks, electric motorized wire rope (cable) hoist/trolley, stainless steel cable and hook, bridge and hoist controller, electrical panels, and accessories in Existing Pump Station Building. The crane, trolley and hoist equipment in the Existing Pump Station Building shall be an explosion-proof and spark resistant system meeting the Class I, Division II, Group D criteria for atmosphere that have the potential of containing gasoline.
- D. Two (2) ½ Ton Hand Chain Hoists with Push Trolleys on the monorails in the Electrical Control Room in the Well House Building.

1.2 RELATED SECTIONS

- A. Division 16 - Electrical.

1.3 REFERENCES

- A. Equipment shall meet the requirements of the following specifications unless more stringent requirements are otherwise specified:
1. ANSI B30.2.0 – Safety Standard for Overhead and Gantry Cranes.
 2. ANSI B30.11 – Safety Standard for Underhung Cranes and Monorail Systems.
 3. ANSI B30.16 – Safety Standard for Overhead Hoists.
 4. ANSI B30.17 – Safety Standards for Overhead and Gantry Cranes
 5. ANSI MH27.1 – Specifications for Underhung Cranes and Monorail Systems.
 6. HMI 100 – Standard Specifications for Electric Wire Rope Hoists.
 7. HMI 200 – Standard Specifications for Hand-Operated Chain Hoist.
 8. HMI 400 – Standard Specification for Electric Chain Hoists.
 9. CMAA No.70 – Specifications for Electric Overhead Traveling Cranes.
 10. CMAA No.74 – Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes
 11. NEC – National Electric Code
 12. NEMA – National Electrical Manufacturers Association.
 13. AWS D1.1 – Code for Welding in Building Construction.

1.4 OVERHEAD CRANE SYSTEM DESCRIPTION

- A. Overhead underhung crane systems shall consist of an underhung, single girder, floor control, overhead crane designed for capacities shown on the drawings. Crane and hoist shall be suitable for infrequent service at full loading during regular annual pump servicing.
- B. Classification: ASME H4 and ISO M4.
- C. Center to center of rail and lift (travel) are as indicated on the drawings.

- D. The underhung bridge crane with electric motorized end trucks, electric motorized cable hoist/trolley, stainless steel cable and hook, bridge and hoist controller, electrical panels, and accessories in Existing Pump Station Building shall be an explosion-proof and spark resistant system meeting the Class I, Division II, Group D criteria for atmosphere that have the potential of containing gasoline.
- E. Minimum and maximum hook heights and approach distances shall be as indicated on drawings.
- F. Install runways and rails to frame structure to meet manufacturer's tolerance specifications.
- G. Provide stops at each end of runway with limit switches to terminate operation upon reaching stop.
- H. Motor-driven, under hung, single girder bridge. The bridge travel speed shall be approximately 80 and 40 feet per minute. The bridge shall be motorized. The electrical controls for the bridge shall be included in the control devices.
- I. Underhung single girder crane bridge - The bridge girder travel shall be electrically controlled by a pushbutton pendent control positioned for operation at Floor Elev. 421. Wheel stops shall be positioned at each end of bridge girder.
- J. Motorized hoists and motorized trolley shall be operated by the crane bridge pushbutton pendent control positioned for operation at Floor Elev. 421. The pendent shall have the standard 4-button (momentary contacts) with a red emergency on/off (maintained contacts).
- K. Chain Hoist shall have a lifting speed of approximately 11 feet per minute for 5 ton chain hoists and 14 feet per minute for 2 ton chain hoist. A steel chain container shall store full chain length. An appropriate reel shall be provided for pendant.
- L. Cable Hoist shall a lifting speed of approximately 16 feet per minute.
- M. Hoist trolley travel speed shall be approximately 40 feet per minute.
- N. Configure hoist perpendicular to beam.
- O. Electrical supply to the electric crane motor shall be by a 4 conductor figure 8 feedrail and collector system. The feedrails shall be protected by ultraviolet resistant PVC cover, supported by hangers on standoff insulators.
- P. An electric cord reel or festooned tagline shall be supplied to adequately provide power to both hoist and trolley motors. The cord reel shall allow movement of the trolley along the full length of bridge girder and runway rails as shown on Drawings.

- Q. Although only the principal items are described herein, it is understood that all items necessary for safe and efficient operation shall be supplied, so that bridge crane/hoist/trolley system shall be complete in all respects and ready for operation.
- R. The Contractor shall furnish all labor, equipment, materials and services required to install the required overhead cranes (including bridges, end trucks, trolleys, hoists and all required accessories), as shown and as specified. Work shall be complete in all respects and ready for operation. Although only the principal items are described herein, it is understood that all parts necessary for safe and efficient operation shall be supplied. This shall include all necessary safety devices, stops, brakes and complete electrical hookup, and all additional structural supports necessary to make the system complete and ready for safe operation.

1.5 HAND CHAIN HOIST AND PUSH TOLLEY

- A. Capacities of hand chain hoists with push trolley are shown on the drawings.
- B. Hoists shall have lift (travel) as shown on drawings.
- C. Chain rigged for operation from the Floor Elev. 421.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate as a minimum, plans, elevations, anchor bolt size and layout, and sectional views fully dimensioned to indicate actual clearance along with other pertinent data.
- B. Panel Layout and Schematic Wiring Diagrams: Provide complete wiring diagrams indicating all electrical devices, numbered terminal strips and wiring and complete description of control system.
- C. Catalog data and information shall be submitted for each unit.

1.7 QUALITY ASSURANCE

- A. All equipment shall be from one manufacturer or supplier.
- B. All materials shall be new and of first class materials and construction.
- C. All equipment, including trolleys, hoists, switches and electrification devices, shall be installed by a manufacturer approved installer to ensure system completeness, operational integrity and safety.
- D. Hoist manufacturer shall coordinate hoist system requirements with hoist beam supplier and shall verify compatibility and suitability of hoist beams where indicated on Drawings.

- E. Provide a written certification that the equipment has been installed in accordance with the requirements under this Section.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of these Special Provisions.
- B. Maintenance Data: Include a parts catalog with complete list of equipment replacement parts and local distributors.
- C. Operation Manuals: Include description of system's method of operation and control, including motor control system and special or non-standard features provided.
- D. Maintenance Manuals: Include instructions for lubrication, adjustment and care of equipment, including detailed technical descriptions of operation, adjustment, and settings of electrical circuits and mechanical equipment.
- E. Provide legible schematic wiring diagrams covering electrical equipment as supplied and installed, including changes made in final work, with symbols listed corresponding to identity or markings on equipment.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified with minimum ten years documented experience. The suppliers of equipment under this Section shall be members of the Crane Manufacturer's Association of America, Inc.
- B. Installer: Company specializing in performing the work of this section and approved by equipment manufacturer.

1.10 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.11 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Harrington Hoists and Cranes
- B. ACCO/Louden/Wright.
- C. R&M Materials Handling Inc.
- D. Saturn.
- E. North American Industries, Inc.

2.2 GENERAL

- A. Service Classifications: All equipment shall be designed for minimum Class C (Moderate Service) as specified in ANSI MH27.1, and outdoor operation in ambient temperatures (-15 degrees to 40 degrees C). Equipment shall be suitable for outdoor storage and usage under varied atmospheric conditions.
- B. Classification: ASME H4 and ISO M4
- C. The maximum allowable stresses in materials used for various parts of the equipment are specified herein. However, manufacturer shall be responsible for an adequate design based on factors proven in practice and shall use lower working stresses wherever he deems necessary or desirable.
- D. Adequate factors of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact, or shock. Under the most severe conditions of static or dynamic loading expected in normal operation, stresses in the materials shall not exceed the values specified below. Maximum shear stresses in ferrous materials shall not exceed 60% of the allowable stresses in tension, except as noted below. The design stresses for components not listed herein shall be selected by manufacturer, but the maximum stresses in tension or compression shall not exceed one-third of the yield strength nor one-fifth of the ultimate tensile strength.
- E. Structural building components as shown on the Drawings are separate from this specification. All other supports, connections, clamps, nuts, washers, etc., are part of this specification.
- F. Track end stops shall be of the welded type and shall be capable of withstanding the impact of a fully loaded crane or carrier traveling at 50% of the full load speed.
- G. All working parts shall be arranged for convenient inspection, lubrication, adjustment, repair, or replacement. The equipment shall be assembled, painted, tested, and adjusted in the shop as far as practicable before shipment.

2.3 POWER SUPPLY

- A. All electric power supply equipment shall be suitable for 480-volt, 3-phase, 60-hertz electric service. All hoisting equipment shall be provided with suitable junction boxes for connection of field services and complete with a ground pad. Connections shall be located as shown.

2.4 MOTORIZED TROLLEY

- A. Trolley wheels shall be designed to operate on the bottom flange of the crane girder, wheels shall be tapered, hardened treads, designed to carry the maximum wheel load under normal conditions without undue wear, with diameter no less than is shown in Table 4.1 of Hoist Manufacturers Institute - Standard Specifications HMI-100-74 for contour wheels with treads no less than 25 mm (1-inch) wide. Wheels shall be machined to match diameters with treads to match the rolling surface of the lower flange of the hoist beam.
- B. Wheel bearings shall be double row precision ball bearings, provided with fittings and seals for pressure lubrication.
 - 1. Bearings shall be selected to provide a minimum B10 life of 5,000 hours.
- C. The electrical controls for the trolley shall be included in the push-button operation for the hoist.
- D. Routine inspection of gear train shall require no disassembly of major components.

2.5 ELECTRIC HOIST

- A. Certified and listed to UL 1340
- B. Electric hoist controls shall comply with N.E.C. requirements for the application being considered and shall include control fusing and contacts mechanically and electrically interlocked.
- C. Hoist and appurtenances shall be designed to withstand all stresses imposed under safe operating conditions while handling loads within the rated capacity.
- D. Load bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20% of the ultimate strength of the material.
- E. Furnish suitable push-button pendant control. Push-button arrangement to be supplied with strain relief protection.
- F. Hooks shall be supported by anti-friction thrust bearings and permit 360° rotation. Provide latch to bridge opening of the hook.

- G. Hoists shall be equipped with overload limit device to limit loads to rated capacity.
- H. Provide an upper limit switch which will automatically stop the hoist motion when the block reaches its highest position.
- I. The braking system shall be capable under normal operating conditions with rated load to stop and hold the load when controls are released. Two brakes shall be provided; Mechanical load brake and electrical motor brake.
- J. Controlled lowering shall be limited to 120% of rated lowering speed. In the event of complete power failure, the load shall be stopped and held.
- K. All bearings shall be heavy duty, anti-friction type with a minimum B10 life of 5,000 hours.
- L. All gearing shall be forged heat treated alloy steel machined for smooth quiet operation. All gearing shall meet AGMA quality specifications. No cast gears shall be permitted.
- M. Chain Hoists shall have chains that are Grade 80, super strength, nickelplated load chain, certified to DIN standards, resistance to fatigue and wear.
- N. A notched hook and latch system shall provide positive closing and resistance against lateral forces.

2.6 ELECTRICAL EQUIPMENT

- A. All electrical equipment and wiring shall comply with the requirements of PUMP STATION ELECTRICAL WORK of the Special Provisions.
- B. Power supply shall be 480V, 3 phase, 60 Hz. All electrical interconnections for the monorail system shall be provided by the manufacturer.
- C. Motor voltage shall be 460V, 3 phase, 60 Hz. Controls, lights and heaters shall be operated on 120V, single phase, 60 Hz, derived from the control power transformer in motor starters. Push-button control voltage shall not exceed 120V.
- D. Motors shall be fully enclosed non-ventilated, 60- minute duty, Class F insulation, 85oC temperature rise over 50oC ambient, 1.15 service factor, NEMA hoist-duty. Motors shall be wound-rotor type except those rated less than 7.5 KW (10 HP) and no more than two speeds may be of either wound-rotor type or squirrel-cage type. Each motor shall be braced and insulated to withstand plugging service and heavy shocks and vibrations transmitted to it by the driven machinery. Motor bearings shall be anti-friction type, grease-lubricated with provision for applying and draining grease and for preventing overgreasing. Motor bearings shall have AFBMA B10 life of not less than 10,000 hours.

- E. DC magnet-actuated disc brake shall be provided for rapid stopping of the motor with minimum or zero hook drift.
- F. Motor starters shall be combination circuit breaker, full voltage, reversing, magnetic, NEMA Size 1 minimum, with thermal overload on each phase, fused control power transformers, NEMA 4 enclosure. The starter coil voltage shall not exceed 120V.
- G. All floor-operated functions shall be executed through a common pendent pushbutton station. The pushbutton station shall be heavy duty, oil-tight, with heavy-duty, multi-conductor cable supported mechanically in a satisfactory manner to protect the electrical conductor against strain. The pushbutton station shall be constructed to prevent electrical shock and clearly marked for identification of functions.
- H. Hoist-driven rotating cam or traveling nut type limit switches shall be provided for the upper and lower hook positions, and a block-operated backup over travel limit switch which directly interrupts power to the hoist motor shall be provided for the extreme upper position. Lever-operated end-of-travel limit switches shall be provided for motorized bridge and trolley. All limit switches shall be actuated in one direction only, automatically reset, mounted in NEMA 4 enclosures.

2.7 EXPLOSION-PROOF AND SPARK RESISTANT SYSTEM.

- A. All components of the under hung bridge crane with electric motorized end trucks, electric motorized cable hoist/trolley in the Existing Pump Station Building have be rated at an explosion -proof and spark resistant system with Class I, Division II, Group D criteria.
- B. Electric Hoist shall have a stainless steel cable and hooks.
- C. Control Enclosures, Limit Switch Enclosures and PB Station Enclosure shall be NEMA Type 7.
- D. Trolley and end trucks shall bronze or stainless steel wheels.

2.8 HAND CHAIN HOIST AND PUSH TOLLEY

- A. Hoist shall have top hook suspension from a push trolley.
- B. Hoist shall have a standard slip clutch device to prevent the hoist from being used to lift damaging loads beyond rated capacity.
- C. Hoist shall have reliable braking with double enclosed brake cover that keeps out dust, rain, and dirt. Hoist shall have double pawl springs to provide redundancy for reliable operation of brake mechanism.
- D. The hoist shall be all steel construction with rugged gear case enclosure and handwheel cover.

- E. The chain shall be Grade 100 heat-treated manganese alloy that resists abrasion and wear while minimizing chain weight.
- F. The hook shall be forged and heat-treated alloy steel designed to open slowly, without fracturing under excessive loads.
- G. Provide test certificate that verifies hoist has been factory load tested to 125% of rated capacity, in accordance with ASME B30.16 requirements.

2.9 FINISHES

- A. All material shall be cleaned of loose rust, mill scale and foreign matter.
- B. Equipment shall be painted with the manufacturer's standard finish, suitable for weather exposure.
- C. Equipment must be adequately protected against damage and rust in shipment

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify location and layout of anchor bolts.
- B. Verify that electrical power is available and of correct characteristics.

3.2 INSTALLATION

- A. Install system and components in accordance with ANSI B30.11
- B. The bridge crane system installer shall provide all labor and perform all work to install and make operable all mechanical and electrical equipment necessary to assure safe and reliable operation.
- C. Structural members shall not be cut, drilled or otherwise altered without permission of the Engineer.
- D. Structural supports as shown on the Drawings are separate from this specification. All other supports, connections, clamps, nuts, washers, etc., are part of this specification.

3.3 TEST BY REGULATORY AGENCIES

- A. Perform tests required by ANSI B30.11 and ANSI B30.2.0 in the presence of the Engineer and DEPARTMENT. Each hoist shall be tested through a complete lift and lowering cycle and through complete trolley travel along beam to determine that the equipment will perform the function of hoisting, braking and traveling quietly and smoothly. The hoisting capacity shall be tested as near actual anticipated loads as possible with available loading facilities such as material or equipment which is readily available within area served. Defects in the equipment indicated by tests shall be promptly corrected.
- B. Schedule tests with two week notice.
- C. Remove protective coverings from protected surfaces.
- D. Clean surfaces and components ready for inspection.

The application of this Section will proceed per the PUMP STATION GENERAL WORK special provision, which is amongst the accompanying special provisions.

End Section 412200

Schedule of Values:

- 1.1 A Schedule of Values shall be submitted as payment basis for PUMP STATION GENERAL WORK.
- 1.2 The Contractor shall submit a Schedule of Values, as specified herein, at the Pre-Construction Meeting and shall provide information as requested to substantiate the prices included in the Schedule of Values.
- 1.3 The Schedule of Values must be approved by the Engineer and District 8, Bureau Electrical Operations, prior to any project payments.

1.4 Complete Schedule of Values

- (a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.
- (b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.
- (c) The Schedule of Values shall have each item further itemized by Specification Division as listed in the Specification index.
- (d) For the item Pump Station General Work, each item which has an installed value of over \$10,000, a list of the costs for the major products or operations shall be indicated under each item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

Method of Measurement: Pump Station General Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract lump sum price for PUMP STATION GENERAL WORK.

PUMP STATION MECHANICAL WORK

Description:

This work shall include furnishing, installing, constructing, and all other necessary work for the mechanical systems inside the new Well House Building and the Existing Pump Station building as shown in the plans and specified herein.

The Pump Station Mechanical Work shall include, but not be limited to, the following:

1. **Maintenance of existing conditions** as shown in the plans and as described in Sections 020100 of this Special Provision.
2. **Common work for plumbing** as shown in the plans and as described in Sections 220500 and 220553 of this Special Provision.
3. **Valves** and related items as shown in the plans and as described in Section 220523 of this Special Provision.
4. **Hangers, supports**, fasteners, and related items as shown in the plans and as described in Section 220529 of this Special Provision.

5. **Plumbing insulation** as shown in the plans and as described in Section 220700 of this Special Provision.
6. **Plumbing piping** and fittings as shown in the plans and as described in Section 221000 of this Special Provision.
7. **Sanitary sewer**, vent piping, and related accessories as shown in the plans and as described in Section 221316 of this Special Provision.
8. **Domestic water heaters** as shown in the plans and as described in Section 223300 of this Special Provision.
9. **Emergency Shower water heaters** as shown in the plans and as described in Section 223301 of this Special Provision.
10. **Plumbing fixtures** including faucets, flushometers, toilet seats, fixture supports, water closets, urinals, lavatories and related accessories as shown in the plans and as described in Section 224000 of this Special Provision.
11. **Common work for HVAC** as shown in the plans and as described in Sections 230500 and 230553 of this Special Provision.
12. **Vibration and seismic controls for HVAC** piping and equipment including isolation pads, isolation and spring mounts, hangers, supports, guides, and related items as shown in the plans and as described in Section 230548 of this Special Provision.
13. **HVAC insulation** as shown in the plans and as described in Section 230700 of this Special Provision.
14. **Metal ducts**, sheet metal, and related items as shown in the plans and as described in Section 233113 of this Special Provision.
15. **Air duct accessories** as shown in the plans and as described in Section 233300 of this Special Provision.
16. **Extruded aluminum combination louver/dampers** as shown in the plans and as described in Section 233310 of this Special Provision.
17. **HVAC power ventilators**, fans, and related items as shown in the plans and as described in Section 233423 of this Special Provision.
18. **Diffusers, registers, grills**, and accessories as shown in the plans and as described in Section 233713 of this Special Provision.
19. **Air to air heat pump systems** and accessories as shown in the plans and as described in Section 238126 of this Special Provision.

20. **Liquid filled electric baseboard radiators** and accessories as shown in the plans and as described in Section 238233 of this Special Provision.
21. **Unit heaters** and accessories as shown in the plans and as described in Section 238239 of this Special Provision.
22. **Submersible, non-clogging pump** with appurtenances as shown in the plans and as described in Section 332005 of this Special Provision.
23. **Vertical turbine solids handling pumps** with appurtenances as shown in the plans and as described in Section 332006 of this Special Provision.
24. **Submersible vertical well pumps** and motor replacement, including removal of the existing pumps from existing wells, motor replacement, and related work as shown in the plans and as described in Section 332010 of this Special Provision.
25. **Storm and groundwater pump seal system** to provide lubrication water to the pumps as shown in the plans and as described in Section 334500 of this Special Provision.
26. **Small collector well pumps** with appurtenances as shown in the plans and as described in Section 334510 of this Special Provision.
27. **Large collector well pumps** with appurtenances as shown in the plans and as described in Section 334520 of this Special Provision.
28. **Collector pump station process piping**, fittings, valves, and related accessories as shown in the plans and as described in Section 402300 of this Special Provision.
29. **Variable area flowmeter** and related accessories to regulate seal water flow as shown in the plans and as described in Section 409200 of this Special Provision.

OPERATION AND MAINTENANCE DATA

1.1 Operation and Maintenance Data

- 1.1.1 Five copies of an Operation and Maintenance Data shall be furnished to the ENGINEER for all equipment and associated control systems furnished and installed.
- 1.1.2 Prior to the Work Reaching 75 Percent Completion, two copies of the data shall be submitted to the ENGINEER for approval with all specified material. The approval copies shall be submitted with the partial payment request for the specified completion. Submit final revised 3 copies within 14 days after field testing and start up of the pump station. Space shall be provided in the manual for additional material. Any missing material for the manual shall be submitted prior to requesting certification of substantial completion.

- 1.1.3 Each copy of the data shall consist of the following and shall be prepared and arranged as follows:
- (a) A section of an equipment data summary (see sample form at page 1A-19) for each item of equipment.
 - (b) A section of an equipment preventive maintenance data summary (see sample form at page 1A-20) for each item of equipment. A 5 year maintenance schedule for all installed equipment shall also contain in the manual.
 - (c) A section of the equipment manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.
 - (d) List of electrical relay settings and control and alarm contact settings.
 - (e) Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.
 - (f) One valve schedule giving valve number, location, fluid, and fluid destination for each valve installed. All valves in same piping systems shall be grouped together in the schedule. A sample of the valve numbering system shall be obtained from the ENGINEER.
 - (g) 5 year maintenance schedule for all equipment furnished and installed.
 - (h) The record of the initial performance of the equipment from the Field Testing.
 - (i) All O&M Data material shall be on 8-1/2 inch by 11 inch commercially printed or typed forms or an acceptable alternative format.

- 1.1.4 Each data shall be organized into sections paralleling the equipment specifications. Each section shall be identified using heavy section dividers with reinforced holes and numbered plastic index tabs. The data shall be compiled in high-quality heavy-weight, hard cover binders with piano-style metal hinges or in an alternate approved format. Large drawings and other materials which would be opened or removed for reading shall be provided with heavy clear plastic pouches within the binders. The number of binders shall be as required to hold all required material without over-filling. Various sections, as appropriate shall have suitable dividers. All volumes shall be labeled. All loose data shall be punched for binding. Composition and printing shall be arranged so that punching does not obliterate any data. The project title, and manual title, as furnished and approved by the ENGINEER shall be printed on the cover and binding edge of each manual.
- 1.1.5 All operating and maintenance material that comes bound by the equipment manufacturer shall be left in its original bound STATE. The appropriate sections of the CONTRACTOR's O&M data shall be cross-referenced to the manufacturers' bound manuals.

1.1.6 O & M Equipment Data Summary and Preventive Maintenance Summary shall be as follows:

STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS	
MISSOURI AVENUE PUMP STATION	
Operation and Maintenance Data	
<u>Equipment Data Summary</u>	
Equipment Name:	_____
Specification Reference:	_____
Manufacturer	
Name:	_____
Address:	_____
Telephone:	_____
Number Supplied:	_____
Location/Service:	_____
Model No:	_____
Serial No:	_____
Type:	_____
Size/Speed/Capacity/Range (as applicable):	
Power Requirement (Phase/Volts/Hertz):	
Local Representative	
Name:	_____
Address:	_____
Telephone:	_____
NOTES:	

STATE OF ILLINOIS DEPARTMENT
OF TRANSPORTATION
DIVISION OF HIGHWAYS

MISSOURI AVENUE PUMP STATION

Operation and Maintenance Data

Preventive Maintenance Summary

Equipment Name: _____
Location / Service: _____
O&M Data Reference: _____

Manufacturer
Name: _____
Address: _____
Telephone: _____

Number Supplied: _____
Model No: _____
Serial No: _____
Type: _____

Maintenance Task Lubricant/Part * D W M Q SA A

NOTES:

** D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual*

- 1.1.7 Binders shall be labeled Volume 1, 2, and so on, where more than one binder is required. The table of contents for the entire set, identified by volume number, shall be included in each binder.

020100 MAINTENANCE OF EXISTING CONDITIONS

1.1 Pump Station Maintenance During Construction

- 1.1.1 From the first day the Contractor begins work at the site until the day of final acceptance by the Engineer, the Contractor shall be fully responsible for maintenance of the existing pump station in a manner such that the roadways served by the pump station are adequately protected from flooding by storm water and ground water during construction. The Contractor shall also be responsible for the security of pump station during construction. Maintenance of pump station shall be as directed by DEPARTMENT staff. DEPARTMENT will provide a designated staff to coordinate maintenance of pump station during construction.

- 1.1.2 Prior to the starting of work, the Contractor shall notify the Engineer and arrange for a pre-construction inspection. At the pre-construction inspection, the facility and its equipment shall be examined and defective or missing items shall be repaired by the District 8 Electrical Operations or shall otherwise be noted. A record of inspection shall be furnished to the Engineer.

1.1.3 Emergency Service Requirements:

The Contractor shall be responsible for providing 24-hour, 7 days a week emergency response to pumping station alarms. Upon notification of a pump station alarm, the Contractor shall dispatch emergency service personnel to the station immediately and shall arrive at the station within 45 minutes of the receipt of the alarm. All necessary emergency repairs required to restore the pump station to its normal operating condition shall be done by the Contractor immediately. Emergency service personnel shall remain at the station to monitor the situation until the alarm(s) are cleared or otherwise notified by the DEPARTMENT engineer.

- (a) Failure to respond or meet the emergency service requirements of a pumping station alarm, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the DEPARTMENT to perform the necessary alarm response.

1.1.4 Routine Monthly Maintenance Requirements:

Ongoing maintenance activities are required to maintain the existing pumping station for proper roadway and groundwater drainage. Routine maintenance inspections of all equipment (existing or new installation) shall be conducted by the Contractor.

- (a) Failure to meet the routine maintenance requirements of the pumping station, the Contractor shall be liable to the Department in the amount paid to other subcontractors hired by the DEPARTMENT to perform the necessary routing maintenance.

1.1.5 All routine monthly maintenance requirements listed below and within apply to the existing pumping station and all new facilities installed under this contract and specified herein.

GENERATOR

Check the following items:

- () Check Fuel in Generator Tank
- () Check Alarm Indicator Lights
- () Check Engine oil level/antifreeze
- () Check engine block heater operation
- () Check transfer switch
- () Check heater/ventilation operation
- () Equalize charge D.C. control system batteries
- () Check Battery levels
- () Load Test generator

PUMPS, MOTORS, & STARTERS

Check the following items:

- () Pump operation
- () Pump Vibration
- () Discharge Leakage

GENERAL ITEMS

Check the following items:

- () Check and Clean Trash Rack if Needed

1.1.6 Should it become necessary to perform maintenance work beyond the scope of the Contract, the Contractor shall be reimbursed the exact amount of the pay cost. Extra work shall be paid as outlined in the Standard Specifications for Road and Bridge Construction.

1.1.7 Basis of Payment. This work shall be paid as part of the Contract lump sum price for PUMP STATION MECHANICAL WORK, which shall be payment in full for the work described herein.

1.2 Continuous Operation

- 1.2.1 The existing pump station facility shall remain in continuous operation during construction. Brief shut-down periods may be permitted to facilitate construction needs when approved by the Engineer. The Contractor shall submit, to the Engineer, all requests for a brief shut-down indicating detailed written description of all particulars such as date, time of day, length of shutdown and all related details. The work required to meet this requirement shall be included at no additional cost. Removal of any pump station equipment and well shut down require at least 48 hours advance notice and approval. Deep wells can only be turned off for a maximum of 12 hours daily. Operation of pump station and deep well shut down shall be as directed by DEPARTMENT staff. DEPARTMENT will provide a designated staff to coordinate operation of pump station. Impending storm or forecast may result in the Engineer denying or rescheduling request for shut down, even if prior approval was given.
- 1.2.2 Continuous operating integrity shall require coordination of construction activities. Prior to starting work, the Contractor shall submit a detailed sequenced plan of work, for review and approval by the Engineer. Every Monday morning the Contractor must meet with the Resident Engineer at the site, to review the work for the week and coordinate the Contractor's work.
- 1.2.3 Continuous operation may require that some of the existing electrical equipment be disconnected, relocated and reconnected as temporary systems.
- 1.2.4 Continuous operation will require that new pumps and piping be installed sequentially. Only one pump may be removed from service at a time. Once a pump is removed the Contractor must continue to work on installation to the completion of new pump and operational.

1.3 Protection and security of Pump Station and Drainage Facilities During Construction

- 1.3.1 Unless otherwise noted in the Contract Drawings, the existing pump station and drainage facilities shall remain in use during the period of rehabilitation.
- 1.3.2 Locations of existing pump station and drainage structures and sewers as indicated on the Contract Drawings are approximate. Prior to commencing work, the Contractor, at his own expense, shall determine the exact location of the existing structures which are within the proposed construction site.

- 1.3.3 All pump station and drainage structures are to be kept free from any debris resulting from construction operations. All work and material necessary to prevent accumulation of debris in the pump station drainage structures will be considered as incidental to the Contract. Any accumulation of debris in the drainage structure resulting from construction operations shall be removed at the Contractor's expense and no extra compensation will be allowed.
- 1.3.4 Contractor is responsible for security of pump station during construction. DEPARTMENT will not patrol construction fence area. Anything inside temporary construction fence is Contractor's responsibility. DEPARTMENT authorized personnel will have access to the pump station at any times. Contractor shall provide extra keys for DEPARTMENT personnel (3 or 4). All entrances, roof hatches, etc. at the pump station must be secured at the end of the day.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 020100

220500 COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Sleeves.
 5. Escutcheons.
 6. Grout.
 7. Plumbing demolition.
 8. Equipment installation requirements common to equipment sections.
 9. Supports and anchorages.

1.2 SUBMITTALS

- A. Shop Drawings – Prior to purchase, submit for Engineer/Architect's review complete shop drawings for the following:
 1. Plumbing fixtures and specialties.
- B. Welding Certificates.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

- A. Standards: Any procedure, material or operation specified by reference to applicable standards or codes shall comply with the current or most recent edition. In conflicts between listed standards, the more stringent shall govern.
 - 1. Applicable Standards:
 - a. Illinois State Plumbing Code, latest edition
 - b. Local plumbing code
 - c. National Fuel Gas Code, latest edition
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. Materials must be new, in first class condition. Work must be done by trained, experienced, skilled journeyman (woman) under an approved full time supervisor, with every possible precaution taken by contractor to assure safety of all persons of all categories.

1.5 GUARANTEE

- A. Each entire overall installation, including every special item, device, and part and every specialized system shall be fully guaranteed from standpoint of satisfactory performance, safety, workmanship and material for one year after formal written acceptance by Engineer/Architect, any unsuitable, unsatisfactory, noisy, ineffective, defective, improperly sized or applied equipment or material, or unacceptable workmanship shall be quickly replaced or modified during guarantee period or any extension thereof, as directed and as approved by Engineer/Architect in writing.
- B. Individual items and systems shall be guaranteed for the same period in addition to the above regardless of any limitations of manufacturer's guarantee period.

PART 2 – PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

- E. PVC Pipe: ASTM D 1785, Schedule 40.
- F. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Quantities Required and Clarifications:
1. Contractor shall determine quantities required from drawings and job conditions except that where specifications call for specific quantities, these quantities shall also govern. If there is conflict between quantities called for on drawings and in specifications, greater quantity shall govern.
 2. Where an item is specified by a manufacturer's number, such number is for general information only, and shall be modified by any additional data, size, etc., which may be shown and/or specified. Where there is conflict between number and other data, it shall be contractor's responsibility to request clarification from Engineer/Architect.
 3. Where clarification is required for any purpose, including discrepancies within written specifications on drawings, or between them, it shall be contractor's responsibility to request such clarification from Engineer/Architect at least 7 days before Bids are due and in all cases subsequent interpretations or clarifications made by Engineer/Architect shall be final.
- B. Identification:
1. Every piece of equipment, disconnect, etc. which does not have an identifying name plate shall be stenciled to identify its use, by means of the abbreviations used in these specifications. Stencil shall be painted in approved colors, with letters at least ¼" high. Stencil shall be located as approved by the Engineer/Architect. At contractor's option, tags may be riveted or screwed to equipment, in place of stencils.
- C. Cleaning:
1. Piping, conduit, equipment, devices, etc. shall be thoroughly cleaned before being offered for acceptance.
 2. The following shall be thoroughly cleaned, or finished out, or blown out before installation is offered for acceptance.
 - a. Plumbing equipment, fixtures, devices, etc.
 3. Labels, stickers, temporary protection, etc. shall be removed and work shall be provided contractor without increase in contract price.
- D. Verification of Points of Connection:
1. Before submitting his bid, contractor shall visit site to verify all exposed, concealed, and buried points of connection as to locations, flow, size, type, depth, pressure, elevation, operating characteristics, etc., including but not limited to the following:
 - a. Water service and shut-offs.
 - b. Sanitary sewer connections.
 - c. Storm sewer connections.

2. If contractor finds that any present point or points of connection to existing facilities are incorrectly shown on plans or incorrectly specified, he (she) shall notify Engineer/Architect in writing at least 7 days before bids are due to be submitted. Engineer/Architect will issue as addendum to all contractors, calling their attention to revised point or points of connection.
3. If contractor fails to notify Engineer/Architect in writing as outlined above, it will be assumed that his bid includes everything required to provide proper connections to all present points of connections as they actually exist and will pay for all relocations, replacements, additional runs and extensions, without increase in contract price.

3.2 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- B. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- C. Install equipment to allow right of way for piping installed at required slope.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.10 EXCAVATION AND BACKFILLING

- A. Depth of bury of cover over exterior underground construction shall not be less than the following, unless otherwise noted or required.
 - 1. Sewers: 4'-0".
 - 2. Water pipes : 4'-0" .
- B. Contractor shall do excavation required to install his (her) work, including pockets as required for fittings, etc., and after same are in place and tested and approved, he (she) shall replace drives, curbs and remove surplus earth and debris from the premises as directed by Architect. Backfill under concrete or asphalt and within 5'-0" of same shall be thoroughly compacted small size gravel. Sand may be used for bedding the pipe, but shall be free of debris, rock, concrete, etc. and settled with water in layers as directed by Engineer/Architect. No materials except clean sand shall be placed within 6" of any pipe, sewer, conduit, cable or metal part.

- C. Excessive excavations, excavations required to reach undisturbed soil, lower trenches, etc., shall be filled with thoroughly compacted small sized gravel to provide adequate bedding and support. Lines shall be bedded on materials at least 2" thick.
- D. No trenches shall be filled until work has been inspected and approved by Engineer/Architect.

3.11 PRESSURE TESTS

- A. Test shall be applied in Engineer/Architect's presence to all equipment, valves, devices, and piping, in groups or sections as work progresses. Unless otherwise noted, tests shall be made with water, after piping and equipment have been completely vented. Pressure shall be maintained for at least four hours without drop or visible leak. If leaks appear, they shall be repaired by replacing defective material or workmanship (peining, swaging or caulking will not be permitted), refill system with water, completely vented, and repeat test as often as necessary to show no drop in 2 hours. After tests, systems shall be completely drained. Precautions shall be taken to prevent freezing of test water and to protect or remove devices or equipment, or parts thereof, controls, gauges, thermometers, etc. which may be harmed by test pressures. Tests shall be made before painted and before covering.
- B. Piping etc., shall be tested to at least 125 psi.
- C. After pressure test, each complete system, piping and equipment shall be tested for complete drainage by opening unions, caps, plugs, faucets, or hose valves at low points. If system does not drain completely, piping shall be regraded and/or drain points added until complete drainage is demonstrated to Engineer/Architect. Systems shall be left dry in freezing weather.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 220500

220523 GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Brass ball valves.
 2. Bronze ball valves.
 3. Bronze swing check valves.
 4. Iron globe valves
 5. Iron gate valves
 6. Brass needle valves
 7. Solenoid valves

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Handlever: For quarter-turn valves NPS 6 and smaller.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.
- g. Provide with handwheel actuator

2.6 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.
- h. Provide with handwheel actuator

2.7 BRASS NEEDLE VALVES

- A. Description:
1. Body Material: ASTM B283, brass
 2. CEP Rating: 300 psig
 3. Body Design: Horizontal Flow
 4. Ends: Threaded
 5. Stem Seal: Fluorocarbon Rubber

2.8 SOLENOID VALVES

- A. Description:
1. Body Material: Brass
 2. Operating Pressure Differential: 125 psig
 3. Body Design: Horizontal Flow
 4. Ends: Threaded
 5. Seals and Discs: NBR
 6. Shading Coil: Copper
 7. Electrical rating per control drawings
 8. Standard Type 1 Watertight Enclosure or Explosion Proof Type 3 as required

PART 3 – EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball valves.
 2. Throttling Service: Ball valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.3 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 4 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 220523

220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
- D. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Welding certificates.

1.3 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.

9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.
 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.

- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Piping Hanger Spacing:

Pipe Size	Distance From Sleeve In Wall, End, Offset Or Corner to Hanger (Max.)	Hanger Spacing (Max.)
Up to 1¼"	2'-0"	8'-0"
1½, 2"	3'-0"	10'-0"
2½" & Up	3'-0"	12'-0"

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- J. Install lateral bracing with pipe hangers and supports to prevent swaying.

- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

- N. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 220529

220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- B. Pipe Label Color Schedule:
1. Seal Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Blue.
 2. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Green.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 220553

220700 PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 2. Insulating cements.
 3. Adhesives.
 4. Mastics.
 5. Sealants.
 6. Factory-applied jackets.
 7. Tapes.
 8. Securements.
 9. Corner angles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.7 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three Insert number locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Cold Water (Potable) and Seal Water (Non-Potable): Insulation shall be one of the following:
1. Flexible Elastomeric: 1/2 inch thick.
 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 220700

221000 PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Base Bid:
1. Contractor provides pipe and fittings as shown in the Drawings and described herein.

1.2 SUBMITTALS

- A. Shop Drawings: Not required for Engineer/Architect Review.
- B. Product Data: Not required for Engineer/Architect Review.

1.3 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of first quality. Manufactured products shall be Manufacturer's standard product with specified options but shall not be field or factory modified unless specified.
- B. All materials and equipment shall bear the Manufacturer's nameplate or marking with type, size, catalog numbers and ratings as appropriate.
- C. Only qualified welders shall perform welding. Welders shall be certified under the requirements of ANSI/ASME B32.1 and qualified in accord with the American Welding Society (AWS) or local union requirements. Welders shall furnish proof of qualifications.
- D. Piping to be ASTM labeled for rating specified.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Domestic Hot Water (HW), Hot Water Return (HWR), Cold Water (CW), and Non-Potable Seal Water:
 - 1. Type L, hard drawn copper tube conforming to ASTM B88 with cast or wrought copper fittings conforming to ASTM B16.18 and B16.22. Joints made from lead free solder. Piping sizes shown on the drawings are nominal pipe sizes.

PART 3 - EXECUTION

3.1 GENERAL

- A. Systems shall be installed as shown on the Drawings, and in a neat and workmanlike manner using only new materials. Lines shall be installed parallel with or at right angles to walls unless otherwise shown on Drawings.
- B. Materials and equipment shall be thoroughly cleaned and inspected, prior to installation. No cracked, broken or defective piece shall be used in the work.
- C. Connections to existing systems or equipment shall be performed to insure a minimum of disturbance.
- D. The interior surfaces of all piping and equipment shall be clean and free of all dirt, loose scale, rust, and other foreign material before installation.

- E. Pipe ends shall be reamed to remove all burrs, and pipe sections shall be cleaned inside to remove all chips and foreign material prior to making up joints. Pipe lines shall be installed with as few joints as possible and short lengths of pipe coupled together shall not be used. Pipe shall not extend into the waterway of the pipe fitting.
- F. Install dielectric unions or flanges for connections between dissimilar metals (i.e. where copper pipe and ferrous pipe are jointed together).
- G. "Street fittings" shall not be used.
- H. Prior to joining the pipe, the ends of the pipe to be jointed and the jointing material shall be clean and dry. The interior of the pipe shall be cleaned of all foreign materials as the work progresses. At the end of the work day, temporarily plug and block open end of pipe.
- I. Bending of pipe will not be permitted, only ells shall be utilized for a change in direction.
- J. Comply with ANSI/ASME B31.9 for pressure piping installations

3.2 PIPING

- A. Install piping parallel to building walls at such heights as not to obstruct portion of window, doorway, stairway or passageway.
 - 1. Where interference develops in field, offset or reroute piping as required to clear such interferences.
 - 2. Consult Drawings for location of pipe spaces, ceiling heights, door and window openings or other architectural details and report discrepancies to the Engineer/Architect, before installing piping.
- B. Pitch Piping to Drain
 - 1. Minimum pitch of 1-inch per 100 feet (except waste or drainage piping).
 - 2. Make piping equipment drainable.
 - 3. Accomplish pipe drainage using drain valves located on equipment and fixtures or separate drains.
- C. Provide backing and sleeves required in walls or floors for setting of fixtures or equipment.
- D. Where transition occurs from sweated fittings (as at connections to fixture supplies, etc.), provide rigid anchorage so that no strain will be placed upon tubing.

3.3 JOINTS

A. Threaded:

1. Cut piping carefully, ream, thread and work into place without springing.
2. Threaded joints shall be in accordance with ANSI B1.20.1. Threaded joints shall be made of Teflon or lead free pipe joint compound applied to the male thread only. Should a joint be loosened after being made up, it shall not be made up a second time unless the threads are cleaned and new compound applied.
3. All steel piping which is assembled with screwed joints shall have exposed threads thoroughly primed with a coat of lead free rust resistant paint. Paint immediately after installation. This shall apply to both piping, which is to be covered as well as uncovered.

B. Welded:

1. All welding procedures and welders must be qualified as required by Section IX of the ASME Boiler and Pressure Vessel Code (B31.9, Building and Services Piping, permits qualification to AWS D10.9).
2. Nipples or half couplings welded into the mains will not be accepted. Welded branch connections shall be used to tap mains only where the mains are at least two pipe sizes larger than the branch.
3. All openings cut into pipe for welded outlets shall be accurately made, to give matched intersections. For welded branch outlet fittings the opening shall be cut before the fittings welded.
4. Long radius type ells shall be on all bends in welded pipe lines. No field fabricated or factory segmentally fabricated fittings will be allowed.
5. Piping for hot water shall be cut short and cold sprung into place before welding or installation to compensate for expansion of lines when hot.
6. Welds on piping shall be cleaned and primed with corrosion resistant paint before insulation is applied or installation is complete.

3.4 FLANGES AND UNIONS

- A. Provide flanges and unions at all final connections to equipment, traps and elsewhere as required to make-up or disconnect piping.
 - 1. Install flanges and unions to facilitate removal of parts, equipment or fixtures for inspection and cleaning.
 - 2. Install flanges and unions so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.
- B. All flanged connections shall be in accordance with ANSI B16.5 for steel flanges and ANSI B16.1 for cast iron flanges.
- C. Bolting shall be in accordance with ASTM A307 Grade B with bolts and nuts in accordance with ANSI B18.2.1 and ANSI B18.2.2.
- D. Tighten flange bolts in sequence 180 degrees directly opposite each to equal tension.
- E. Flanges and unions shall be made of same material or compatible material as piping systems in which they are installed.

3.5 PIPING EXPANSION

- A. Install piping to allow thermal expansion and contraction without injury to piping, equipment or structure.
 - 1. Use loops or expansion joints where necessary and where shown in the Drawings.
 - 2. Provide pipe guides at loops and expansion joints as necessary and where indicated in the Drawings.

3.6 WELDED STEEL PIPING

- A. Make welds by oxy-acetylene or electric process in accordance with ANSI B31.1.
- B. Welding Rods: Use grade recommended for purpose by manufacturer; each rod stamped with manufacturer's name and identification.
- C. Line Welds: Single V-butt type.
- D. Make welds of sound weld metal, thoroughly fused into ends of pipe and to bottom of vee.
- E. Mitered ells will not be permitted.

- F. Do not weld pipe couplings in place of welding fittings for branch connections.
- G. Weld-O-Lets and Thread-O-Lets:
 - 1. Scribe and cut openings in main pipes for welded branches accurately taking care to remove plug and cuttings from main pipe.
 - 2. Full weld fillet weld for full depth of fillet, with additional beads to form well rounded connection as recommended by Weld-O-Let manufacturer. Partially filled fillets are not acceptable.
- H. Cut openings into pipe for welded connections accurately to give carefully matched intersections.
- I. Make welded fittings of same material with same pressure and temperature rating as pipe with which they are used.
- J. Make flanged connections to control valves, pump suction, and specialties with ANSI standard welding neck flanges. Other flange connections may be made with slip-on flanges provided they are seal welded on inside.

3.7 THREADED STEEL PIPING

- A. Branch connections to screwed piping may be made with Weld-O-Lets or Thread-O-Lets.
- B. Do not use pipe couplings in place of welding fittings for branch connections.

3.8 COPPER PIPING

- A. High temperature soldered joints:
 - 1. Take care to avoid annealing of pipe material.
 - 2. For pipe sizes 2-inch and larger, use a circular torch for soldering joints.
- B. Do not use solder containing lead.
 - 1. Gaps of this size shall be covered by flashing material fastened and sealed into place.

3.9 TESTING OF PIPING SYSTEMS

A. Piping System:

1. Contractor shall subject all piping and equipment to a test of 125 psi for a period of 4 hours and all leaks developed shall be repaired and the test repeated until the system is absolutely tight.
2. Disconnect all traps and devices not rated for operation at test pressures.
3. All instruments and equipment required for testing shall be furnished by the Contractor and tests shall, if so requested, be made in the presence of the Engineer/Architect.

3.10 ADJUST AND CLEAN

A. Protection of Completed Work:

1. When work is completed it shall, when it is subject to damage by ongoing construction, be protected from this damage.
2. As work is being installed, equipment and piping shall be protected from other ongoing construction or from its own construction. Exposed piping ends should not be temporarily covered; hanger shall be supplied in sufficient number to prevent warping or bending of pipe.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 221000

223300 ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Base Bid:

1. Plumbing contractor provide:
 - a. Furnish and Install electric domestic water heater as shown on plan sheets.

1.2 SUBMITTALS

- A. Provide product information for the water heater and circulating pump(s).
- B. Provide O&M manuals.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

A. General:

1. Water heater(s) shall be as specified on plan sheets.
2. Heater(s) shall be listed by Underwriters' Laboratories.
3. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod.
4. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1600°F.
5. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.
6. The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.
7. The drain valve shall be located in the front for ease of servicing.
8. Heater tank shall have a three year limited warranty.

B. Approved Manufacturers:

1. Rheem.
2. A.O. Smith.
3. Bradford White.

2.2 EXPANSION TANK

- A. Expansion tank shall be a pre-charged vertical, steel expansion tank with integral heavy duty butyl diaphragm and Polypropylene or butyl lined dome to completely isolate the water from the shell.
- B. The tank shall be approved for use with domestic potable water systems and designed for a maximum working pressure of 150 psi and maximum working temperature of 200F.

- C. The tank shall have 0.302"-32 charging valve connection (standard tire valve) to facilitate on-site charging of the tank.
- D. The tank shall be Model PT-12 as manufactured by ITT Bell & Gossett.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electric water heater and expansion tank in the configuration shown on the drawings and in accordance with the manufacturer's recommendations.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 223300

SECTION 223301 ELECTRIC EMERGENCY SHOWER WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Base Bid:
 - 1. Plumbing contractor provide:
 - a. Furnish and Install electric emergency shower water heater as shown on plan sheets.

1.2 SUBMITTALS

- A. Provide product information for the water heater.
- B. Provide O&M manuals.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

- A. General:
 - 1. Water heater(s) shall be as specified on plan sheets.
 - 2. Heater(s) shall be listed by Underwriters' Laboratories.
 - 3. Heater(s) shall have 150 psi working pressure.

4. Heating chamber shall be all sil-brazed copper and bronze construction.
5. Enclosure shall be NEMA 4 rated and suitable for wet/outdoor applications.
6. Electric heating elements shall be high quality incoloy sheathed and sized to obtain the rated capacity. Each element is to be operated using zero cross over solid state controls. The heating elements shall be fully modulated from 0-100% to provide precise temperature control through the full range of flows. A hi-limit thermostat with automatic reset shall be factory installed to disconnect each heating element in the event of an over-temperature condition. An electronic digital display temperature controller shall be user adjustable in 1°F increments and shall display flow rate, outlet temperature, inlet temperature and provide error indication.
7. Warranty: All electrical components (3) year from date of substantial completion. Heating chamber (5) years from date of substantial completion.

B. Approved Manufacturers:

1. Hubbell.
2. Haws.
3. Keltech.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electric water heater in the configuration shown on the drawings and in accordance with the manufacturer's recommendations.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 223301

221316 SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, soil, waste, and vent piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise required by code or indicated :
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- C. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.

- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 221316

224000 PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories, bathtub/showers, showers, and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Fixture supports.
 - 5. Water closets.
 - 6. Urinals.
 - 7. Lavatories.
 - 8. Mop Sinks.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Vitreous-China Fixtures: ASME A112.19.2M.
 - 2. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 3. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.

8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Plastic Tubular Fittings: ASTM F 409.
 5. Brass Waste Fittings: ASME A112.18.2.
 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
 2. Grab Bars: ASTM F 446.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Hot-Water Dispensers: ASSE 1023 and UL 499.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 6. Pipe Threads: ASME B1.20.1.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or Architect/Engineer approved alternate.
2. When lavatory faucet is not specified on plan sheets provide the following, subject to compliance with requirements:
 - a. Description: Single-control mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - b. Body Material: Commercial, solid brass.
 - c. Finish: Polished chrome plate.
 - d. Maximum Flow Rate: 0.5 gpm.
 - e. Centers: 4 inches.
 - f. Mounting: Deck, exposed.
 - g. Valve Handle(s): Lever, ADA compliant, Vandal resistant screws.
 - h. Inlet(s): $\frac{1}{2}$ " NPSM supply connection w/ brass coupling nuts.
 - i. Spout Outlet: Vandal-proof aerator, 0.5 gpm.
 - j. Operation: Ceramic cartridge.
 - k. Drain: Grid Strainer.
 - l. Tempering Device: as required by state and local plumbing codes.
 - m. ADA compliant.

2.2 FLUSHOMETERS

A. Flushometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:
2. When flushometer is not specified on plan sheets provide the following, subject to compliance with requirements:
 - a. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - b. Internal Design: Diaphragm operation.
 - c. Style: Exposed.
 - d. Inlet Size: NPS 1.

- e. Trip Mechanism: Oscillating, lever-handle actuator, ADA compliant.
- f. Consumption: 1.6 gal./flush.
- g. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.
- h. Free spinning vandal resistant stop cap.
- i. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
- j. High copper, low zinc brass castings for dezincification resistance.

2.3 TOILET SEATS

A. Toilet Seats:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:
- 2. When toilet seat is not specified on plan sheets provide the following, subject to compliance with requirements:
 - a. Description: Toilet seat for water-closet-type fixture.
 - b. Material: Molded, solid plastic with antimicrobial agent.
 - c. Configuration: Open front without cover.
 - d. Size: Coordinate with water closer.
 - e. Hinge Type: Stainless steel hinge post with concealed check.
 - f. Class: Standard commercial.
 - g. Color: White.

2.4 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Water-Closet Supports:

1. Description: Combination carrier designed for standard, unless noted otherwise, mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.5 WATER CLOSETS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:

B. When water closet is not specified on plan sheets provide the following. Subject to compliance with requirements:

1. Description: Floor-mounting, floor-outlet, vitreous-china fixture designed for gravity-type tank operation.
 - a. Style: Close coupled.
 - b. Bowl Type: Elongated with siphon-jetdesign. Include bolt caps matching fixture.
 - c. Height: Standard or Accessible.
 - d. Design Consumption: 1.6 gal./flush.
 - e. Tank: Gravity type with trim. Include cover.
 - f. Trip Mechanism: Lever-handle actuator.
 - g. Color: White Insert color.
 - h. Supply: NPS 3/8 NPS 1/2 chrome-plated brass or copper with screwdriver stop.

2. Description: Floor-mounting, floor-outlet, vitreous-china fixture designed for gravity-type tank flushometer valve operation.
 - a. Style: Flushometer valve.
 - b. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - c. Height: Standard or Accessible.
 - d. Design Consumption: 1.6 gal./flush.
 - e. Color: White.

2.6 URINALS

A. Urinals:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:
2. When urinal is not specified on plan sheets provide the following, subject to compliance with requirements.
 - a. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - b. Type: Washout with extended shields.
 - c. Strainer or Trapway: Open trapway with integral trap.
 - d. Design Consumption: 1 gal./flush.
 - e. Color: White.
 - f. Supply Spud Size: NPS 1-1/4.
 - g. Outlet Size: NPS 2.
 - h. Fixture Support: Urinal chair carrier.

2.7 LAVATORIES

A. Lavatories:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:

2. When lavatory is not specified on plan sheets provide the following, subject to compliance with requirements:
 - a. Description: Wall-hung, vitreous china, rear over flow lavatory.
 - b. Type: Ledge back.
 - c. Size: 19 by 17 inches rectangular.
 - d. Faucet Hole Punching: Three holes, 4-inch centers.
 - e. Faucet Hole Location: Top.
 - f. Pedestal: Not Required.
 - g. Color: White Insert color.
 - h. Faucet: Lavatory.
 - i. Supplies: NPS 3/8 chrome-plated copper with stops.
 - j. Drain: See faucet.
 - 1) Location: Near back of bowl.
 - k. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, thick tubular brass waste to wall; and wall escutcheon.
 - l. Fixture Support: Lavatory.

2.8 MOP SINKS

A. Mop Sinks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or an Architect/Engineer approved equal:
2. When mop sink is not specified on plan sheets provide the following, subject to compliance with requirements:
 - a. Description: Floor mount, compression molded stone sink.
 - b. Color: White.
 - c. Size: 24 by 24 by 9 inches square.
 - d. Supplies: Dome strainer and lint basket.
 - e. Drain: 3 inch cast brass drain and drain seal gasket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
 - D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
 - E. Install wall-mounting fixtures with tubular waste piping attached to supports.
 - F. Install fixtures level and plumb according to roughing-in drawings.
 - G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
 - K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
 - L. Install toilet seats on water closets.
 - M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - P. Install traps on fixture outlets:
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

- Q. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 224000

230500 COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.2 SUBMITTALS

- A. Welding certificates.
- B. Submit product information for all materials used for the various mechanical systems.

1.3 REFERENCES

A. Standards:

1. ASME American Society of Mechanical Engineers.
2. AWWA American Water Works Association.
3. UL Underwriters Laboratories, Inc.
4. MCA Mechanical Contractors Association.
5. IBR Institute of Boiler and Radiators Manufacturers AISE Association of Iron & Steel Engineers.

6. SAE Society of Automotive Engineers.
7. NEMA National Electric Manufacturers Association ASTM American Society for Testing and Materials.
8. ANSI American National Standard Institute.
9. AWS American Welding Society.

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of first quality. Manufactured products shall be Manufacturer's standard product with specified options but shall not be field or factory modified unless specified. All materials and equipment shall bear the Manufacturer's nameplate or marking with type, size, catalog numbers and ratings as appropriate.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Acceptance (at site): Take delivery of all items delivered to site. Be responsible for inspection of materials and equipment to detect transit damage.
- B. Protection (prior to application or installation):
 - 1. Materials shall be stored inside building. Piping may be stored outside.
 - 2. Be responsible for all damage to materials stored on site.

1.7 PROJECT CONDITIONS

- A. When existing conditions prohibit the proper installation as shown on the Drawings or as specified herein, the Contractor shall notify the Engineer/Architect, in writing, requesting a solution.
- B. Contractor is responsible for the verification of new and existing conditions on the site before that particular phase of installation begins.

1.8 WARRANTY

- A. Contractors and manufacturers warranty shall be 3 years after substantial completion.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.
- F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated Rough brass Polished chrome-plated and rough brass.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. "Street fittings" shall not be used.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Where pipe passes through building walls and floors cuts shall be square or round and ground smooth.

- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- N. Bending of pipe will not be permitted, only ells shall be utilized for a change in direction.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 TESTING OF PIPING SYSTEMS

- A. Piping Systems:
 - 1. Contractor shall subject all piping and equipment to a test of 125 psi for a period of 8 hours and all leaks developed shall be repaired and the test repeated until the system is absolutely tight.
 - 2. Disconnect all traps and devices not rated for operation at test pressures.
 - 3. All instruments and equipment required for testing shall be furnished by the Contractor and tests shall, if so requested, be made in the presence of the Engineer/Architect.

3.9 ADJUST AND CLEAN

- A. Protection of Completed Work:
 - 1. When work is completed it shall, when it is subject to damage by ongoing construction, be protected from this damage.
 - 2. As work is being installed, equipment and piping shall be protected from other ongoing construction or from its own construction. Exposed piping ends should not be temporarily covered; hanger shall be supplied in sufficient number to prevent warping or bending of pipe.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 230500

230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Isolation pads.
 2. Isolation mounts.
 3. Restrained elastomeric isolation mounts.
 4. Restrained spring isolators.
 5. Housed spring mounts.
 6. Elastomeric hangers.
 7. Spring hangers.
 8. Spring hangers with vertical-limit stops.
 9. Pipe riser resilient supports.
 10. Resilient pipe guides.
 11. Restraining braces and cables.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
1. See structural general notes on Drawings S001 for wind parameters
 2. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. See structural general notes on Drawings S001 for seismic parameters

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.

- B. Pads : Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant .
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts : All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators : Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

- F. Restrained Spring Isolators : Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts : Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers : Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop : Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support : All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

- C. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 230548

230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black Blue Red White Yellow Insert color.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 230553

230700 HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; AeroSeal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 3. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.6 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, and securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.8 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.4 MINERAL-FIBER INSULATION INSTALLATION

- A. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, exposed supply and outdoor air.
2. Indoor, exposed return located in nonconditioned space.
3. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 230700

233113 METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Rectangular ducts and fittings.
 2. Round ducts and fittings.
 3. Sheet metal materials.
 4. Sealants and gaskets.
 5. Hangers and supports.
- B. Related Sections:
1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

- a. Supply Ducts (except in Mechanical Rooms): 1-inch wg.
- b. Return Ducts (Negative Pressure): 1-inch wg.
- c. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Leakage Class:

- a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
- b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables: Stainless steel complying with ASTM A 492.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Dimensions on drawings indicated inside dimensions of air flow area. Outside duct dimensions must be increased for internally lined ducts to allow for liner thickness.
- D. Install round ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Install test holes in locations required for air balancing.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 DUCT SCHEDULE

- A. Fabricate ducts with aluminum:
- B. Intermediate Reinforcement:
 - 1. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 10 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 12 Inches Insert dimension and Larger in Diameter: Standing seam.
- D. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical tap.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

3.6 INSPECTION

- A. Inspect ductwork before insulating. Repair or replace damaged duct materials. Seal visible holes. Do not rely on insulation to seal holes.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 233113

233300 AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Manual volume damper installations.
- c. Control damper installations.
- d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
- e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized or paint.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. American Warming and Ventilating; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Duro Dyne Inc.
 5. Greenheck Fan Corporation.
 6. Lloyd Industries, Inc.
 7. Nailor Industries Inc.
 8. NCA Manufacturing, Inc.
 9. Pottorff; a division of PCI Industries, Inc.
 10. Ruskin Company.
 11. SEMCO Incorporated.
 12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 3000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
1. Material: Galvanized steel.
 2. Diameter: 0.20 inch.

- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Front of rear screens.
 - 6. 90-degree stops.
- N. Sleeve: Minimum 20-gage thickness.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.

4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

2.4 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Duro Dyne Inc.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. Lloyd Industries, Inc.
 8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
 9. McGill AirFlow LLC.

10. METALAIRE, Inc.
 11. Metal Form Manufacturing, Inc.
 12. Nailor Industries Inc.
 13. NCA Manufacturing, Inc.
 14. Ruskin Company.
 15. Vent Products Company, Inc.
 16. Young Regulator Company.
- B. Frames:
1. Galvanized-steel channels, 0.064 inch thick.
 2. Mitered and welded corners.
- C. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Parallel- and opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
1. Molded synthetic.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.

2.5 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

2.7 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Flexmaster U.S.A., Inc.
 5. Greenheck Fan Corporation.
 6. McGill AirFlow LLC.
 7. Nailor Industries Inc.
 8. Pottorff; a division of PCI Industries, Inc.
 9. Ventfabrics, Inc.
 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.

- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect flexible ducts to metal ducts with nylon ties and seal connections with tape.
- M. Install duct test holes where required for testing and balancing purposes.
- N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 233300

233310 EXTRUDED ALUMINUM COMBINATION LOUVER/DAMPER

1.1 SECTION INCLUDES

- A. Extruded aluminum combination louver dampers designed to protect intake and exhaust openings that at times require tight air shutoff. Design incorporates a drainable head member, drainable stationary blades, and operable blades with exposed blade linkage.

1.2 REFERENCES

- A. AAMA 605.2 - High Performance Organic Coatings on Architectural Extrusions and Panels.
- B. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data including performance data.
- B. Shop Drawings: Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.

2.1 EXTRUDED ALUMINUM COMBINATION LOUVER/DAMPER

A. Fabrication:

1. Frame:

- a. Material: Extruded aluminum, Alloy 6063-T5.
- b. Wall Thickness: 0.081 inch, nominal.
- c. Depth: 6 inches.

2. Blades:

- a. Drainable design
- b. Material: Extruded aluminum, Alloy 6063-T5.
- c. Wall Thickness: 0.081 inch .
- d. Centers: 6 inches, nominal.

3. Bird Screen:

- a. Material: Aluminum, 1/2 inch mesh x 0.063 inch.
- b. Frame: Removable.

4. Seals: Dual-durometer extruded vinyl blade and jamb seals

5. Assembly: Factory assemble louver components.

B. Performance Data:

1. Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.

2.2 FACTORY FINISH

A. Color Anodize Finish:

1. Comply with Aluminum Association AA-C22A44.
2. Apply finish following chemical etching and pretreatment.
3. Electrolytically deposited color anodized finish.
4. Minimum Thickness: 0.7 mils (0.018 mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
- B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- C. Install joint sealants

3.3 CLEANING

- A. Clean louver surfaces in accordance with manufacturer's instructions.
- B. Repair minor damaged surfaces as directed by Architect.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 233310

233423 HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.
 - 2. Centrifugal wall ventilators.
 - 3. Ceiling-mounting ventilators.
 - 4. In-line centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or engineer approved equal:
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, galvanized steel, mushroom-domed top; square, one-piece, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.

- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 - 2. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

2.2 CENTRIFUGAL WALL VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or engineer approved equal:
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 2. Wall Grille: Ring type for flush mounting.
 - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

2.3 IN-LINE CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or engineer approved equal:
- B. Description: In-line, direct-driven or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
 - 2. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.4 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- E. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

- F. Install ducts adjacent to power ventilators to allow service and maintenance.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 233423

233713 DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 QUALITY ASSURANCE

- A. Comply with the following applicable standards:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"
 2. NFPA 90B, "Warm Air Heating and Air Conditioning Systems"
 3. NFPA 251, "Standard Methods of Fire Tests of Building Construction and Materials"

1.4 COORDINATION

- A. Installation of air distribution devices shall be coordinated with the building structure, lighting fixtures, piping, conduit, reflected ceiling plans and other trades as necessary.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Arrange product delivery to minimize storage time. Store air distribution devices in cartons in position indicated on box until installation. Handle air devices with care to prevent damage to finishes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Diffusers shall be as shown in the diffuser schedule on the plans. In the absence of a schedule or if diffuser is not called out on the plans, the specifications in Part 2.3 & 2.4 shall apply.

2.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 GRILLES AND REGISTERS

- A. Refer to equipment schedules on plans for description and performance information.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Suspend ceiling air devices from structure on wire hangers or from rigid ductwork. Finished ceiling must not be used to support air distribution devices.

3.2 INSPECTION

- A. Inspect air devices for scratches and dents after installation. Repair dents and touch up scratches. If damage is visible replace device.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 233713

238126 AIR TO AIR HEAT PUMP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes air-to-air heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

- A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Air Conditioning; Div. of Carrier Corp.
2. Lennox Industries Inc.
3. Mitsubishi Electronics America, Inc.; HVAC Division.
4. Trane Co. (The); Unitary Products Group.
5. York International Corp.

2.2 AIR HANDLING UNIT

A. Horizontal Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Galvanized steel, with connection for drain; insulated.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

D. Fan Motor: Multispeed.

E. Filter Rack: External, installed in return air duct. Side accessible and sealed during operation.

F. Filters: 2 inch thick, pleated, MERV 8.

2.3 AIR-COOLED, HEAT PUMP UNIT

- A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Refrigerant Charge: R-407C or R-410A.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 20 deg F.
- H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan. Two-stage cooling, single stage heating. Non-programmable with auto-changeover from heating mode to cooling mode.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

- C. Economizer:
 - 1. Economizer logic module: Standalone, wired directly to set back space thermostat and sensors to provide outdoor air, dry-bulb economizer control.
 - 2. Sensors:
 - a. Mixed air temperature sensor
 - b. Outdoor air temperature sensor
 - c. Return air temperature sensor
 - 3. Dampers:
 - a. Modulating intake air damper: Included with louver, 120V, 2-10VDC actuation.
 - b. Two-position exhaust air damper: Included with louver, 120V, power open, spring close.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install on stand as described on the project plans.
- C. Install compressor-condenser components on stand as described on project plans. Provide restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Connect supply and return water coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- C. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- D. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 238126

238233 LIQUID FILLED ELECTRIC BASEBOARD RADIATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Liquid filled electric baseboard radiators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 LIQUID FILLED ELECTRIC BASEBOARD RADIATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. Markel Products; a division of Marley Engineered Products.
 - 5. Marley Electric Heating; a division of Marley Engineered Products.
 - 6. Ouellet Canada Inc.
 - 7. Qmark Electric Heating; a division of Marley Engineered Products.
- B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.
- C. Heating Elements: Nickel-chromium-wire heating element immersed in a heat-transfer liquid and sealed in a heater length copper tube.
- D. Rust-Resistant Enclosures: Minimum 0.032-inch thick ASTM A 653/A 653M, G60 galvanized-steel, removable front cover.
 - 1. Full-height back.
 - 2. End panel.
 - 3. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
 - 4. Element Brackets: Primed and painted steel to support front panel and element.
- E. Unit Controls: Integral line-voltage thermostat

PART 3 - EXECUTION

3.1 BASEBOARD RADIATOR INSTALLATION

- A. Install units level and plumb.
- B. Install baseboard radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

3.2 CONNECTIONS

- A. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace units that do not pass tests and inspections and retest as specified above.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 238233

238239 UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Equipment schedules to include rated capacities, furnished specialties, and accessories.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Airtherm; a Mestek Company.
 - 2. Engineered Air Ltd.
 - 3. McQuay International.
 - 4. Rosemex Products.
 - 5. Ruffneck Heaters; a division of Lexa Corporation.
 - 6. Trane.
- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.

- D. Cabinet: Removable panels for maintenance access to controls.
- E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- F. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- G. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.
- H. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- I. Fan Motors: Comply with requirements in"" Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Type: Permanently lubricated.
- J. Control Devices: Wall mounted thermostat.
- K. Capacities and Characteristics:
 - 1. Refer to equipment schedule on plans.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Comply with safety requirements in UL 1995.

- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 238239

332005 SUBMERSIBLE, NON-CLOGGING PUMP

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

- A. This section includes the requirements to provide a submersible, non-clogging, wastewater pump with appurtenances as required and specified (SW-P04). A spare pump shall also be provided and stored in the Generator Room of the Collector Well Pump Building. Only (1) guide bracket and discharge base shall be supplied.

1.02 QUALITY ASSURANCE

- A. The pump manufacturer shall perform the following inspections and tests on the pumps before shipment from the factory.
1. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
 2. Each pump shall be tested for flow versus head at the design conditions in accordance with the latest edition of the Hydraulic Institute Standards.
 3. A written report with certified flow versus head curves stating the foregoing has been completed shall be supplied with each pump at the time of shipment. The curves indicated shall include head, capacity, horsepower, efficiency and input KW.
 - a. Manufacturer shall be certified ISO 9001

1.03 SUBMITTAL REQUIREMENTS

- A. The submittals for the pumps and accessories shall include but not be limited to the following:
1. Equipment Layout (plan and elevation)
 2. Overall Dimensions
 3. Anchor Bolt or Mounting Hole Dimensions
 4. Weight Total and Weights of Shipping Units
 5. Detail Dimensions
 6. Materials of Construction
 7. Capacity
 8. Performance Curves
 9. Nameplate Data
 10. Wiring Diagrams and Schematics Diagrams
 11. Interconnection Diagram (Electrical)
 12. Mounting Details
 13. Bill of Materials
 14. Ambient Conditions Necessary for Efficient Operation

1.04 WARRANTY

- A. The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pumps and not the motor for a period of three (3) years from the date of startup. The motors shall have a warranty period of (3) years from the date of substantial completion.

PART 2 PRODUCTS

2.01 SERVICE CONDITIONS

- A. The pumps shall be vertical, submersible, solids handling type pump, designed to handle wastewater and clean water. The pumps shall be furnished as one complete pump system, all of the system components supplied by one manufacturer.
- B. The pump unit shall be installed in the wet well when lowered into place on its mating discharge connection. The pump shall be easily removable along two stainless steel guide bars or cables for inspection or service. Guide mechanism on the pump shall be constructed of bronze, shall be non-sparking and U.L. Listed.
- C. The pumps shall perform under the following operating conditions:

Design Point

- 1. Pump Capacity 1000 gpm
- 2. Total Dynamic Headloss 40.2 ft.
- 3. Maximum Allowable Pump Speed 1155 rpm
- 4. Motor 20 hp
- 5. Minimum Allowable Solids Handling 3.5" Sphere-Non compressible
- 6. Discharge Connections 6" inch
- 7. Maximum Allowable NPSHr 12' Ft
- 8. Minimum Allowable Efficiency 75%

2.02 PUMP ASSEMBLY CONFIGURATION

- A. Cooling System
 - 1. Motors are cooled by the surrounding environment or pumped media. Pump shall be capable of continuous operation at any elevation above the "Off" float elevation for this pump.
- B. Cable Entry Seal
 - 1. The Cable leads are to allow the connection of a cable to the motor, to be accomplished in the field without soldering cable. All leads are to be sealed with a grommet and a epoxy compound system with strain relief to prevent cable-wicking to conduit box location in the top of the motor. Leads are connected to a water-tight fully O-ringed terminal board with brass lugs.
 - 2. Total grommets or other similar sealing systems are not acceptable. Motor shall be supplied with 50 feet of multi-conductor type RHW or Re Neoprene power cable and control cable. Cable sizing shall conform to NEC specifications.
 - 3. Separate terminal board which is fully o-ringed and each terminal individually o-ring to form a water tight barrier.

C. Motor

1. Motors shall be rated for Class I, Division I, Group D.
The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class F insulation. The stator-winding and lead shall be insulated with moisture-resistant Class F insulation for continuous duty in 40 C rise liquids. The motor shall be designed for continuous duty capable to minimum of ten (10) start per hour. Motor shaft shall be 416 stainless steel: the rotor and shaft together is to be dynamically balance to meet NEMA vibration limits: all hardware to be stainless steel.
2. Thermal switches set to open at 311F shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and the pump shall be produced by the same manufacturer.
3. The combined service factor shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
4. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
5. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. Pumps shall be sized based on the total hydraulic capacity based on test data, reduction in the head range or chopped pump curves are not acceptable.

D. Bearings

1. The pump shaft shall rotate on two sets of bearings. Motor bearings shall be permanently grease lubricated. The lower bearing shall compensate for axial thrust and radial forces. The Lower shaft bearing shall be lapped on place to prevent shaft movement and to take thrust loads. Bearing shall be pre lubricated at the factory.

E. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The mechanical seals must be commercially available and manufactured by a major seal manufacturer, Chesterton. Seal shall be constructed of a polymeric body with SC/TC faces for the lower and carbon/ni-resist for the upper. Seal body shall designs such it will not snap sewage when in operation.
2. The motor shall be able to operate unsubmerged up to 15 minutes without damage while pumping under load.
3. Seal lubricant shall be FDA Approved, nontoxic.

F. Pump Shaft

1. Pump and motor shaft shall be the same unit. The shaft shall be 416 stainless steel.
2. The use of stainless steel sleeves will not be considered equal to stainless steel shafts.

G. Impeller

1. The Impeller shall be one piece, single suction, enclosed single-vane, radial flow design with well-rounded leading vane edges and thick hydrofoil shape which prevents the accumulation of solids and stringy material through the impeller. It is to be dynamically balanced and secured to the shaft by means of a key and fastener. Wiper vanes are not allowed. The impeller waterways and clearance between the impeller periphery and volute cutwater shall be capable of passing sphere sizes as listed in 2.02 C. There shall be provisions for adjustable shims behind the impeller to maintain clearance between the impeller and suction head wear rings. Semi open impellers or impellers without hard metal wear rings are not acceptable. Coated wear rings are not acceptable. Impeller shall be designed to be fully trimmable. Semi open type impellers or impellers that will not accept wear rings are not allowed.
2. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in storm water up to 3%.
3. Axial wear rings constructed of 416 stainless steel shall be provided for both impeller and volute. Wear rings shall be the axial design and fully adjustable. Radial type rings are not allowed.

H. Volute-Suction Cover

1. The pump volute shall be a single piece with smooth passages of sufficient size to pass any solids that may enter the impeller. Inlet and discharge size shall be as specified. Spiral grooved suction volute insert plates that act as the impeller enclosing shroud and wear surface are not acceptable.
2. The volute shall be provided with a replaceable hard metal insert/wear ring, which shall be fully axially field adjustable insure effective sealing between the impeller and volute housing. Non-hardened or elastomer or rubber coated metal or stainless steel wear rings are not acceptable.
3. The pump discharge shall be provided with an integrally cast flange. The seal between the pump discharge and discharge piping shall be watertight.

I. Guide/Bracket

1. Guide rails shall be provided by the general contractor on which the pump rides when being raised or lowered in the sump an mount on the discharge base/elbow. The rails shall align the pump with the discharge elbow as it is lowered into place. An upper rail guide shall be furnished to support and align the rails at the top of the sump. For guide rail lengths greater than 20 feet, an intermediate guide bracket shall also be included.
2. Guide rails shall be provided on which the pump rides when being raised or lowered in the sump and mounted on the discharge base/elbow. The rails shall align the pump with the discharge elbow as it is lowered into place.
3. Guide bars shall be stainless steel and the diameter shall be as recommended by the pump manufacturer.
4. An upper rail guide shall be furnished to support and align the rails at the top of the sump.
5. The guide rail system shall be non-sparking and approved for use in Class 1, Division 1, Group D hazardous locations.

J. Discharge Base

A rigid discharge straight thru discharge/base to support the total weight of the pumping unit shall be provided. The base is to be bolted directly to the floor with the 90 degree 125lb. ANSI flange discharging horizontally.

K. Protection

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 311F , stop the motor and activate an alarm.
2. A leakage sensor shall be provided to detect water below the upper seal and in the stator housing as well.

L. Spare Parts (for each pump unit provided)

1. 2 sets of all gaskets.
2. Mechanical seal set.
3. Complete replacement bearing set.
4. Any special tools required for pump disassembly.

- M. Check Valve
- a. A single increasing size cushioned swing check valve constructed with heavy-duty cast iron body, stainless steel body seat ring, resilient faced disc, stainless steel shaft for attachment of weight and lever, and bronze cushion chamber shall be provided on the discharge of the pump. The valve must be tight seating and operate without hammer or check. The air cushion chamber shall be attached to side of the valve body externally. Basis of design is GA Industries.
- N. Grit Shield
- a. Pump will be provided with custom fitted grit shield. Grit shield shall be constructed of chrome iron with a minimum hardness of 500-600BPH. Grit shield shall fully line and cover the pump fronthead providing protection from material erosion caused by abrasives in pumpage. Grit shield must have integral speed bumps, randomly located to distort the flow pattern and extend the life of the grit shield. Grit shield shall also serve as a casing wearing based on an axial design.

2.03 MATERIALS OF CONSTRUCTION

Impeller	Cast Iron A48-CL30
Impeller Bolt	Steel SAE Bolt Steel GR-8
Impeller Nut	SAE Bolt Steel
Impeller Washer	A108 GR12L14
Volute	Cast Iron A48-CL30
Fronthead	Cast Iron A48-CL30
Impeller wearing ring	416 stainless steel (300-350BHN)
Volute wearing ring	416 stainless steel (300-350BHN)
Discharge Base Elbow	Cast Iron A48 CL-30
Impeller Key	Steel A108 GR1018
Guide Bracket	Brass B584 AL836
Volute Gasket	Tagboard F104
Bearing Shims	Steel A108 Commercial
Volute Handhole Cover	Cast Iron A48-CL30
Volute Handhole Cover Gasket	Tagboard F104
Upper Guide Bracket	Steel
Upper Guide bracket Bushing	Rubber
Guide Mechanisum	Bronze / non-sparking
Discharge Coupling	Non-Sparking
Lower Mechanical Seal	Silicon Carbide vs. Tungsten Carbide
Upper Mechanical Seal	Carbon vs. Ni-Resist

PART 3 EXECUTION

3.01 INSTALLATION

- A. The Contractor shall install the pump assemblies in the permanent locations as shown on the drawings and in accordance with the manufacturer's instructions.
- B. Contractor shall install interconnecting electrical wiring, conduit, etc. between submersible pumps and control equipment so that when power and control wiring is brought to the control equipment, the submersible pump system will be a complete operational system.

3.02 TESTING

- A. All pumps supplied shall be tested per the latest addition of HI. At the owner's request all testing shall be witnessed. All associated costs for the owner or the owner's representative to travel and witness the HI testing shall be the responsibility of the of owner or the owners representative. Any additional costs to the pump supplier for a witnessed test will be submitted as a change order to the project.
- B. Prior to system operation, all equipment shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance by means of a functional test.
- C. Field Testing
 - 1. Functional Test - required.
 - 2. Performance Test - required.
- D. Before final acceptance of the pumps specified herein, the Contractor shall submit five (5) copies of certified and properly identified performance curves which shall reflect the operating characteristics of each pump model and impeller combination being supplied. The curves shall indicate head, capacity, horsepower, efficiency and input KW.

3.03 FINISHES

- A. Shop - All pump assemblies supplied under this section shall receive finishes that are in accordance with the pump manufacturer's standard finish.
- B. Field - All pump assemblies shall be touch-up painted with matching paint supplied by the pump manufacturer.
- C. Drive Motors - All pump drive motors furnished under this section shall only receive finishes that are in accordance with the motor manufacturer's standard finish. DO NOT apply shop or field coatings to the drive motors.

3.04 MANUFACTURER'S SERVICES

- A. The Contractor shall include with his bid the services of the equipment manufacturer's field service technician for a period of one (1) trip for a period of two (2) 8-hour days at the site. This service shall be for the purpose of check-out, initial start-up, certification, and instruction of plant personnel. A written report covering the technician's findings and installation certification shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 332005

332006 VERTICAL TURBINE SOLIDS HANDLING PUMPS

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

- A. This section includes furnishing and installation of three (3) vertical turbine solids handling pumps (SW-P01, SW-P02, and SW-P03) as specified and as shown on the drawings.

1.03 QUALITY ASSURANCE

- A. Each pump shall be designed and constructed to operate satisfactorily with a reasonable service life, when installed in a typical continuous turbine pump application. The pump shall be the product of a manufacturer regularly engaged in the production and marketing of vertical turbine solids handling pumps.

- B. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program. This quality assurance program meets the requirements of 10CFR50 Appendix B, NCA 4000, MIL 1 45208A and Z299.1

1.04 ISO-9001 Certification

- A. Pumps are to be engineered and manufactured under the certification of ISO - 9001.

1.05 REFERENCE TO STANDARDS

- A. American Standards Association Publication for Vertical Turbine Pumps

1.06 SUBMITTALS

- A. Sufficient technical data shall be submitted to properly evaluate the pump.
- B. Certified Curve (prior to shipment).
- C. Hydrostatic test results of bowl assembly and discharge head (prior to shipment).
- D. Motor commercial test report (prior to shipment).
- E. Comply with requirements of Section 01330 – Submittal Procedures.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Care shall be taken to avoid damage at the site. The pump shall be supported such that no weight is carried by the bowl assemblies.
- B. The motor shall be stored indoors and protected from rain, moisture, and condensation.
- C. The Contractor shall rotate the motor and bowl assembly shaft weekly.
- D. The vertical turbine pump shall be factory assembled. The driver and top shaft may be shipped unassembled for field assembly by the Contractor.

1.08 WARRANTY

- A. The Contractor shall warranty all vertical turbine solids handling pumps for a period of three (3) years from the date of final completion. The Contractor shall at his own expense replace any part or parts that may provide defective in material or workmanship within the three (3) year warranty period.

1.09 SERVICE

- A. The services of manufacturer's service representative for 2 trips and 2 days are required to assure proper installation, start-up and testing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer's Qualifications

Manufacturers of the Pumping Equipment shall have experience in providing similar type equipment and at the request of the Engineer shall show evidence of this by providing a complete equipment submittal of at least fifteen (15) separate installations where equipment of the same material and same application of the type and size specified herein have been in satisfactory operation for at least ten (10) years. In addition to the technical data the submittal shall include the telephone number and contact person of the both Plant Superintendent and Design Engineer at each of the fifteen (15) qualifying installations. If requested, this information must be submitted to the Engineer within (10) working days following the request.

Submittal data for the proposed pump shall also be provided and shall be supplied per the project submittal requirements of these bidding documents. Submittals shall include a breakdown of the pump components and weights of each component.

All required submittal data must be submitted through a General Contractor bidding the project. Submittals received direct from the manufacturer or pump supplier will not be accepted and returned to the sender.

2.02 GENERAL

- A. Contractor shall furnish and install a quantity of three (3) single stage, VTSH Vertical Turbine Solids - Handling Pumps. Each unit shall be supplied complete with non-clog bowl assembly, column with splitter vane, enclosed line shaft, surface discharge head, sole plate, water flush system driver, and right angle gear drive. Pumps less than 30 feet in length shall be shipped completely assembled, less driver.
- B. The project location is reusing an existing wet well. Maximum allowable OD of the bowl assembly or suction bell shall not exceed 37.75".
- C. Structural modifications are proposed for existing wet well to facilitate the installation of the proposed pumps. Modifications were based on Fairbanks Morse VTSH-20 pumps. Costs associated with additional structural modifications beyond the proposed modifications to accommodate pumps other than the Fairbanks Morse VTSH-20 shall be the responsibility of the General Contractor.

2.03 OPERATING CONDITIONS AND CONTROL

- D. 20-VTSH Pumps – Three (3) Required
- E.

	Flow (GPM)	TDH (ft.)	Max. Pump Speed (RPM)	Minimum Acceptable Bowl Efficiency	Max. Shutoff Head (ft.)	Maximum Acceptable NPSHr
Design Condition	8,000	40'	705	84%	71'	16.5'
Secondary Condition	6,840	44'	705	82%	71'	14'
Secondary Condition	10,500	28'	705	82%	71'	26'
Secondary Condition	12,500	17'	705	66%	71'	35'
Secondary Condition	2,500	55'	705	44%	71'	13'

Maximum pump rotative speed shall not exceed 705 RPM. Pump setting from bottom of baseplate to bottom of suction bell is 12 inches. Pumps shall be factory tested in accordance with Hydraulic Institute Standards, level 1U and a Certified Test Curve shall be submitted to the engineer prior to pump shipment to the site.

2.04 PUMP CONSTRUCTION

- A. Bowl Assembly

1. Pump bowl shall be of close-grained cast iron construction conforming to ASTM Designation A48 Class 30A. They shall be free of blow holes, sand holes or other faults and must be accurately machined and fitted to close tolerances. Discharge bowl shall contain (2) symmetrically arranged diffusion vanes. Impeller shall be of the enclosed non-clog type, statically and dynamically balanced, containing a maximum of two (2) vanes and shall be one piece cast iron conforming to ASTM Designation A48 Class 30A. All casting connections shall be rabbet fitted. The impeller and bowl diffusion vanes shall be of a hydrofoil design with well-rounded leading edges to prevent the accumulation of fibrous and stringy material. The non-clog impeller shall be secured to the tapered shaft using a key and bolt. Upper and lower bronze backed rubber bearings shall maintain alignment of the shaft through the bowl. The bowl shaft shall be 416 stainless steel with chrome plating at the bearing area. The impeller and bowl waterways and the clearance between the periphery of the maximum diameter impeller and bowl diffuser vanes shall be capable of passing a 5 inch diameter sphere. Fabricated bowls shall not be acceptable.

2. The impellers shall be so designed that at no point over the entire performance range of the bowl assembly will the driver be overloaded beyond 100% of the rated motor horsepower with lineshaft friction included.
3. The suction bell shall be free of bearing hubs and supporting ribs or vanes to allow unobstructed flow to the impeller and fitted with an axial type wear ring of ASTM A743 CA15 material with a hardness range of 300-350 Brinell.
4. To prevent vortexing and undesirable eddys, a cast aluminum (fabricated on 30") hydrocone shall be provided for each pump. The contractor shall permanently mount the Hydrocone to the sump floor. It is to be located below the suction bell on the pump centerline.
5. The bowls, suction and discharge housings shall be constructed from close grained cast iron having a minimum tensile strength of 30,000 PSI and shall conform to ASTM Designation A48, Class 30A. They shall be free from sand holes, blow holes or other faults and must be accurately machined and fitted to close tolerances.

B. Column Assembly

1. The column pipe shall be not less than 20 inches and shall have a minimum wall thickness of 3/8 inches. Column pipe shall be furnished in lengths of not over ten (10) feet, and shall be connected by flanged joints registered to ensure proper alignment after assembly. Column pipe shall contain a splitter vane to prevent trash material from accumulating on the shaft enclosing tube. The vane shall run the entire length of the column aligned with bowl diffusion vane and discharge elbow splitter vane and securely welded in place. Use of "spider" type bearing retainers is not acceptable.
2. The line shafting shall be a minimum of 2 7/16 inches in diameter and shall be 416 stainless steel and furnished in interchangeable sections of not over ten (10) feet in length, and shall be coupled with threaded couplings. An enclosing tube shall be provided to house the line shaft. It shall be of 4 inches schedule 80 pipe furnished in interchangeable sections not to exceed five feet in length and with ends machined to receive bronze connector bearings. Line shaft bearings shall be of bronze designed for fresh water flush.

C. Discharge Head Assembly

1. A suitable base of fabricated steel or standard cast iron for below ground discharge and sole plate shall be provided for mounting the driver. Discharge elbow shall be of the surface type designed to prevent the collection of stringy material by the use of a splitter vane. The discharge head shall be provided with a 150 pound ANSI flanged connection to mate with a 20" ductile iron pipe, a packing box which shall connect to the shaft enclosing tube with a threaded line shaft bearing. A suitable drain tap shall be provided for packing box leakage and tapped connection for installation of an air release valve. A two-piece top shaft shall be provided with a 304 stainless steel sleeve at the packing box.
2. The diameter of the water passage through the discharge head elbow shall be at least equal to the diameter of the column pipe furnished.
3. The motor stand shall be provided with a tension bearing and tension ring, which when tightened will allow tension to be placed on the shaft enclosing tube, insuring positive alignment.
4. Pump shall be supplied with the pump manufacturer's standard fabricated steel sole plate, suitable for grouting with a smooth machined surface for mounting the pump supply size. All hardware for securing the head to the base plate shall be supplied by the pump manufacturer.

D. Water Flush Lubrication System

- a. A water flush assembly for flushing, lubricating and cooling the bearings shall be connected to the stuffing box and consist of a pressure gauge, flow meter, flow switch, pipe and fittings. The contractor shall pipe to this flush water assembly, a water supply of 2 GPM at 55 psi water. The bearings must be flushed for a minimum of five (5) minutes prior to pump start-up, continuously while in operation, and at least 15 minutes after stopping for proper lubrication and heat dissipation, and to prevent grit and foreign material from fouling the bearings. The flow meter shall be of the variable area type.

E. Driver, Electric Motor

1. The pumps shall be driven by a 10-pole electric motor rated not more than 125 HP operating at not less than 705 RPM or greater than 705 RPM manufactured for vertical turbine pump service.
2. Motors shall be 460 Volt, 3-Phase, 60 Hz suitable for use on 3 phase, 60 hertz, 480 volt commercial supply. The motors shall not be overloaded beyond their name plate rating, at the design condition, nor at any head shown on the published pump performance curve for the impeller or impellers selected. The motors shall have three (3) Positive Temperature Coefficient (PTC) thermistors connected in an open-delta configuration and brought out to terminal box. Motor shall be rated for a Class 1, Division 1 or 2, Group D environment.
3. A suitable thrust bearing shall be incorporated in the upper end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts under all conditions of operation. The thrust rating of the motor bearings shall not be exceeded throughout the operating range of the pump. The motor shall have incorporated a non-reverse ratchet to prevent rotation of the motor in reverse direction; thus preventing high speed back spin.
4. The unit shall be driven by a vertical solid shaft and shall be non-overloading anywhere on the hydraulic curve.

F. Variable Frequency Drives

1. The pumps shall be controlled by a variable frequency drive (VFD) to vary the speed of the pump.

H. Data Plates

1. All data plates shall be of stainless steel suitably attached to the pump. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

PART 3 EXECUTION

3.01 TESTING

- A. A certified non-witnessed performance test of the bowl assembly shall be made in accordance with Section A 6.2 of the American Standard for Vertical Turbine Pumps ASA B58.1 (latest edition). A certified pump curve shall be forwarded to the Owner prior to shipment from the factory, for the Owner or his engineering representatives review.

- B. A hydrostatic test of the bowl assembly and discharge head shall be performed at the pump factory in accordance with ASA B58.1, (latest edition), with the test results forwarded to the Owner or his engineering representative.
- C. The vertical turbine pump shall be factory assembled per the latest edition of the HI standards. The factory tests shall be based on HI 1U. The driver shall be shipped unassembled for field installation by the Contractor.

3.02 INSTALLATION

- A. The installation by the Contractor shall be done according to the pump manufacturer's requirements. This installation shall be checked by the manufacturer's service representative in every detail prior to operation of the pump.

3.03 PAINTING

- A. All areas of the pump to be painted shall be shop coated with primer. The primer used shall be compatible with the finish paint to be provided by the Contractor. Finish paint per Section 09900.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 332006

332010 SUBMERSIBLE VERTICAL WELL PUMP AND MOTOR REPLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Removing existing pumps from four existing wells and replacing with new pumps.
- B. Replacing one motor with a new motor on one existing well
- C. Reuse existing column pipe and restore new pumps to the existing pump setting depth

PART 2 - PRODUCTS

2.1 SUBMERSIBLE PUMPS AND MOTOR REPLACEMENT

- A. This item consists of furnishing all materials, labor, tools, and equipment necessary to install four new submersible pumps (wells # 2,3,4,and 6) and one new motor (well # 4) in the existing wells at the locations as indicated on the Plans, as directed by the Engineer, and as specified herein. The existing stainless steel pump pipe columns shall be removed, inspected, and reused providing the same depth of pump setting as the existing pump it replaces. Existing motors and cable to be reused shall be removed, inspected, and reused. New cable shall be provided on the new motor and terminated at the surface at the same point as the existing motor to be replaced.
- B. Submersible Pumps: Pumps shall be submersible motor driven deep well turbine rated for performance under the following conditions:

WELL NUMBER	2	3	4	6
Pump Discharge (gal/min)	800	800	800	800
TDH	200 feet	200 feet	200 feet	200 feet
Screen Length	30 feet	25 feet	50 feet	50 feet
Well Depth	108 feet	110 feet	103 feet	105 feet
HP	60	60	60	60
Column Pipe	6 inch	6 inch	8 inch	8 inch
Casing Pipe	16 inch	24 inch	24 inch	24 inch

Note: The total dynamic head (TDH) includes the total change in elevation of the water, from the pumping water level to the point of discharge, plus the friction and turbulence losses through the drop pipe and force main, valves, and fittings, from the pump to the point of discharge under worst case pipe fouling conditions.

- C. Submersible Pump Bowl Assembly: (ANSI/NSF Standard 61 Classified) Pump bowls, suction and discharge cases shall be lead and zinc free cast bronze, ASTM B584, free of blow holes, sand holes, or other imperfections. Tensile strength shall be a minimum of 30,000 psi. The bowl assembly shall be flanged construction utilizing 304 stainless steel bolts; or it threaded, must be left hand threads. Right hand threads will not be permitted. All mating surfaces shall be precision machined and fitted and no gaskets will be allowed. Rabbeted fits shall be utilized throughout the bowl assembly for accurate fit and alignment. Each bowl casting shall be factory tested at hydrostatic test pressure of 150 psi before assembly to assure integrity of each bowl, and certification of test shall be provided if requested.

- D. Impellers shall be precision lead and zinc free cast bronze, ASTM B584, machined and dynamically balanced for maximum efficiency and vibration-free operation. Enclosed type impellers, with sufficient skirt material thickness to enable repair and restoration of proper running clearance by installation of wear rings shall be furnished. Each impeller shall be securely fastened to the shaft with a split taper collet of stainless steel or lead and zinc free bronze.
- E. The shaft shall be of sufficient diameter to transmit the pump horsepower with liberal safety factor and rigidly support the impellers between the bowl or case bearings. The shaft material shall be 416SS, polished and precision straightened, with a minimum diameter of 1 inch.
- F. The motor coupling shall be a stainless steel coupling, accurately machined for perfect alignment, balance, and power transmission. The coupling shall be fastened to the end of the pump shaft by means of reset Allen screw to prevent loss of coupling during handling and disassembly. The coupling shall be keyed to the pump shaft and splined to the motor shaft. The coupling shall be capable of transmitting the total torque of the unit, regardless of the direction of rotation.
- G. Intermediate bowls, motor adapter and discharge case shall have cutlass rubber bearing to support and guide the shaft, and lend resistance to sand abrasion wear on shaft bearing surface. The discharge case shall be grease packed, with a top bearing plug to seal the bearing and also restrict excessive vertical upthrust on the shaft during start-up, Imposed hydraulically or by positive suction pressures.
- H. The pump shall have been classified by UL laboratories as complying with ANSI/NSF Standard 61 and shall carry a label to clearly and positively show compliance.

2.2 PUMP MOTOR

- A. Submersible Pump Motor: The motor shall be of submersible type designed for continuous underwater operation. The motor shall be 60 HP, 3600 RPM, 460 volt, 3 phase, 60 Hz if the squirrel cage induction type, suitable for across the line starting, and conforming to the latest National Electrical Manufacturers Association (NEMA) Specification for submersible motors.
- B. The motor thrust bearing shall be of Kingbury design, sized to carry the weight of all rotating parts plus the hydraulic thrust of the pump. The thrust bearing shall have sufficient capacity to permit the pump to operate momentarily with the discharge valve closed.
- C. The motor shaft shall be stainless steel, splined and fitted with a rotary face type seal to prevent entry of foreign material into the motor.

- D. Motor leads shall be of sufficient length to be spliced above the bowl assembly. Leads shall be protected for the entire length of the bowl assembly by a stainless steel cable guard supplied with the pump. The motor shall have provisions for proper grounding.
- E. Minimum flow velocity around the motor shall be 6 in/sec. If design flow velocity is less than 6 in/sec or the motor is installed within the screened section of the well, a shroud shall be installed around the pump and motor to direct the flow of water around the motor for cooling purposes.
- F. Submersible Pump Cable: The power cable shall be sized such that voltage drop will not exceed 5% from the power source to the motors terminals, at the motor full load current and voltage. Cable shall be three (3) conductor with ground jacketed, an all four (4) included in a single outer jacket. The conductor insulation shall be water and oil resistant, suitable for continuous immersion. The cable shall be suitably strapped to the column pipe by means of stainless steel bands on each joint of pipe. The cable shall have 3 layers of electrical tape applied, half-lapped, extending $\frac{3}{4}$ -inches each side of each stainless steel band. A continuous length of cable, without splices, from the motor leads through the surface plate is required. The splice of the motor leads to the cable shall be watertight at the pressure encountered in the application. The entire length of the cable and motor, together, shall be checked for insulation resistance (cable ground) and winding resistance (cable to cable) and shall be within the motor manufacturer's recommended values.

PART 3 EXECUTION

- A. Submersible Pump Submittal: Complete data shall be submitted to the Engineer for approval, including a single stage pump performance characteristic curve, with actual horsepower required per stage and pump efficiency shown clearly. Statements from the pump manufacturer confirming ANSI/NSF Standard 61 may be required.
- B. Submersible Pump Warranty: The pump manufacturer shall warrant the units being supplied to the Department against defect in workmanship and materials for a period of three (3) years from the date of acceptance of Department.

- C. Submersible Pump Quality Assurance: The pump manufacturer shall perform the following inspections and tests on the pumps before shipment from the factory.
1. Impeller size, motor rating, and electrical connections shall first be checked for compliance to the customer purchase order.
 2. A motor and cable insulation test for moisture content or insulation defects.
 3. Pressurize the motor with an environmentally safe gas and use a sniffer device to check for leaks at all joints and seals.
 4. Prior to submergence, the pump shall be run dry to establish correct rotation, proper amp readings, and mechanical integrity.
 5. The pump shall run for 30 minutes submerged a minimum of 6 feet under water.
 6. After operational test No. 5, the insulation test (No. 2) is to be performed again.
- A written report stating the foregoing has been done shall be supplied with each pump at the time of shipment.
- D. A written report stating the foregoing has been done shall be supplied with each pump at the time of shipment.
- E. The pump manufacturer's representative shall witness the pump installation and testing after the installation is complete. A written report covering the representative's findings and installation certification shall be submitted to the Engineer covering all inspections and outlining, in detail, any deficiencies noted.
- F. Submersible Pump Testing: Before final acceptance of the pumps specified herein, the Contractor shall submit five (5) copies of certified and properly identified performance curves which shall reflect the operating characteristics of each pump model and impeller combination being supplied. The curves shall indicate head, capacity, horsepower, efficiency, and input QU. Test shall be performed in accordance with test code for Centrifugal Pumps per the standards of Hydraulic Institute. Test shall be performed on the actual assembled pumps to be supplied-prototype model tests are not acceptable. Test shall cover a range from shut-off to a minimum 20% beyond specified design.
- G. All existing pumps and motor not used shall be salvaged and given to the Owner.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 332010

334500 STORM AND GROUNDWATER PUMP SEAL WATER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification includes the requirements for a complete packaged system with automated controls to provide continuous lubrication water to three storm water pumps located in the surface water pump house and four groundwater pumps located inside the new horizontal collector well building. Each pump requires between 1 and 2 gpm of seal water when in operation. Up to three groundwater pumps and two surface water pumps can be in operation at one time.
- B. The system will utilize potable water that has been passed through a reverse pressure zone backflow preventer as its main supply. A backup supply shall include quick connections to a portable truck mounted water tank. Additionally, and only to be used in extreme conditions, process groundwater available from the main collector well discharge header shall be utilized. The system shall deliver from 1 to 20 gpm at 100 psi to the system at all times. The system shall utilize pumps drawing from a break tank to pressurize the water, multiple redundant control valves to control the pressure, and hydro pneumatic tank to accommodate the flow variations. Individual solenoid valves shall direct the water to each surface water or groundwater pump selected for operation. Lastly, individual automatically adjusting control meter / valve control devices shall feed a set amount of water to each surface water or groundwater pump regardless of internal pump seal pressure.
- C. The seal water system shall be located in the collector well pump room. The four collector well pumps shall be supplied locally and individually by the seal water system. Additionally, a single supply pipe shall extend from the system to the storm water pump station where a distribution manifold shall be located. The three storm water pumps shall be fed by this distribution manifold.
- D. The packaged unit shall be provided with a single control panel fed by 480V, 3 Phase power supply. This supply shall power all functions of the seal water system. The seal water system supplier shall provide all controls to make the system fully operational.

1.2 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by the manufacturers specifically named herein.
- B. Unit responsibility. Pumps, complete with motor and all other specified accessories and appurtenances, shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.

1.3 PERFORMANCE

- A. Two pumps shall be provided. They shall be designed for continuous operation under normal service and at the projected delivery flow and pressure variations.
- B. Individual Pump performance requirements:
 - 1. Design point: 20 gpm @ 250 feet total dynamic head.
 - 2. Non-overloading motor under any pumping condition.
- C. Break Tank
 - 1. 500 gallons
- D. Physical Conditions:
 - 1. Product Pumped: Nonpotable water.
 - 2. Product Temperature: 32-85 degrees F.

1.4 SUBMITTALS

- A. Submit Product Data in accordance with Section 013300 – Submittal Procedures to include a complete description of all products, components, and accessories (specified or implied herein) as to manufacturer, model, function, materials of construction, and installation and operation requirements. Submit nameplate data and bill of materials for pump assembly; total assembled weights and shipping weights for all products, components, and accessories specified or implied herein.
- B. Submit Shop Drawings in accordance with Section 013300 – Submittal Procedures to detail all component, accessory, system, and layout dimensions and clearances for installation, operation, and maintenance; and all piping, wiring, and other connections indicated or otherwise implied by the Contract Documents.
- C. Submit manufacturer's certified test results for the factory tests specified herein. Provide manufacturer's certified pump performance curves showing the performance test results required by this specification section.
- D. Submit manufacturer's loading, unloading, handling, storage, installation, starting, adjusting, and maintenance instructions.
- E. Submit manufacturer's statement of qualifications to provide products as specified herein.

- F. Submit certification from pump manufacturer that the products furnished under this section comply with the Contract Documents.
 - G. Submit Product Data, Shop Drawings, Test Reports, Manufacturer's Instructions, Qualification Statements, and Certificates for review a minimum of two weeks prior to shipment of pump to jobsite.
 - H. Motor Data:
 - 1. Complete descriptive specifications of the motor, with necessary cuts, photographs, and drawings to indicate the construction of the motor, the treatments used to prevent corrosion of parts, bearing construction, and type of insulation used on all windings.
 - 2. Dimensional outline drawings
 - 3. Motor characteristic curves (test or calculated), indicating the speed, power factor, efficiency, current and kilowatt input, all plotted against percent load as abscissas. Also, curves shall shown locked-rotor current and time of acceleration under full load.
 - I. Submit operation and maintenance manuals.
- 1.5 The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pumps, motor, and other equipment for a period of three (3) years from the date of startup.

PART 2 - PRODUCTS

2.1 PUMPS

- A. Two pumps shall be provided. They may be submersible and mounted in the break tank, or mounted on a skid and connected to the break tank by appropriately sized piping. The supplier shall provide all supports and piping to accommodate the installation.
- B. Pump housings shall be seamless bronze or stainless steel construction, minimizing deterioration due to water conditions and electrolysis.
- C. The impellers shall be precision molded out of cast iron or stainless steel. Water passages throughout the impeller and diffuser shall be smoothed for minimum friction, increasing pump efficiencies. Diffusers shall have molded in stainless steel wear rings at all critical wearing points.
- D. The pump shaft shall be heavy-duty design, constructed of stainless steel. Keyways shall be spaced 180 degrees apart for smooth transition of motor torque.

- E. Each pump shall be provided with a discharge check valve, discharge isolation valve, and discharge 0-160 psi pressure gauge. Skid mounted pumps shall also be provided with inlet isolation valve and 0-60 psi suction pressure gauge.

2.2 MOTOR

- A. Nonsubmersible motors shall be open drip proof design and all motors shall have a 1.15 service factor and rated for VFD use at 50% speed (even though VFD will not be provided with this project). The motors shall be of sufficient size to be non overloading over the entire pump curve.

2.3 BREAK AND HYDROPNEUMATIC TANKS

A. General:

- 1. The break tank shall be provided as a single unit. The hydro pneumatic tank will be provided as a part of the skid mounted pumping system.

B. BreakTank

- 1. Translucent with content gradations.
- 2. Non corroding
- 3. With cover and drain
- 4. Reinforced piping connections
- 5. Connections and support for three float operated fill valves
- 6. 500 gallon capacity
- 7. Reinforced for submersible pump installation, if provided

C. Connections

- 1. Reinforced connections shall be provided for one primary and two secondary supplies. Minimum connection size shall be 2" diameter IPS. Each inlet shall be designed to withstand the weight of a self contained float valve.
- 2. A valved 1 inch diameter drain shall be located for easy access and no more than 1" above the tank floor. It shall be configured to allow connection of a flexible hose.
- 3. The lid shall contain a hinged access plate and supports for three control floats and an ultrasonic level transducer. The ultrasonic transducer shall be installed inside a stilling well.

4. A reinforced inlet shall be provided for water to be returned into the tank from an excess pressure relief valve.
5. A 4" diameter overflow reduced to 2" diameter and routed to the nearest floor drain

D. Hydropneumatic Tank

1. The floor mounted hydropneumatic tank shall be sized by the system supplier to accommodate the full range of pressures and flow rates anticipated.
2. The materials of construction shall be noncorrosive, stainless steel is preferred.
3. The air bladder shall be capable of at least 150 psi and rechargeable.
4. The fluid volume shall be sufficient to carry small system flow rates without unreasonably cycling the pumps on and off. The fluid volume shall be a minimum of 40 gallons when in normal operation.

2.4 FLOAT VALVES

- A. Float valves shall be provided to control the introduction of the primary and secondary water supplies. Two identical valves shall be provided for the primary supply.
- B. Each float valve shall be designed for and capable of passing the maximum 20 gpm flow rate. The primary supply pressure at the inlet of the valve is approximately 50 psi and the secondary inlet pressure is approximately 5 -30psi.
- C. The valve bodies shall be bronze with stainless steel and erosion resistant elastomeric trim. Valve seats and the modulating assembly shall be designed for constant throttling of the flow at the rates and pressures indicated.
- D. Each valve shall be operated by a float set to allow the primary water supply to be lead and the secondary supplies to be lag. The floats shall be stainless steel.
- E. Isolation valves shall be provided to allow any float valve to be removed from service without affecting system operation.

2.5 PRESSURE RELIEF VALVE

- A. A pressure relief valve shall be provided to allow any excess pressure to be introduced back into the storage tank.

- B. The valve shall be an adjustable globe style diaphragm type designed for continuous operation at the maximum flow and pressure generated by the pumps operating together. The initial relief pressure shall be 120 psi. The range of pressure loss across the valve shall be no greater than 10 psi from no discharge to full flow discharge.
- C. The valves shall be bronze body with stainless steel and corrosion resistant elastomeric materials.
- D. Each valve shall be configured for it to be individually removed from operation without affecting the system's operation.

2.6 WATER DISTRIBUTION

- A. Seal water shall be distributed from the pump discharge manifold to two distribution panels. One panel will be located in the collector well pump room (beside the seal water pump system) and one will be remotely located in the storm water pump station.
- B. Each distribution panel shall be piped with similar function for each of the pumps requiring seal water as shown on the Drawings.
- C. Each distribution panel shall be mounted on a stainless steel wall mounted back plate and contain a master isolation valve, pressure gauge, inlet piping couplings, and individual pump piping. The stainless steel panel shall be sealed with a clear urethane to prevent oxidation of the stainless steel.
- D. The seal water delivery piping for each surface water or groundwater pump shall be one half inch diameter schedule 80 PVC and shall contain:
 - 1. Submaster isolation valve
 - 2. Bypass connection with isolation valves
 - 3. Heavy duty 120 V stainless steel solenoid valve
 - 4. 0-10 gpm control rotameter (pressure rated at 160 psi)
 - 5. Needle valve
 - 6. Discharge pressure gauge
 - 7. Discharge side coupling
 - 8. Flow switch

2.7 EMERGENCY CONNECTIONS

- A. The system's piping shall be designed and constructed to
1. allow the connection of a two inch diameter quick connect to the pump suction piping or break tank allowing a remote portable tank to supply the entire system.
 2. By provided piping and valves allow the direct manual feed of the nonpotable water supply (following the reverse backflow protector) into the break tank or pump suction piping manifold.
 3. The overflow shall be piped into the nearest floor drain and capable of at least 50 gpm discharge.
- B. Other:
1. Pressure gauges shall be provided on each inlet supply and pump discharge with stainless steel case and wetted parts and shall be shipped loose for field mounting by the Contractor. The pressure gauge shall be scaled 0 to 160 psi.

2.8 CONTROLS

- A. General
1. The control system shall consist of direct acting float valves to introduce water into and maintain set water levels in the break tank, an ultrasonic level transmitter, control valves for each pump to control pressure, and alarms to engage if the primary supply fails (the tank level falls to a low set point) or the tank overflows.
 2. Alarm floats shall be totally encapsulated 120 Volt contacts with a waterproof tether cord. The floats shall be capable of suspension by the cord.
 3. All alarm signals shall terminate in a NEMAA terminal strip box mounted on the skid.
 4. The arrangement of the control system shall be provided by the system supplier.
 5. The ultrasonic transmitter shall be provided with a local display for wall mounting next to the storage tank. It shall be equipped with 4-20 ma output proportional to tank level.

6. The control valves shall be capable of maintaining the set system pressure to within 10%. It shall be of stainless steel and bronze construction and may include an elastomeric diaphragm. It shall be rated for continuous duty to supply the flow rates and pressures required.
- B. A pressure transducer shall be provided on the pump discharge header. It will provide a 4-20 ma proportional signal of the pressure inside the header. 0-160 psi range.
 - C. Other:
 1. Pressure gauges shall be provided on each inlet supply and pump discharge with stainless steel case and wetted parts shall be shipped loose for field mounting by the Contractor. The pressure gauge shall be scaled 0 to 160 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written recommendations.
- B. All strain from attached piping shall be eliminated from the pumps and any evidence of pump or driver misalignment, noisy operation, or other signs of improper setting shall be corrected at no extra cost to the Contract. Care during storage, installation, and lubrication shall be in strict accordance with the manufacturer's recommendations.

3.2 PAINTING

- A. Provide protection for all shop-applied coatings during handling, loading, shipping, unloading, storage, and installation.

3.3 FIELD TESTS

- A. Functional Test: Prior to startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test in accordance with manufacturer's instructions.
- B. Performance Test: Perform field tests on completed pump assemblies to demonstrate their conformance to the Specifications to the satisfaction of the Engineer. A test log shall be presented to the Engineer upon the completion of each test that records the flow, as measured by plant instrumentation and/or storage volumes, pump suction and discharge pressures as measured by calibrated gauges, converted to feet of the liquid pumped, driving motor voltage and amperage measured for each phase.

- C. Field testing shall be witnessed by Owner and Engineer.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 230553

334510 SMALL COLLECTOR WELL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification includes the supply of 2 vertical turbine enclosed lineshaft pumps (CW-P02 and CW-P03). Each unit shall include a bowl assembly, suction strainer, column and enclosed lineshaft, discharge head, sealing assembly and driver. Units shall be shipped to the jobsite assemble less the motor, top shaft and coupling.

1.2 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. Unit responsibility. Pump(s), complete with motor, necessary guards and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- C. The vertical turbine pump(s) specified in this section and Section 334520 shall be furnished by and be the product of one manufacturer.
- D. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program.
- E. Pump(s) are to be engineered and manufactured under the certification of ISO-9001:2000.

1.3 PERFORMANCE

- A. The pump(s) shall be designed for continuous operation and will be operated continuously under normal service.

B. OPERATION CRITERIA

1. Listed primary design conditions and listed secondary design conditions are listed to ensure all anticipated flow characteristics are covered. Due to continual and unpredictable system characteristics the listed design parameters are critical for this project. Pump manufactures and suppliers must meet the listed parameters. All costs associated with modification to existing standard or engineered products to meet the design requirements during testing or after installation will be the responsibility of the General Contractor and pump supplier. Pumps not meeting all the listed criteria shall not be allowed.

	Flow (GPM)	TDH (ft.)	Max. Pump Speed (RPM)	Minimum Acceptable Bowl Efficiency	Max. Shutoff Head (ft.)	Maximum Acceptable NPSHr
Design Condition	2000	140'	1200	80%	220'	19'
Secondary Condition	1000	180'	1200	50%	220'	21'
Secondary Condition	2500	110'	1200	80%	220'	19'
Secondary Condition	2800	85'	1200	60%	220'	24'
Secondary Condition	2000	80'	1000	80%	140'	7'

- C. Total dynamic head shall be as measured at the discharge of the pump and shall include velocity head and vertical static head from the minimum water level to the centerline of the pump discharge.
- D. Minimum water level shall be at elevation 315 feet.
- E. Pump(s) are to be mounted at 320 feet elevation with the sump floor at 303 feet elevation.
- F. Pump discharge centerline shall be at 424 feet elevation.
- G. Maximum pump speed shall not exceed 1200 RPM.
- H. Driver size shall be limited to 100 HP maximum.
- I. Liquid pumped is water with a maximum temperature of 80 deg. F.
- J. Minimum submergence 47.00 inches to prevent vortexing.

- K. The pumps will use an external water supply to lubricate the pump assembly. The primary water supply shall be potable water. In the event the potable supply is not operational an alternate groundwater supply shall be employed. The key water characteristics of this backup supply are 10 mg/L iron, 75 mg/L chloride, 1,100 mg/L Total Dissolved Solids, and a pH range of 7-8. All water delivered to the seals shall be filtered with disposable 5 micron filters. Each pump shall use no more than 2 gpm at 100 psi for this purpose.

- 1.4 The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pump, motor, and other equipment for a period of three (3) years from the date of startup.

PART 2 - PRODUCTS

2.1 PUMPS

A. Design

1. Rotation

- a. The pump will be counterclockwise rotation when viewed from the driver end looking at the pump.
- b. The pump assembly shall be water lubricated with pressurized potable water with product water used in case of a primary water supply failure.

2. Impeller

- a. The impeller shall be of 304L or 316L Stainless Steel. They shall be of one-piece construction, single suction, enclosed vane, and radial flow design. The waterways through the impeller shall have extremely smooth contours, devoid of sharp corners, so as to promote maximum efficiency. They may be coated with an appropriate coating to optimize wear and efficiency.
- b. The impeller is to be balanced and secured to the shaft by means of a 304L or 316L stainless steel drive collet for bowl shafts 1-15/16" diameter and smaller. For bowl shafts larger than 1-15/16" impellers shall be secured to the shaft using a combination of a thrust washer, key and/or snap rings.
- c. Impellers shall be adjustable by means of a top shaft-adjusting nut.

3. Bowls

- a. The bowls shall be made of cast 304L or 316L stainless steel. Castings shall be free from blowholes, sand holes and shall be accurately machined and fitted to close dimensions.
- b. Bowls shall be flange connected with 304L or 316L fasteners.
- c. Bowls shall be designed with smooth passages to ensure efficient operation.
- d. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.

4. Impeller Shaft

- a. Impeller shaft shall be of 304L or 316L stainless steel construction.
- b. The shaft shall be supported by 304L or 316L stainless steel with neoprene bearings located on both sides of each impeller.
- c. Impeller shaft coupling shall be of 304L or 316L stainless steel construction
- d. Pump shaft shall be a minimum diameter of 1.437"

5. Wear Rings

- a. Wear rings shall be provided on both the impellers and bowls so that clearances can be maintained throughout the life of the rings and minimize recirculation.
- b. Impeller wear rings shall be of the radial-type.
- c. Bowl wear rings shall be of the radial-type.
- d. Wear rings shall be attached to the impellers and bowls using an interference fit and Loctite.
- e. Wear rings shall be 304L or 316L stainless Steel.

6. Column

- a. Total length of discharge column shall be sufficient to meet the dimensions shown on the Drawings.
- b. Column pipe shall be not less than 14" inches outside diameter and weigh not less than 55 pounds per foot.
- c. Column pipe shall be furnished in interchangeable sections not over ten feet in length, and shall be connected with flanges.
- d. Column flanged joints are to be butted to insure perfect column alignment after assembly.
- e. Column pipe sections shall be manufactured at the pump manufactures facility with each flange machined to ensure concentricity. Each column section shall be match marked to ensure proper installation. Buy out pipe sections of pipe with OEM flange connections are specifically not allowed.
- f. Pump head and column shall be shipped to the jobsite as components for field assembly and installation by the General Contractor, items being shipped including but not limited to:
 - 1) 16" outlet discharge head
 - 2) Hollow Shaft motor
 - 3) Hollow Shaft
 - 4) Adjusting nut
 - 5) Pump base plate
 - 6) Pump Sole plate
 - 7) Pump column
 - 8) Pump drive shaft
 - 9) Pump Drive shaft couplings
 - 10) Drive shaft bearings
 - 11) Enclosing tube
 - 12) Enclosing tube couplings
 - 13) Pump bowl assembly

7. Lineshafts

- a. Lineshafting shall be of ample size to transmit the torque and operate the pump without distortion or vibration.
- b. Lineshafting shall be made of 304 L or 316 L stainless steel conforming to AISI 1045 and be furnished in interchangeable sections not over ten feet in length.
- c. Lineshafting shall be coupled with extra-strong threaded steel couplings machined from solid bar steel.

- d. Lineshafting shall be fitted with stainless steel replaceable sleeves at each bearing and shall conform to AISI 304L or 316L material.
- e. Lineshaft bearings shall be of neoprene material construction.
- f. Lineshaft bearings shall be retained in 304L or 316L guides that are fitted into the column coupling and secured in place by the butted column pipe ends.

8. Discharge Head Assembly

- a. The pump discharge head shall be of the above ground type of 304L or 316L Stainless Steel ANSI 125# discharge flange.
- b. The discharge head shall be of sufficient design to support the entire weight of the pump and driver.
- c. The discharge head shall be fabricated 304L stainless steel and specifically designed to elevate the discharge head natural frequency above the operating speed.
- d. A drive shaft of the same material as the lineshaft shall extend through the sealing assembly of the discharge head and be coupled to a vertical hollow shaft driver.
- e. The shaft sealing assembly shall consist of a 304L or 316L stainless steel packing box, packing gland, packing box bushing, packing gland nuts and bolts, synthetic packing and a Teflon water seal ring.
- f. Packing box shall be rated for 175 PSI.
- g. Discharge head openings shall be fitted with guards to prevent access to the rotating shaft and/or coupling.

9. Electric Motor

- a. The motor shall be a heavy duty squirrel cage induction type, NEMA design B, 1800 RPM vertical hollow shaft motor, with a non-reverse ratchet to prevent reverse rotation of the rotating elements. A suitable thrust bearing shall be incorporated in the upper end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts under all conditions of operation. The motor shall be normal efficiency with a WP-I enclosure, 1.15 service factor, 100hp and suitable for use on a 230/460 volt, three phase, 60-cycle electric service. Motor shall be rated for continuous operation with the use of a VFD at a speed no greater than 50% at normal operating speed.

10. Vibration Limitations (Field)
 - a. The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.
11. Testing
 - a. A certified factory hydrostatic and performance test shall be performed on each bowl assembly in accordance with Hydraulic Institute Standards, latest edition. Bowls to be tested to HI Level 1U.
 - b. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.
12. Coating
 - a. Coating is not required on the pump assembly including column pipe.
 - b. Coating (clear urethane) is required on the exterior of the discharge head.
 - c.. The motor shall be coated as described in the painting section of these specifications.

2.2 WARRANTY

- A. The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pumps, motor, and other equipment for a period of three (3) years from the date of startup.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install the pump assemblies in the permanent locations as shown on the drawing and in accordance with the manufacturer's instructions.

3.2 TESTING

- A. All pumps supplied shall be tested per the latest addition of HI. At the owner's request all testing shall be witnessed. All associated cost for the Owner or the Owner's representative to travel and witness the HI testing shall be the responsibility of the Owner or the Owners representative. Any additional cost to the pump supplier for a witnessed test will be submitted as a change order to the project.

- B. Prior to system operation, all equipment shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance by means of a functional test.
- C. Field Testing
 - 1. Functional Test – required.
 - 2. Performance Test – required
- D. Before final acceptance of the pumps specified herein, the Contractor shall submit five (5) copies of certified and properly identified performance curves which shall reflect the operating characteristics of each pump model and impeller combination being supplied. The curves shall indicate head, capacity, horsepower, efficiency and input KW.

3.3 FINISHES

- A. Shop – All pump assemblies supplied under this section shall receive finishes that are in accordance with the pump manufacturer’s standard finish.
- B. Field – All pump assemblies shall be touch-up painted with matching paint supplied by the pump manufacturer.
- C. Drive Motors – all pump drive motors furnished under this section shall only receive finishes that are in accordance with the motor manufacturer’s standard finish DO NOT apply shop or field coatings to the drive motors.

3.4 MANUFACTURER’S SERVICES

- A. The Contractor shall include with his bid the services of the equipment manufacturer’s field service technician for a period of one (1) trip for a period of two (2) 8-hour days at the site. This service shall be for the purpose of check-out, initial technician’s findings and installation certification shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 334510

334520 LARGE COLLECTOR WELL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification includes the supply of 2 vertical turbine enclosed lineshaft pumps (CW-P01 and CW-P04). Each unit shall include a bowl assembly, column and enclosed lineshaft, discharge head, sealing assembly and driver. Units shall be shipped to the jobsite assemble less the motor, top shaft and coupling.

1.2 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. Unit responsibility. Pump(s), complete with motor, necessary guards and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- C. The vertical turbine pump(s) specified in this section and Section 334510 shall be furnished by and be the product of one manufacturer.
- D. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program.
- E. Pump(s) are to be engineered and manufactured under the certification of ISO-9001:2000.

1.3 PERFORMANCE

- A. The pump(s) shall be designed for continuous operation and will be operated continuously under normal service.

B. OPERATION CRITERIA

1. Listed primary design conditions and listed secondary design conditions are listed to ensure all anticipated flow characteristics are covered. Due to continual and unpredictable system characteristics the listed design parameters are critical for this project. Pump manufactures and suppliers must meet the listed parameters. All costs associated with modification to existing standard or engineered products to meet the design requirements during testing or after installation will be the responsibility of the General Contractor and pump supplier. Pumps not meeting all the listed criteria shall not be allowed.

	Flow (GPM)	TDH (ft.)	Max. Pump Speed (RPM)	Minimum Acceptable Bowl Efficiency	Max. Shutoff Head (ft.)	Maximum Acceptable NPSHr
Design Condition	3300	233'	1200	80.0%	376'	19.1'
Secondary Condition	1989	287'	1200	70%	376'	21'
Secondary Condition	3960	172'	1200	75%	376'	19.5'
Secondary Condition	4512	87.9'	1200	50%	376'	24'
Secondary Condition	2000	82.75'	700	80%	140'	7'

- C. Total dynamic head shall be as measured at the discharge of the pump and shall include velocity head and vertical static head from the minimum water level to the centerline of the pump discharge.
- D. Minimum water level shall be at elevation 315 feet.
- E. Pump(s) are to be mounted at 320 feet elevation with the sump floor at 303 feet elevation.
- F. Pump discharge centerline shall be at 424 feet elevation.
- G. Maximum pump speed shall not exceed 1200 RPM.
- H. Driver size shall be limited to 250 HP maximum.
- I. Liquid pumped is water with a maximum temperature of 80 deg. F.
- J. Minimum submergence 47.00 inches to prevent vortexing.

- K. The pumps will use an external water supply to lubricate the pump assembly. The primary water supply shall be potable water. In the event the potable supply is not operational an alternate groundwater supply shall be employed. The key water characteristics of this backup supply are 10 mg/L iron, 75 mg/L chloride, 1,100 mg/L Total Dissolved Solids, and a pH range of 7-8. All water delivered to the seals shall be filtered with disposable 5 micron filters. Each pump shall use no more than 2 gpm at 100 psi for this purpose.

1.4 WARRANTY

- A. The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pumps, motor, and other equipment for a period of three (3) years from the date of startup.

PART 2 - PRODUCTS

2.1 PUMPS

A. Design

1. Rotation

- a. The pump will be counterclockwise rotation when viewed from the driver end looking at the pump.
- b. The pump assembly shall be water lubricated with pressurized potable water with product water used in case of a primary water supply failure.

2. Impeller

- a. The impeller shall be of 304L or 316L Stainless Steel. They shall be of one-piece construction, single suction, enclosed vane, and radial flow design. The waterways through the impeller shall have extremely smooth contours, devoid of sharp corners, so as to promote maximum efficiency. . Appropriate coatings may be used to optimize wear and efficiency.
- b. The impeller is to be balanced and secured to the shaft by means of a 304L or 316L stainless steel drive collet for bowl shafts 1-15/16" diameter and smaller. For bowl shafts larger than 1-15/16" impellers shall be secured to the shaft using a combination of a thrust washer, key and/or snap rings.
- c. Impellers shall be adjustable by means of a top shaft-adjusting nut.

3. Bowls

- a. The bowls shall be made of cast 304L or 316L stainless steel. Castings shall be free from blowholes, sand holes and shall be accurately machined and fitted to close dimensions.
- b. Bowls shall be flange connected with 304L or 316L fasteners.
- c. Bowls shall be designed with smooth passages to ensure efficient operation.
- d. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.

4. Impeller Shaft

- a. Impeller shaft shall be of 304L or 316L stainless steel construction.
- b. The shaft shall be supported by 304L or 316L stainless steel with neoprene bearings located on both sides of each impeller.
- c. Impeller shaft coupling shall be of 304L or 316L stainless steel construction
- d. Pump shaft shall be a minimum diameter of 1.437"

5. Wear Rings

- a. Wear rings shall be provided on both the impellers and bowls so that clearances can be maintained throughout the life of the rings and minimize recirculation.
- b. Impeller wear rings shall be of the radial-type.
- c. Bowl wear rings shall be of the radial-type.
- d. Wear rings shall be attached to the impellers and bowls using an interference fit and Loctite.
- e. Wear rings shall be 304L or 316L stainless Steel.

6. Column

- a. Total length of discharge column shall be sufficient to meet the dimensions shown on the Drawings.
- b. Column pipe shall be not less than 14" inches inside diameter and weigh not less than 55 pounds per foot.
- c. Column pipe shall be furnished in interchangeable sections not over ten feet in length, and shall be connected with flanges.
- d. Column flanged joints are to be butted to insure perfect column alignment after assembly.
- e. Column pipe sections shall be manufactured at the pump manufactures facility with each flange machined to ensure concentricity. Each column section shall be match marked to ensure proper installation. Buy out pipe sections of pipe with OEM flange connections are specifically not allowed.
- f. Pump head and column shall be shipped to the jobsite as components for field assembly and installation by the General Contractor, items being shipped including but not limited to:
 - 1) 16" inches discharge head
 - 2) Hollow Shaft motor
 - 3) Hollow Shaft
 - 4) Adjusting nut
 - 5) Pump base plate
 - 6) Pump Sole plate
 - 7) Pump column
 - 8) Pump drive shaft
 - 9) Pump Drive shaft couplings
 - 10) Drive shaft bearings
 - 11) Enclosing tube
 - 12) Enclosing tube couplings
 - 13) Pump bowl assembly

7. Lineshafts

- a. Lineshafting shall be of ample size to transmit the torque and operate the pump without distortion or vibration.
- b. Lineshafting shall be made of 304 L or 316 L stainless steel conforming to AISI 1045 and be furnished in interchangeable sections not over ten feet in length.
- c. Lineshafting shall be coupled with extra-strong threaded steel couplings machined from solid bar steel.

- d. Lineshafting shall be fitted with stainless steel replaceable sleeves at each bearing and shall conform to AISI 304L or 316L material.
- e. Lineshaft bearings shall be of neoprene material construction.
- f. Lineshaft bearings shall be retained in 304L or 316L guides that are fitted into the column coupling and secured in place by the butted column pipe ends.

8. Discharge Head Assembly

- a. The pump discharge head shall be of the above ground type of 304L or 316L Stainless Steel ANSI 125# discharge flange.
- b. The discharge head shall be of sufficient design to support the entire weight of the pump and driver.
- c. The discharge head shall be fabricated 304L stainless steel and specifically designed to elevate the discharge head natural frequency above the operating speed.
- d. A drive shaft of the same material as the lineshaft shall extend through the sealing assembly of the discharge head and be coupled to a vertical hollow shaft driver.
- e. The shaft sealing assembly shall consist of a 304L or 316L stainless steel packing box, packing gland, packing box bushing, packing gland nuts and bolts, synthetic packing and a Teflon water seal ring.
- f. Packing box shall be rated for 175 PSI.
- g. Discharge head openings shall be fitted with guards to prevent access to the rotating shaft and/or coupling.

9. Electric Motor

- a. The motor shall be a heavy duty squirrel cage induction type, NEMA design B, 1800 RPM vertical hollow shaft motor, with a non-reverse ratchet to prevent reverse rotation of the rotating elements. A suitable thrust bearing shall be incorporated in the upper end of the motor adequate to receive the entire hydraulic thrust load of the pump unit plus the weight of the rotating parts under all conditions of operation. The motor shall be normal efficiency with a WP-I enclosure, 1.15 service factor, 250hp and suitable for use on a 230/460 volt, three phase, 60-cycle electric service. Motor shall be rated for continuous operation with the use of a VFD at a speed no greater than 50% at normal operating speed.

10. Vibration Limitations (Field)
 - a. The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.
11. Testing
 - a. A certified factory hydrostatic and performance test shall be performed on each bowl assembly in accordance with Hydraulic Institute Standards, latest edition. Bowls to be tested to HI Level 1U.
 - b. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.
12. Coating
 - a. Coating is not required on the pump assembly including column pipe.
 - b. Coating (clear urethane) is required on the exterior of the discharge head.
 - c. The motor shall be coated as described in the painting section of these specifications.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install the pump assemblies in the permanent locations as shown on the drawing and in accordance with the manufacturer's instructions.

3.2 TESTING

- A. All pumps supplied shall be tested per the latest addition of HI. At the owner's request all testing shall be witnessed. All associated cost for the Owner or the Owner's representative to travel and witness the HI testing shall be the responsibility of the Owner or the Owners representative. Any additional cost to the pump supplier for a witnessed test will be submitted as a change order to the project.
- B. Prior to system operation, all equipment shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance by means of a functional test.
- C. Field Testing

1. Functional Test – required.
 2. Performance Test – required
- D. Before final acceptance of the pumps specified herein, the Contractor shall submit five (5) copies of certified and properly identified performance curves which shall reflect the operating characteristics of each pump model and impeller combination being supplied. The curves shall indicate head, capacity, horsepower, efficiency and input KW.

3.3 FINISHES

- A. Shop – All pump assemblies supplied under this section shall receive finishes that are in accordance with the pump manufacturer’s standard finish.
- B. Field – All pump assemblies shall be touch-up painted with matching paint supplied by the pump manufacturer.
- C. Drive Motors – all pump drive motors furnished under this section shall only receive finishes that are in accordance with the motor manufacturer’s standard finish DO NOT apply shop or field coatings to the drive motors.

3.4 MANUFACTURER’S SERVICES

- A. The Contractor shall include with his bid the services of the equipment manufacturer’s field service technician for a period of one (1) trip for a period of two (2) 8-hour days at the site. This service shall be for the purpose of check-out, initial technician’s findings and installation certification shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 334520

402300 COLLECTOR PUMP STATION PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 1. This section covers the work necessary to provide and test the pipe, fittings, and valves for process groundwater. Building supply, waste and drain piping requirements are included in other sections.

1.2 REFERENCE TO STANDARDS

- A. The portions of the work specified in this section shall conform to the following standards, rules, and regulations with modifications and additional requirements as stated in or reasonably inferred from the Contract Documents.
1. Standard Specifications: "Standard Specifications for Construction of Water and Sewer Main in Illinois", 5th ed., May, 1996.
 2. 10-States Standards: "Recommended Standards for Water Works" as issued by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2003 Edition.
 3. IEPA Technical Policy Statement: "Rules and Regulations for Public Water Supplies" as issued by the Illinois Pollution Control Board (Title 35, Subtitle F, Chapter II, Parts 651-654 of the Illinois Administrative Code).
 4. ANSI/AWWA C104/A21.4-03, American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water, as published by American Water Works Association.
 5. ANSI/AWWA C105/21.5-99, American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems, as published by American Water Works Association.
 6. ANSI/AWWA C110/A21.10-03, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids, as published by American Water Works Association.
 7. ANSI/AWWA C111/A21.11-00, American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings, as published by American Water Works Association.
 8. ANSI/AWWA C115/A21.15-99, American National Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges, as published by American Water Works Association.
 9. ANSI/AWWA C116/A21.16-03, AWWA Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service, as published by American Water Works Association.
 10. ANSI/AWWA C150/A21.50-02, AWWA Standard for Thickness Design of Ductile-Iron Pipe, as published by American Water Works Association.
 11. ANSI/AWWA C151/A21.51-02, American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water, as published by American Water Works Association.

12. ANSI/AWWA C153/A21.53-00, American National Standard for Ductile-Iron Compact Fittings for Water Service, as published by American Water Works Association.
13. ANSI/AWWA C207, AWWA Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in. (100 mm through 3600 mm), as published by American Water Works Association.
14. ANSI/AWWA C219-01, AWWA Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe, as published by American Water Works Association.
15. ANSI/AWWA C500-93, AWWA Standard for Metal-Seated Gate Valves for Water Supply Service, as published by American Water Works Association.
16. ANSI/AWWA C504-00, AWWA Standard for Rubber-Seated Butterfly Valves, as published by American Water Works Association.
17. ANSI/AWWA C509-01, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, as published by American Water Works Association.
18. ANSI/AWWA C510-97, AWWA Standard for Double Check Valve Backflow Prevention Assembly, as published by American Water Works Association.
19. ANSI/AWWA C511-97, AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly, as published by American Water Works Association.
20. ANSI/AWWA C515-01, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service, as published by American Water Works Association.
21. ANSI/AWWA C540-93, AWWA Standard for Power-Actuating Devices for Valves and Sluice Gates, as published by American Water Works Association.
22. ANSI/AWWA C550-05, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.
23. ANSI/AWWA C600-93, AWWA Standard for Installation of Ductile-Iron Water Mains and their Appurtenances, as published by American Water Works Association.
24. ANSI/AWWA C605-94, AWWA Standard for Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water, as published by American Water Works Association.

25. ANSI/AWWA C606-04, AWWA Standard for Grooved and Shouldered Joints, as published by American Water Works Association.
26. ANSI/AWWA C651-99, AWWA Standard for Disinfecting Water Mains, published by American Water Works Association.
27. ANSI/AWWA C653-97, AWWA Standard for Disinfection of Water Treatment Plants, published by American Water Works Association.
28. ASME - Boiler and Pressure Vessel Codes - Section IX.
29. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch) Revision and Redesignation of ASME/ANSI B2.1-1968.
30. ANSI/ASME B 16.3 - Malleable Iron Threaded Fittings Classes 150 and 300.
31. ANSI/ASME B 16.14 - Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads.
32. ASME B 16.18-2001 - Cast Copper Alloy Solder Joint Pressure Fittings.
33. ASME B16.22-2001 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
34. ANSI/ASME B 16.39 - Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300.
35. ASME B 16.9 – Wrought Steel Butt Welding Fittings.
36. ANSI/ASME B31.1 - Code for Pressure Piping, Power Piping.
37. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
38. ASTM A105 - Standard Specification for Forgings, Carbon Steel, for Piping Components.
39. ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
40. ASTM A120 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
41. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

42. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
43. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
44. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
45. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
46. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
47. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
48. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
49. ASTM B32-04 - Standard Specification for Solder Metal.
50. ASTM B75-02 - Standard Specification for Seamless Copper Tube.
51. ASTM B88-03 - Standard Specification for Seamless Copper Water Tube.
52. ASTM D1330-04 - Standard Specification for Rubber Sheet Gaskets.
53. ASTM D 1784-03 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
54. ASTM D1785-04a - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
55. ASTM D2000-04 - Standard Classification System for Rubber Products in Automotive Applications.
56. ASTM D2321-04 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
57. ASTM D2464-99e1 Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
58. ASTM D2466-02 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
59. ASTM D2467-04e1 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

60. ASTM D2564-04 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
61. ASTM D2665-04a Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
62. ASTM D2855-96(2002) Standard Practice for Making Solvent-Cemented Joints with PVC Pipe and Fittings.
63. ASTM D2949-01 Standard Specification for 3.25-In. Outside Diameter Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
64. ASTM F437-99 Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
65. ASTM F438-04 Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
66. ASTM F439-02e1 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
67. ASTM F441/F441M-02 Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
68. ASTM F493-04 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
69. ASTM F1970-01 Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems.
70. MSS SP-43 – Wrought Stainless Steel Butt-Welding Fittings.
71. MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
72. MMS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
73. MMS-SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
74. MMS-SP-85, Cast Iron Globe and Angle Valves.
75. MMS-SP-88, Diaphragm Type Valves.
76. MMS-SP-110, Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flared Ends.
77. MSS SP-114 - Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000.

78. NSF/ANSI Standard 14: Plastic Piping System Components and Related Materials.
79. NSF/ANSI Standard 61: Drinking Water System Components - Health Effects.

1.3 SUBMITTALS

- A. Submittals shall include the following specific information:
 1. Detail installation drawings of each piping system to the scale stated on the Contract drawings, locating each spool, fitting, valve, support, guide, and hanger. Detail product data, including all applicable standards, and shop drawings for all pipe fittings, and valves.
 2. Detail installation drawings, catalog information, and complete component specifications for pipe support systems. Detailed shop drawings of all fabricated supports, including support anchoring devices, shall be supplied with the submittal.
 3. Submit certification that each manufacturer meets the applicable manufacturer's qualifications stated in this section.
- B. Submit the following specific information for welded steel process piping prior to the start of work:
 1. Procedure specifications and qualification records of all welding procedures for all pipe and associated structural welding to be performed under this Section, in accordance with Section IX of the ASME Boiler and Pressure Vessel Code except as modified by the code listed in Code Requirements of this Section.
 2. Welders' qualifications shall be submitted for each individual welder scheduled to execute welding work.

1.4 MANUFACTURER'S QUALIFICATION

- A. The pipe and pipe support manufacturers shall have been in the design, manufacture, and testing of the specified type of pipe, supports and associated equipment for ten (10) years minimum.

1.5 QUALITY ASSURANCE

- A. The manufacturer shall have established an on-going program of quality assurance and shall, upon request, provide records to the Engineer of quality control documentation for the specified products.

1.6 WARRANTY

- A. Submit manufacturer's written guarantee to warrant the equipment to be free of material or workmanship defects for a period of three (3) years from the date of substantial completion established by the Owner.

1.7 REGULATORY REQUIREMENTS

- A. All equipment furnished, and equipment installation, under this section and all referenced sections shall meet requirements of the Federal Occupation Safety and Health Act of 1970 (OSHA), as may be amended to date of order.
- B. All products provided under this section for service in contact with potable water shall be tested and certified by Underwriters Laboratory or NSF International (as an ANSI accredited certifier) against NSF 61: Drinking Water System Components - Health Effects.

1.8 CODE REQUIREMENTS

- A. Welded steel process piping shall meet the requirements of the ANSI Code for Pressure Piping B31.1, Power Piping, hereinafter referred to as the Piping Code.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Fittings, valves, and the ends of pipe shall be covered during shipping.
- B. If possible, store PVC and CPVC pipe inside. When this is not possible, store pipe on level ground which is dry and free from sharp objects.
 - 1. Store different schedules of PVC and CPVC pipe that are stacked together with the pipe with the thickest walls on the bottom.
 - 2. If the PVC and CPVC pipe is in pallets, the pallets should be stacked with the pallet boards touching, rather than pallet boards being placed on the pipe to prevent damage to or bowing of the pipe.
 - 3. If the PVC and CPVC pipe is stored in racks, it shall be continuously supported along its length. If this is not possible, the spacing of the supports shall not exceed three feet (3').
 - 4. The PVC and CPVC pipe shall be protected from the sun and be in an area with proper ventilation to lessen the effects of ultraviolet rays and help prevent heat build-up.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The materials to be used for each piping system are shown on the Drawings.
- B. Insulating gaskets shall be used between flanges of dissimilar metals.
- C. Piping nomenclature for pipe provided under this contract shall be as indicated in the Drawings.

2.2 FLEXIBLE AND TRANSITION COUPLINGS

- A. Expansion joints shall be provided for piping systems where shown. The Contractor may install additional pipe anchors to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection, if required. Acceptable types expansion joints shall be as follows:
 - 1. Expansion Joints: Expansion joints shall be flanged, spool-type, hand-laid elastomer bellows expansion joints and shall be reinforced, wide arch type with 150-pound ANSI flanged ends, split stainless steel flange retaining rings, control rods to protect the bellows from overextension and compression sleeves to protect the bellows from compression. The bellows arch shall be non-filled and lined with a NSF-61 listed Buna-N, nitrile, or butyl. Expansion joints shall be Red Valve, Style J-1W or Mercer Flexmore, Style 450. Burst pressure shall be four times the working pressure rating. Rated compression, elongation and lateral deflection and minimum working pressure ratings shall be equal to the published catalog data for Red Valve expansion joints as listed above. Flange bolt set for elastomer bellows expansion joints shall include washers over the split steel retaining rings to help provide a leak-proof joint under hydrostatic test pressures.
 - 2. Dielectric Pipe Fittings and Unions: When connecting piping system of dissimilar materials provide dielectric fittings and unions, with gaskets suitable for the intended service.

2.3 PIPING SUPPORT SYSTEMS

- A. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalog supports are inapplicable.
- B. Support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

- C. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the station.
- D. Piping supports, guides, and fasteners and those shall be Type 304L stainless steel. All submerged metal piping shall be electrically isolated from the supports with a wrap of 1/4-inch by 3-inch neoprene rubber between the pipe and oversize clamps.
- E. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be stainless steel and of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
- F. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment. A pipe support or hanger shall be installed adjacent to each pipe fitting or valve larger than 4-inch. A pipe support or hanger shall be installed adjacent to each end of each flowmeter larger than 4-inch as shown on the drawings.
- G. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for metallic pipe shall be as follows:

Pipe Size	Maximum Support and Hanger Span	Minimum Rod Size Single Rod Hangers
1-inch & Smaller	6 feet	3/8-inch
1-1/4 through 2-1/2-inch	8 feet	3/8-inch
3-inch & 4-inch	10 feet	3/8-inch
6-inch	12 feet	1/2-inch
8-inch	12 feet	1/2-inch
10-inch & 12-inch	14 feet	5/8-inch
14-inch	16 feet	3/4-inch
16-inch & 18-inch	16 feet	7/8-inch
20-inch	18 feet	1-inch
24-inch & 30-inch	18 feet	1-1/4-inch
36-inch	14 feet	1-1/2-inch

2.4 SERVICE SADDLES

- A. Service saddles shall be capable of withstanding 150 psi internal pressure without leakage or overstressing. The saddle shall be compatible with the pipe on which the saddle is installed. Taps shall be NPT unless noted otherwise or other threads are required by adjacent piping or appurtenances. Saddles shall have malleable or ductile iron bodies and stainless steel straps, steel hex nuts with washers, and neoprene seals. Service saddles shall be of double-strap or triple-strap design. Saddles for plastic pipe shall be listed by the manufacturer for the intended use.

2.5 FIELD INSTALLED FLANGES AND DISMANTLING JOINTS

- A. Provide Field Installed Flanges on ductile iron and steel process piping in lieu of threaded or welded flanges only when type and location of flange are specifically approved by Engineer.
- B. Field Installed Flanges shall be:
 - 1. Restrained Flange Adapter, Series 2100 MEGAFLANGE, as manufactured by EBAA Iron Sales, Inc.
 - 2. For installation adjacent to valves on welded steel piping where space for other Field Installed Flanges is not available, provide set-screw-type, adapter flange rated for 150 psi working pressure and drilling compatible with ANSI B16.1 150 lb. Flanges. Adapter flange shall be Uni-Flange Series 400, EBAA Iron Series 1000 E-Z Flange, Power Seal 3532, or equal.

2.6 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

- A. All piping penetrations of slabs, floors, walls, and roofs shall be ductile iron or steel wall pipes or pipes sleeves with thrust collars, unless otherwise noted on the drawings.
- B. It shall be the Contractor's sole responsibility to coordinate the pipe sleeve and the annular seal sizes.

C. Pipe Sleeves:

1. Provide steel and stainless steel pipe sleeves where steel or stainless steel piping passes through concrete walls, floors, slabs, and roofs which are to be watertight and where shown on the Drawings. Pipe sleeves shall be of a thickness equal to or greater than the passing pipe.
2. All pipe sleeves shall be provided with thrust collars. Thrust collars shall be fabricated of steel or stainless steel, similar to the pipe sleeve. The thrust collar shall be welded to the pipe sleeve. All welds shall be done in the pipe manufacturer's shop by qualified welder. The thrust collar shall be welded continuously around the pipe on both sides of the collar.
3. Thrust collars shall be rated for the thrust load developed at 250 psi and shall have a minimum safety factor of 2. The Contractor shall submit design calculations or the manufacturer's test report substantiating the pressure rating and safety factor specified.
4. The annular space between pipes and sleeves shall be watertight. The joint shall be sealed by a modular mechanical unit consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. The interconnected rubber links shall be assembled with stainless steel bolts and nuts and pressure plates under each bolt head and nut to prevent the nut from turning when the bolt is tightened. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and sleeve opening. The installed closure shall provide electrical isolation of the pipe from the sleeve. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings.

2.7 PIPE SUPPORT BEARING PAD

- A. Each pipe saddle shall receive bearing pads. They shall be 3/16-inch thick and cover 100% of the contact area between the pipe and the pipe saddle. See pipe support details.
- B. Each pipe anchor strap shall receive bearing pads. The bearing pad shall be 3/32-inch thick and cover 100% of the contact area between the pipe and anchor strap. See pipe support details.
- C. The coefficient of friction shall average 0.06 under a compressive load of 2000 psi. The compressive creep shall be a maximum of 2% at 2000 psi at 70°F. The pads shall be a blend of materials composed of virgin (unreprocessed) PTFE resin tested per ASTM D1457 and reinforcing agents including milled glass fibers. The blended material shall have the following physical properties: tensile strength, 2200 psi; elongation, 225%; specific gravity, 2.17 to 2.22.
- D. The bearing pads shall be as manufactured by Con-Serv, Inc., Georgetown, S.C., Model: CON-SLIDE Type CSA or approved equal.

2.8 DUCTILE-IRON PIPE AND FITTINGS

- A. Ductile-Iron Pipe shall be manufactured by one of the following:
1. American Cast Iron Pipe Company.
 2. U. S. Pipe and Foundry Company.
 3. Griffin Pipe Company.
- B. Pipe shall be centrifugally cast, Grade 60-42-10, iron, pipe barrels conforming to AWWA C151. Pipe shall have standard thickness cement-mortar lining with seal coat in accordance with AWWA C104. Pipe for buried installation shall have a bituminous coating applied to the pipe exterior. Pipe for interior installation shall have an epoxy prime coat on the pipe exterior as specified in Section 099600 - High-Performance Coatings.
1. Flanged pipe barrel thickness shall be in accordance with AWWA C115.
 2. Buried pipe class shall be as determined by AWWA C150 as a minimum and as follows:
 - a. Buried pipe pressure class diameter and smaller shall be AWWA C151 Special Thickness Class 50 or pressure class 350.
 - b. Buried pipe larger than 12-inch diameter shall be AWWA C151 Special Thickness Class 52 or pressure class pressure class 350.
- C. Evidence of compliance with the ANSI/AWWA standards referenced in this specification shall be provided by an accredited independent third party inspection organization such as NSF International or approved equal.
- D. Fittings shall be ductile iron and have standard thickness cement-mortar lining with seal coat in accordance with AWWA C104. Where taps are shown on fittings, tapping bosses shall be provided. Fittings for interior installation shall have an epoxy prime coat and fittings for buried installation shall have a bituminous coating applied to the exterior surfaces. A fusion bonded epoxy coating on the interior and exterior surfaces that conforms to AWWA C116 is acceptable in lieu of cement mortar lining and bituminous exterior coating for fittings provided for buried service or in lieu of the cement mortar lining and exterior epoxy primer for exposed service.
1. Flanged fittings shall conform to AWWA C110. Flanges shall be flat faced and drilled in accordance with Class 150 ANSI B16.1.
 2. Push-On and Restrained Push-On fittings shall conform to AWWA C110 or AWWA C153.
 3. Mechanical Joint and Restrained Mechanical Joint fittings shall conform to AWWA C110 or AWWA C153.

4. Boltless Restrained Joint fittings shall conform to applicable sections of AWWA C110 or AWWA C153. Restrained joint fittings shall be a boltless-type joint and capable deflection after assembly. Restrained joint fittings shall be TR Flex, as manufactured by U. S. Pipe and Foundry Company or Flex-Ring, as manufactured by American Cast Iron Pipe Company.
- E. Flanged pipe joints shall conform to AWWA C111 and AWWA C115 for threaded ductile iron flanges.
 - F. Push-On pipe joints shall conform to AWWA C111. Push-on joints shall be:
 1. Tyton Joint complete with Tyton gasket and lubricant supplied by pipe manufacturer.
 2. Fastite Joint complete with Fastite gasket and lubricant supplied by pipe manufacturer.
 - G. Restrained Push-On pipe joints shall conform to AWWA C111. Push-on joints shall be:
 1. Tyton Joint complete with Field-lok gasket and lubricant supplied by pipe manufacturer.
 2. Fastite Joint complete with Fast-Grip gasket and lubricant supplied by pipe manufacturer.
 - H. Mechanical Joints shall conform to AWWA C111. Glands 24-inches and larger may be segmented at the manufacturer's option. Mechanical joints shall use a low alloy steel or ductile iron follower gland except where a restrained mechanical joint is required or indicated on the Drawings.
 - I. Restrained Mechanical Joints shall conform to AWWA C111. Restraint of mechanical joints between pipes shall be incorporated into the follower gland and shall include a mechanism to impart multiple wedging action that increases with increasing pipe pressure. Follower glands with restraining mechanisms shall be manufactured of ductile iron conforming to ASTM A536, shall conform to and shall be compatible with dimensions of mechanical joints conforming to AWWA C111 and AWWA C153, shall have a working pressure of 250 psig, and shall have a minimum design safety factory of 2:1. The mechanical joint follower gland with restraint mechanism shall be Series 1100 MegaLug as manufactured by EBAA Iron, Inc. or Uni-Flange Series 1400 as manufactured by Ford Meter Box Company.

- J. Boltless Restrained Joints shall conform to applicable sections of AWWA C111, shall be a boltless-type joint that is capable deflection after assembly. Restrained joints shall be one of the following:
1. Flex-Ring bell-ends and factory spigot-ends or Flex-Ring bell-ends and Field Flex Rings for field-cut pipe-ends, as manufactured by American Cast Iron Pipe Company.
 2. TR Flex bell-ends and factory spigot-ends or TR Flex bell-ends and TR Flex Gripper Rings for field-cut pipe-ends, as manufactured by United States Pipe and Foundry Company.
 3. SNAP-LOK – Tyton bell-ends and factory spigot-ends for 6-inch through 24-inch diameter piping. SNAP-LOK – Fastite bell-ends and factory spigot-ends for 30-inch through 48-inch diameter piping. SNAP-LOK FC – Tyton for 6-inch through 24-inch diameter field-cut pipe.
- K. Flanged Joint Bolting: Provide stainless steel, finished, Grade A hex head bolts and Grade A heavy hex head nuts for flanged joints. Flange bolting shall conform to AWWA C111, including Appendix C, and the length and diameter of nuts, bolts and studs shall conform to the dimensions given in AWWA C115.
- L. Mechanical Joint Bolting: Provide anti-rotation, high-strength, low-alloy (Cor-Ten) T-bolts with ASTM A563, Grade A heavy hex head nuts. Bolting shall conform to AWWA C111, including Appendix A.
- M. Bolting shall be of domestic origin.
- N. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted, Styrene-Butadiene (SBR) synthetic rubber conforming to AWWA C111, ASTM D-1330 Grade II, and ASTM D-2000 Type AA with Durometer Hardness of 75 Shore A ± 5 , unless otherwise specified. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in the intended service. Gaskets shall be ring-type for 14-inch and larger pipe diameters and full-face type for smaller sizes with nominal inside diameter, outside diameter, and bolt holes as shown in Appendix A of AWWA C115. Specially designed gaskets with one or more annular rings in the gasket to improve joint performance and supplied by the pipe manufacturer may be substituted with approval from the Engineer.
- O. Gaskets for push-on, restrained push-on, mechanical, restrained mechanical, and boltless restrained joints shall be SBR, styrene butadiene rubber, conforming to AWWA C111. Where contaminated soil is encountered, elastomers that are compatible with and chemically resistant to the soil contaminants shall be provided. Gaskets for restrained push-on joints shall have stainless steel wedging elements manufactured as part of the gasket.

P. Gaskets shall be manufactured or supplied by the following pipe manufacturers:

1. American Cast Iron Pipe Company.
2. U. S. Pipe and Foundry Company.
3. Griffin Pipe Company.
4. No substitutions will be allowed.

P. Lubricant for piping shall be the pipe manufacturer's standard only, no substitutes will be permitted.

2.9 MILL TYPE STEEL PIPE AND FITTINGS

A. Pipe shall be black carbon steel meeting the requirements of ASTM A120 and A53, Grade B seamless or electric resistance welded.

B. Pipe Wall Thickness shall be as follows:

1. 4-Inch through 6-Inch: Schedule 40.
2. 8-Inch through 12-Inch: Schedule 20.
3. 14-Inch through 24-Inch: 1/4-inch.

C. 4-inch through 24-inch fittings shall be Butt-Welding Type, Carbon steel, to match pipe wall thickness, ASTM A234, Grade WPB, meeting the requirements of ANSI B16.9.

D. Branch connections, 4-Inch and Larger shall be:

1. Straight or reducing tees.
2. Standard weight forged steel, ASTM A105, Grade II, commercial welding branch fittings with butt-welding outlet.
3. Use tee for branch outlet full size of run or one size reduced.

E. Flanges shall be forged steel, hub type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Hub flanges or Steel-ring, plate type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Ring flanges. All steel-ring, plate type flanges shall be fabricated with an inside diameter not greater than 1/8-inch larger than the associated pipe outside diameter.

F. Provide carbon steel, finished, hot-dipped galvanized, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A heavy hex head nuts for AWWA Class D flanges and carbon steel, finished, hot-dipped galvanized, ASTM A193, Grade B7 hex head bolts and ASTM A194, Grade 2H heavy hex head nuts for AWWA Class E flanges.

G. Provide 1/8-inch thick gaskets, conforming to ANSI/AWWA C207 for rubber gaskets, for flanged joints unless otherwise specified. Provide flat-faced gaskets between flat-faced flanges and ring gaskets for mating to a raised-face flange.

H. Covered welding electrodes shall be as specified in the welding procedure and welding rod and bare electrodes shall be as specified in this Section.

2.10 FABRICATED WELDED STEEL PIPE AND FITTINGS

- A. Pipe shall be Carbon steel, black, electric fusion welded from ASTM A283, Grade C, or ASTM A570, Grade C plate, straight seamed, 1/4-inch thick minimum, unless otherwise indicated in the Piping Schedules shown on the Drawings. Pipe shall be designed and fabricated in accordance with the requirements of AWWA C200 and the ASTM standards referenced therein. Pipe sizes shown in these Documents shall be for nominal outside diameter, unless otherwise noted, and shall conform to the requirements of ANSI B36.10.
- B. Joints shall be butt-welded or flanged, as specified herein.
- C. Fittings shall be butt-welding-type, carbon steel, to match pipe wall thickness, fabricated from the pipe material in accordance with the dimensions shown in AWWA C208 as four or five-piece fittings. Tees, reducing tees, or laterals shall be as specified in this Section.
- D. Flanges shall be:
 - 1. Forged steel, hub type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Hub flanges.
 - 2. Steel-ring, plate type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Ring flanges. All steel-ring, plate type flanges shall be fabricated with an inside diameter not greater than 1/8-inch larger than the associated pipe outside diameter.
- E. Provide carbon steel, finished, hot-dipped galvanized, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A heavy hex head nuts for AWWA Class D flanges and carbon steel, finished, hot-dipped galvanized, ASTM A193, Grade B7 hex head bolts and ASTM A194, Grade 2H heavy hex head nuts for AWWA Class E flanges.
- F. Provide 1/8-inch thick gaskets, conforming to ANSI/AWWA C207 for rubber gaskets, for flanged joints unless otherwise specified. Provide flat-faced gaskets between flat-faced flanges and ring gaskets for mating to a raised-face flange.
- G. Covered welding electrodes shall be as specified in the welding procedure and welding rod and bare electrodes shall be as specified in this Section.

2.11 GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

- A. Galvanized pipe shall conform to ASTM A53/A53M for Hot-Dip Galvanized, Type E, electric resistance welded, or Type S, seamless, Grade A or B. Unless noted otherwise in the Drawings or Piping Schedule, pipe shall be Schedule 80 for Carbon Dioxide service and Schedule 40 for other service.

- B. Joints in galvanized piping, four-inch and smaller, shall be threaded conforming to ANSI B1.20.1 and sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated. Joint compound shall meet Federal Spec.TT-S-1732 for water and compatible chemical service.
- C. Galvanized fittings, four-inch and smaller, shall conform to ANSI/ASTM A16.3 with galvanizing conforming to ASTM A153. Unless notes otherwise in the Drawings or Piping Schedule, fittings shall be Class 300 for Carbon Dioxide service and Class 150 for other service.
- D. Galvanized plugs, bushings, and locknuts, four-inch and smaller, shall conform to ANSI/ASTM A16.14 with galvanizing conforming to ASTM A153.
- E. Galvanized unions, four-inch and smaller, shall conform to ANSI/ASTM A16.39 with galvanizing conforming to ASTM A153. Unless notes otherwise in the Drawings or Piping Schedule, unions shall be brass to iron seat Class 300 for Carbon Dioxide service and Class 150 for other service.

2.12 STAINLESS STEEL PIPE AND FITTINGS

- A. Stainless steel pipe and fitting dimensions and materials shall conform to ASTM A312, MSS-SP-114, Class 150 or Class 1000 as noted and shall be 316L. Pipe threads shall conform to ASME B1.20.1. General dimensions for stainless steel flanges shall conform to MSS-SP-51. Dimensions of flange bolt hole and circle diameters shall conform to ANSI B16.5. All 150 LB Stainless Steel fittings and flanges shall be identified with the manufacturer's trademark, nominal pipe size, and material grade.
- B. Cast 150 LB fittings and flanges shall be manufactured from material conforming to ASTM-A-351 CF8/304, CF8M/316, or CN7M/A-20, as noted. Forged/barstock 150 LB fittings and flanges shall be manufactured from forged or wrought barstock materials conforming to the chemistry of ASTM-A-182 (F304 or F316) or ASTM-B-473 (A-20) in a proper state of heat treatment to provide desired mechanical properties and corrosion resistance.
- C. Cast 150 LB fittings shall be suitable for use at pressure/temperature ratings for MSS-SP-114 Class 150 Fittings (300 psi CWP / 150 psi SWP). MSS flanges and flanged fittings shall be suitable for use at pressure/temperature ratings for MSS-SP-51 Class 150LB. Forged/barstock 150 LB Fittings shall be suitable for use at pressure/temperature ratings for MSS-SP-114 Class 1000 Fittings (1000 psi CWP).
- D. Threaded joints in stainless steel piping shall be sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated. Joint compound shall meet Federal Spec.TT-S-1732 for water and compatible chemical service.

- E. The exterior of all stainless steel piping in exposed areas shall be properly prepared and coated with clear polyurethane at 3 to 5 mil thickness.
- F. The exterior of all stainless steel piping in buried or immersed areas shall be properly prepared and coated with cured coal tar epoxy at 7 to 20 mil thickness.

2.13 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454-B (Type 1, Grade 1 PVC 1120) as identified in ASTM D 1784.
 - 1. PVC Schedule 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785.
 - 2. PVC Schedule 80 fittings shall conform to ASTM D 2467.
 - 3. PVC Schedule 80 threaded fittings shall conform to ASTM D 2464.
 - 4. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785.
 - 5. PVC Schedule 40 fittings shall conform to ASTM D 2466.
 - 6. Unions and flanges meet the requirements of ASTM F 1970 with gasket that is compatible with intended service.
 - 7. Solvent cement and primer shall conform to ASTM D 2564 and shall be as recommended by the pipe and fitting manufacturer. Cement for chemical piping systems shall be IPS Weld-On CPVC 724 or Ipex Zirtec 24 CPVC cement or shall be listed by manufacturer for compatibility with specific chemical service.
 - 8. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.
 - 9. All pipe and fittings shall be manufactured in the United States.
 - 10. Pipe and fittings shall conform to NSF Standard 61 and NSF Standard 14.
- B. Provide solvent-cement joints, except where connecting to unions, valves, and equipment with flanged or threaded connections that may require future disassembly.

- C. Flanges shall be flat faced, compatible with ANSI 125-pound drilling, and the same Schedule as the adjacent piping, unless noted otherwise. Flange gaskets shall be full-faced, 1/8-inch thick, material suitable for the intended service. Chemical service gaskets shall be 100% expanded PTFE. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect PVC flange from bolting moment. Provide flange bolting of Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts. Provide bolts and nuts with washers on each side, of the same material as the bolts and nuts.
- D. Threaded joints shall be sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated. Joint compound shall meet Federal Spec. TT-S-1732 for water and compatible chemical service.

2.14 BRONZE BALL VALVES

- A. Standard-port, NPT-end, two-piece ball valves shall be Apollo 70-100, Nibco T-580-70, Milwaukee BA-150C, or equal.
- B. Standard-port, solder-end, two-piece ball valves shall be Apollo 70-200, Nibco S-580-70, Milwaukee BA-100, or equal.
- C. Union-end, standard-port, NPT end, two-piece ball valves shall be Apollo 70-300, or equal.
- D. Union-end, standard-port, solder-end, two-piece ball valves shall be Apollo 70-400, or equal.
- E. Full-port, NPT-end, two-piece ball valves shall be Apollo 77-100, Nibco T-585-70, Milwaukee BA-125, or equal.
- F. Full-port, solder-end, two-piece ball valves shall be Apollo 77-200, Nibco S-585-70, Milwaukee BA-155, or equal.
- G. All non-AWWA ball valves shall be furnished in accordance with MSS-SP-110 and with bronze body and ball, reinforced TFE seats, adjustable packing gland, zinc-plated steel lever actuator, and 600 psi WOG rating.

2.15 PLASTIC BALL VALVES

- A. PVC plastic ball valves shall have true-union end connections compatible with adjacent piping, PVC body and ball, ABS or PVC actuating lever, TFE ball seats, viton O-rings, and 230 psi rating at 70 degrees F.
- B. Vented, CPVC plastic ball valves shall have true-union end connections compatible with adjacent piping, CPVC body and ball, ABS or PVC actuating lever, TFE ball seats, viton O-rings, and 150 psi rating at 70 degrees F.

2.16 STAINLESS STEEL BALL VALVE

- A. Stainless steel ball valves shall be all 316L stainless steel with threaded joints. TFE seat and seal shall be rated for no less than 150psi working pressure. Furnished with lever operator.

2.17 NON-AWWA GATE VALVES

- A. 3-inches and smaller Non-AWWA gate valves shall be Crane 438, Nibco T-113, or Milwaukee 105 for NPT ends and Crane 1701-S, Nibco S-113, or Milwaukee 115 for solder ends.
- B. 2 to 4-inch outside screw and yoke Non-AWWA gate valves shall be Nibco T-617-0, or equal.
- C. 4-inch and larger outside screw and yoke Non-AWWA gate valves shall be Crane 465-1/2, Nibco F-617-0, or Milwaukee F-2885.
- D. All non-AWWA cast iron gate valves shall be furnished in accordance with MSS-SP-70 and with cast iron body, brass stem, cast iron or fabricated steel handwheel, solid bronze or bronze faced cast iron wedge, bronze seats, graphite packing.
- E. All non-AWWA bronze gate valves shall be furnished in accordance with MSS-SP-80 and with bronze body, silicon bronze stem, bronze wedge, iron handwheel, and graphite packing.

2.18 AWWA TYPE GATE VALVES

- A. AWWA Type gates valves shall have AISI Type 316L stainless steel or better fasteners, and end connections as designated on the valve schedule or Drawings. Valves for buried service shall be furnished with standard 2-inch square wrenchnut and valve box. 16-inch and larger valves shall be fitted with enclosed bevel gear operator to accommodate installation of valve in horizontal position in buried installation.

B. AWWA Gate valves shall conform to the following:

1. Resilient seat/wedge, NRS type rated for 250 psig cold water working pressure.
2. In full accordance with ANSI/AWWA C515 for 3-inch through 36-inch sizes or ANSI/AWWA C509 for 4-inch through 16-inch sizes or in accordance with all applicable provisions of ANSI/AWWA C509 for 18-inch through 24-inch sizes.
3. 316L Stainless Steel valve body, bonnet, and gate.
4. Non rising stem
5. Provided with wedge gate that is encapsulated with rubber, symmetrical, and seals equally well with flow in either direction.
6. Provided with O ring stem seals.
7. Certified to ANSI/NSF Standard 61 by either Underwriters Laboratory or NSF International.
8. Valves shown on the Drawings to be attached to a flanged hydrant shoe, tapping valve, tapping saddle, or flanged branch of a tee or cross shall have one flanged end compatible with the mating flange.
9. Valves shall open counter-clockwise unless noted otherwise. Valve designations ending with the suffix "(R)" shall open to the right or clockwise.

2.19 MANUALLY OPERATED KNIFE GATE VALVE INSIDE COLLECTOR PUMP STATION

A. Submittals

1. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, and pressure rating.
2. Upon request, provide shop drawings that clearly identify the valve dimensions including all supplied accessories.

B. Quality Assurance

1. Supplier shall have at least ten (10) years experience in the manufacture of knife gate valves utilizing elastomer seats, and shall provide references and a list of installations upon request.

C. Slurry Knifegate Valves

1. Knife Gate Valves shall be bonnetless and packingless valves made with a ductile iron body in sizes 3" through 12" or a fabricated steel body in sizes 14" and up. They shall be rated for normal operating pressure of 150 psi. Port areas shall be 100% of the full pipe area throughout the entire length. The valve body to be fully flanged to suit ANSI 816.5 Class 150 drilling dimensions. The flush port of the valve is to be a minimum of 70% of the body length. A standard splash containment or optional pipe-a-way containment shall be available if atmosphere dumping is not desired.
2. All sizes shall have two full-port slurry sleeves. The sleeves will be molded with an integral stiffener ring that maintains round configuration of the sleeves, relieves stress on the seal and ensures the sleeves provide a "blind-flange" bi-directional shut-off when in the closed position. The slurry sleeves shall be used as wiper rings to clean the gate of debris as it moves from the close to open position. The valve shall be equipped with a slotted body in lieu of body spacers to guide the gate. The valve shall incorporate grease fitting for the stem and gate. Standard stem material shall be 17-4PH stainless steel with a brass stem bearing and bronze oilite bearing. Standard gate material shall be 316 stainless steel. Composite or high alloy gates shall be available to meet various process conditions. When in the open position, the gate shall be removed from the flow path and can be replaced without removing valve from service. The valve shall be manufactured in the U.S.A.

D. Function

1. Rotating the handle (and therefore the threaded nut) clockwise pushes the threaded stem towards the valve body, sliding the gate between the rubber sleeves until the opening is completely blocked. Rotating the handle counter-clockwise pulls the gate out from between the sleeves, opening the valve.

E. Installation

1. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

F. Manufacturer's Customer Service

1. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.
2. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

2.20 CHECK VALVES

- A. Check valves shall be designed and constructed in accordance with requirements of AWWA C508 and provide full pipeline flow area with disc at 25 degrees open, and shall allow for 45 degrees total disc rotation. Check valves shall have .ASTM Class B epoxy coated cast iron body, AWWA C508 cast bronze body seat, ductile iron disk, rubber seat ring selected by the manufacturer in accordance with potable water requirements, as given in AWWA C508. The disc shall be attached to the disc arm by an articulated mechanism, constructed with stainless steel hinges and pins, and designed to insure uniform compression of the disc seal ring to the disc seat, under any pressure condition, up to the maximum working pressure. The disc attachment arm shall be constructed of ductile iron. The disc hinge shaft shall be stainless steel and supported in the valve body by solid or sleeve type bronze bearings. The disc hinge shaft shall pass completely through the valve body at one end, to permit attachment of the external counterweight arm. The shaft shall employ stainless steel keys for attachment of the disc arm (internal) and counterweight arm. All welded surfaces shall be epoxy coated or made of with other similar corrosion resistant materials.

2.21 MAGNETIC FLOWMETER

- A. Flow meter shall operate on electromagnetic induction principle and give an output signal directly proportional to the velocity of the process medium.
- B. Primary (Flow Head)
- C. Each primary shall have a flanged 316L stainless steel metering tube and a non-conductive corrosion resistant liner suitable for the liquid being metered. End connections shall be steel flanged for sizes 1/2" and greater, ANSI Class 150#, for meter sizes up to 24" and AWWA Class B or D for meters larger than 24". The housing shall be epoxy coated steel welded at all joints. Bolted coil enclosures shall not be acceptable.
- D. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current. The coils must be located on the outside of the flow tube. Coils embedded in liner are not acceptable.
- E. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by a remote converter. Output signal from the primary shall be fed through DS proprietary cable supplied with the meter for remote signal converters. A length of 100 DS cable shall be required to connect the primary to the remote converter.
 - 1. The Primary Flow head shall have a housing rated for:
 - a. Complete Submergence (IP68)
 - 2. Electrode material shall be compatible with process fluid.

3. Meters sized 1" to 120" shall be hard rubber lined
 4. Build-up of foreign substances on the electrodes shall be prevented, while meter is in service, in the following manner: "Hot Tap" removable electrodes shall be provided on sizes 14" to 120". High Impedance circuits shall not be acceptable in lieu of hot tap removable electrodes.
 5. The instrument shall be manufactured in an ISO 9001 approved facility.
 6. When installed in lined or non-metallic piping, the meter shall be provided with virtual grounding. Grounding rings and electrodes shall not be acceptable.
- F. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to .02% accuracy, and be traceable to National standards.

2.22 Magnetic Inductive Flow Converter

- A. The magnetic inductive flow converter shall be remote mounted and provide precisely controlled and regulated, bi-polar DC primary field excitation pulses which are digitally selectable at 12 different frequencies. The unit shall convert the primary flow meter signal into a standard linear analog or pulse/frequency output directly proportional to the flow rate or flow total. The accuracy of the converter shall be .2% +/- 1mm of measured value for all flow velocities above 3 feet per second in flow tube sizes 3/8th to 80 inches. The converter shall have empty pipe indication/stabilization standard. The Converter shall be capable of Virtual Reference, negating the need for grounding rings/electrodes in processes with conductivity greater than 200 micromho's. The converter shall be capable of up to (4) inputs or outputs with selectable combinations of.
1. Standard 4-20 mA DC with HART
 2. Totalized pulses.
 3. Frequency output of 0 – 10 kHz
 4. Control Input
 5. Alarm/Status Output
- B. The full scale measuring range shall be a configurable input in all standard engineering units as well as any user defined unit, and freely adjustable over a range from 1.0 to 40 ft/sec velocity.

- C. Converter shall be capable of continuously monitoring all common modes of failure of magnetic inductive flow meters, verifying a 100% check of flow meter software and hardware components, 100% check of accuracy and linearity, and 100% check of process conditions that may adversely affect flow measurement uncertainty. The converter shall provide local display of detected errors, as well as the ability to assign any or all errors to outputs. All diagnostics shall be available on the standard HART communication protocol, PACTware or other bus protocol as specified. The converter shall be microprocessor based and be completely interchangeable with other converters of the same type. The converter housing shall contain an EEPROM memory, saving the original calibration data, factory default configuration settings, and (2) user defined configuration setting profiles, which can be uploaded to temporarily test configuration changes or re-configure replaced electronics. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of the flow converter. The converter shall have two independent counters, which are assignable as Positive, Negative or Sum totals. Counters shall be password protected to prevent unauthorized resetting. The counters shall maintain their accumulated values with power loss, and continue counting when power resumes. The converter shall be provided with local graphical display (back-lit white), 128 x 64 pixels with three separate display pages; pages 1 and 2 shall allow viewing from 1 to 3 lines of measured values (user assignable) in engineering units or with 0-100% bar graph. User selectable measurements (i.e. flow rate, counter 1 and/or 2 (+, -, or sum), diagnostics, etc.) on either display page and display line. Display page 3 shall show all diagnostics that are currently active or occurred since last acknowledgement. The top line of the display shall show the meter Tag Number as configured into the unit, as well as a graphical indication of errors detected.
- D. Programming of the flow converter shall be accomplished without removing the glass cover via 4 optical keys or remotely with hand held HART terminal or with vendor and protocol independent PC configuration software; PACTware (Process Automation Configuration Tool) over HART or other bus protocols. Manufacturer shall provide necessary drivers (DTM's) at no additional charge.
- E. Analog outputs shall have user configurable time constant of 0 to 100 seconds. User adjustable low flow cutoff to force readings to zero on decreasing flow and de-activate on increasing flow, settable from 0% to 20% of full scale setting, with the decreasing flow setting < increasing flow setting (providing hysteresis). The converters basic input and output shall contain four I/O's;
1. Analog mA output
 2. Pulse or Analog Frequency output
 3. Status outputs

- F. The basic outputs can be altered in the field by programming. All inputs / outputs shall be galvanically isolated from each other and all other circuits. The analog outputs can be assigned to represent any of the following measurements; Flow Velocity, Volume Flow Rate, Mass Flow Rate, Coil Temperature (indicative of process temperature), or Process Conductivity.
- G. The converter shall have HART smart protocol as standard. Optionally the converter shall have Foundation Fieldbus or Profibus PA or DP protocols as required.
- H. The converter shall provide the ability to simulate flow rates, to verify analog output spans are correct in receiving devices. The converter shall self test for over load or open circuits on the analog output and alarm if either condition exists. The converter shall provide the capability to test all inputs and outputs for proper operation to assist in commissioning. The converter shall self test all variables that can affect magnetic inductive flow meters performance, and verify all variables are within tolerance, and alarm when measurements are uncertain, without the use of additional test equipment. Ten year data retention during storage without the need for auxiliary power.
- I. The signal converter shall be manufactured in an ISO 9001 Facility.
- J. The flow rate and totalizer indication shall be located in the Motor Control Room at a location selected by the owner.

2.23 RELEASE AIR & VACUUM BREAKER VALVES

- A. The air & vacuum valve shall vent air and gas during the filling of a pipeline or system and automatically close when liquid rises in the valve. The valve shall remain closed when the system is pressurized but automatically re-open to admit air during draining or a negative pressure condition. It shall have an elongated body not less than 20" (508mm) tall suitable for use with "dirty" fluids and be of the float operated, compound lever type with an adjustable seat.
- B. The valve's venting orifice diameter shall be no less than the nominal size of the valve as shown on the plans and/or in the valve schedule. Valves 3" (80mm) and smaller shall have NPT inlet and outlet connections and 1" (25mm) size valves shall have a 2" (50mm) inlet connection (2" x 1") to minimize plugging. Sizes 4" (100mm) and 6" (150mm) shall have a flanged inlet and NPT outlet connections.
- C. The valve body and cover shall be cast or ductile iron and rated for 200 PSI (1,379 KPa) and shall be epoxy coated inside and out.
- D. The float ball, internal trim and linkage mechanism shall be made from Type 316L stainless steel. Non-metallic components are not acceptable.
- E. The seat shall be replaceable and made from Buna-N rubber or other suitable elastomer compounds.

- F. Valves shall be as manufactured by GA Industries, LLC, Cranberry Township, PA, Apco, or Val-Matic

PART 3 - EXECUTION

3.1 PIPE PREPARATION AND HANDLING

- A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
- B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe and coatings. Do not drop or dump pipe into trenches under any circumstances.
- C. Ream, clean, and remove burrs from piping before making up joints.
- D. Cut copper pipe square and remove burrs. Clean both inside of copper fittings and outside of pipe before sweating. Take care to prevent annealing of fittings and hard-drawn tubing when making connections.
- E. Bends in soft temper copper pipe shall be long sweep, wherever possible. Bends shall be shaped with bending tools and shall be made without appreciable flattening, buckling, or thinning of the tube wall at any point.

3.2 INSTALLATION OF BURIED PIPING

- A. General:
 - 1. Buried piping shall be installed in accordance with "Standard Specifications", "10-States Standards", "IEPA Technical Policy Statements", AWWA C600 and AWWA C605 except for requirements regarding measurement and payment and as modified herein.
 - 2. Assembly of buried pipe and fittings shall be in accordance with the manufacturer's written instructions and recommendations.
 - 3. Field cut pipe shall be cut square, beveled, field-gauged, and rounded in accordance with manufacturers written instructions and recommendations.

4. Solid sleeves shall be installed with buried piping only where shown on plans. Provide a make-up pipe spacer to fill the gap between pipe ends covered by the sleeve. The pipe spacer shall be cut from the same pipe material as adjacent pipe and shall be cut to length such that all adjacent joints remain fully seated.
 5. All buried piping shall be uniformly sloped and installed to the line and grade indicated on the drawings. Minimum depth of cover shall be 4'-0" unless noted otherwise.
 6. If a grade conflict is determined, the Contractor shall notify the Engineer, who shall then determine what adjustments are required.
- B. Excavation - Provide trench bottom with bedding as specified below to support pipe barrel at required line and grade.
- C. Bedding and Backfilling -
1. Pipelines greater than five (5) feet beyond the limits of any structure:
 - a. Backfill with clean cohesive soil material
 - b. Ductile Iron Pipe: Bed in flat trench bottom raked to loosen soil to a 2-inch minimum depth, and provide reliefs cuts in trench bottom for pipe joints.
 - c. HDPE, PE, PVC, or PVCO Pipe: Bed from 4-inches below pipe to pipe springline in FA-1 or FA-2 material that meets the backfill requirements of Section 312333 – Trenching and Backfilling.
 - d. Place and compact initial backfill and bedding from bottom of trench to 12-inches above pipe in uniform 6-inch layers on alternating sides of pipe.
 - e. Place and lightly consolidate final backfill in uniform 12-inch layers to finish grade.
 - f. Place all bedding and backfill material to the full width of the trench.

2. Pipelines within 5 feet of any structure, pavement, or sidewalk or under any pavement or sidewalk:
 - a. Bed and backfill with FA-1 or FA-2 material compacted to a minimum of 95% of the maximum dry density as determined by a Standard Proctor Compaction Test and placed to the full width of the trench.
 - b. Cut relief for pipe joints in bedding prior to placing pipe.
 - c. Extend bedding and backfill from the bottom of the trench to rough grade or to the sidewalk or pavement subgrade.
 - d. Place and compact fill materials in uniform 6-inch layers up to the top of the pipe and in uniform 12-inch layers from the top of the pipe to rough grade or to the sidewalk or pavement subgrade.
 3. Pipe under any structure:
 - a. Prepare trench bottom by placing and compacting a uniform 6-inch layer of FA-1 or FA-2 material to the full width of the trench.
 - b. Compact trench bottom to a minimum of 95% of the maximum dry density as determined by a Standard Proctor Compaction Test.
 - c. Cut relief for pipe joints in compacted trench bottom prior to placing pipe.
 - d. Place backfill material. Backfill with flowable fill for the full width of the trench from trench bottom to the bottom of footing for pipes under footings, to the bottom of compacted granular material for pipes under floor slabs, or to the bottom of the compacted site fill for pipes under floor slabs on fill areas.
 - e. Refer to Cast in Place Concrete for requirements for flowable fill material.
 4. Pipe and fittings in contact with flowable fill shall be encased in polyethylene in accordance with AWWA C105. Flowable fill shall not be allowed to obstruct the bell face of any pipe or fitting.
 5. Compaction methods shall conform to the requirements of these specifications.
- D. Thrust block all crosses, tees, bends, plugs, fire hydrants and valves against undisturbed earth as detailed in the drawings. Backfill thrust blocks a minimum of 24 hours after placement. Thrust blocks or misplaced concrete shall not contact the bell face or fasteners of any pipe, fitting, or valve.

3.3 INSTALLATION OF EXPOSED PIPING

- A. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible on common size ranges.
- B. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.
- C. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings.
- D. Pipe taps to the pipe barrel are acceptable only where specifically indicated on the Drawings. Pipe tap connections to ductile iron piping shall only be made at a tapping boss of a fitting, valve body, or equipment casting. Pipe tap connections to steel piping shall be made only with a welded threadolet connection.
- E. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.
- F. Straight runs of piping equal to five pipe diameters upstream and three pipe diameters downstream of flow measuring devices shall be smooth and unobstructed unless otherwise approved by the meter manufacturer.
- G. Where valve handwheels are shown, valve orientation shall be as shown. Where valve handwheels are not shown, valves shall be oriented to permit easy access to the handwheels, and to avoid interferences.

3.4 VALVE INSTALLATION

- A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseal or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.
- B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads prior to making joints. Joints shall be watertight at test pressures before acceptance.

3.5 VALVE STEM ORIENTATION

- A. All valves installed in horizontal runs of pipe having centerline elevations 4-feet 6-inches or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of pipe having centerline elevations greater than 4-feet 6-inches above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits the stem orientation listed above, the stems shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.
- B. Valves installed in suspended solids application, shall be positioned with the plug or wafer horizontal axis and rotating to the top of valve body when open.
- C. Inverted operating stems will not be permitted unless specifically approved by the Engineer.

3.6 VENTS AND DRAINS

- A. Vent the high points and drain the low points of all pipelines, except gravity flow services, whether shown on the Drawings or not, with 3/4-inch ball valves on those pipelines 2-1/2-inch and larger and 1/2-inch ball valves on those pipelines 2-inch and smaller. Similarly, each high point of those pipelines running through stepped galleries shall be vented through a ball valve to the gallery floor scupper, whether shown or not.

3.7 WALL PIPES AND PIPE SLEEVES

- A. Wall pipes and pipe sleeves embedded in concrete roofs, walls, floors, and slabs shall be embedded as shown on the drawings. Primary support for all pipes embedded in concrete roofs, walls, floors, and slabs shall be by the formwork. The reinforcing steel shall provide secondary support if needed.

3.8 INSTALLATION OF FLEXIBLE COUPLINGS, FLANGED COUPLING ADAPTERS, AND SERVICE SADDLES

- A. Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean surface for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used for bolt tightening.

3.9 TESTING

- A. General: Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer will monitor the tests. Test pressures and type of test shall be as specified in the Piping Schedule shown on the Drawings.
- B. Testing New Pipe Which Connects to Existing Pipe: New pipelines which are to be connected to existing pipelines shall be tested by isolating the new pipe with special valves or blind flanges as necessary.
- C. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints and valve stem packing shall show no visible leakage under test. Tighten or repack stem packing, and repair joints that show signs of leaking prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for any damage caused by the testing.
- D. Preparation and Execution:
 - 1. Buried Pressure Piping: Conduct pressure and leakage tests in accordance with AWWA C-600, Hydrostatic Testing. Test pressures shall be as indicated on Pipe Schedule in Drawings. Buried pressure piping under structures shall be tested prior to backfilling and shall be "leak tight". No drop in pressure and no testing allowance is acceptable for buried piping under structures.
 - 2. Exposed Pressure Piping: Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors, but prior to insulation. All exposed pressure pipe shall be leak tight with no pressure drop at the specified pressure.
- E. Hydrostatic Leak Tests:
 - 1. Equipment: Furnish any and all equipment required for successful completion of the hydrostatic tests. Provide any and all plugs, taps, connections, caps, valves, bracing, support, etc. necessary for successful performance and completion of hydrostatic tests.
 - 2. Procedure: Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be potable water or clean water of such quality as to minimize contamination and corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule or shown on the Drawings.

3. Gravity piping shall be tested with 10 feet of water to include the highest horizontal vent in the filled piping. Where vertical drain and vent systems exceed 10 feet in height, the systems shall be tested in 10 vertical foot sections as the piping is installed.
 4. The 150 psi hydrostatic test pressure shall be continuously maintained for a minimum time of 30 minutes and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the Contractor's sole expense.
 5. Buried Gravity Process Piping Lines: Conduct pressure and leakage tests in accordance with pressurized watermain testing requirements of AWWA C-600. Test pressures shall be as listed in the Pipe Schedule. Buried gravity piping under structures shall be tested prior to backfilling and shall be "leak tight". No drop in pressure and no testing allowance is acceptable for buried gravity process piping.
- F. Test Records: Records shall be made of each piping system installation during the test and recorded. These records shall include but not limited to the following:
1. Date of test.
 2. Description and identification of piping tested.
 3. Test fluid.
 4. Test pressure.
 5. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
 6. Certification by Contractor and signed acknowledgement by Engineer.

3.10 INTERIM CLEANING

- A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, etc. within pipe sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.11 FINAL CLEANING

- A. Following assembly and testing and prior to final acceptance, all pipelines installed under this section, except plant process air lines and instrument air lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2-inch and larger or by removing spools and valves.

3.12 EXTERIOR COATINGS

- A. All surfaces of pipe, fittings, valves, supports, hangers, accessories, and appurtenances that are exposed to the atmosphere during normal plant operation shall be field painted with a tie-coat and two-coat epoxy system. Ductile iron pipe and fittings and iron body valves shall have a manufacturer-applied epoxy primer. Piping products with asphaltic exterior coatings are not acceptable for field applied paint systems. The manufacturer of the field coatings shall submit specific recommendations for the tie coat to be compatible with piping manufacturer's shop primers. All surfaces shall be solvent cleaned in accordance with SSPS SP1 prior to field painting. Epoxy primers that have developed significant chalking or have exceeded the manufacturer's recoat window shall be brush blasted in accordance with SSPC SP7, or scuff sanded with 150 grit sandpaper, to a uniformly abraded surface prior to the SP! Solvent cleaning.

3.13 INTERIOR COATINGS

- A. All surfaces of pipe, fittings, valves, supports, hangers, accessories, and appurtenances that are exposed to potable water, process water, or the vapors thereof during normal plant operation shall be furnished by the manufacturer with an epoxy coating system that is NSF 61 listed for the proposed service. Ductile iron pipe and fittings shall have cement mortar or fusion-bonded epoxy lining. Non-ferrous pipe, fittings, and valves that are NSF 61 listed for the intended service without a coating are not required to have an interior coating.

3.14 PAINTING

- A. Painting of piping systems shall be in accordance with the additional requirements specified elsewhere in the Contract Documents.

3.15 INSTALLATION OF DUCTILE-IRON PIPE

- A. Care shall be taken not to damage the cement lining when handling the pipe. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Dress cut ends of pipe in accordance with the type of joint to be made. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer. Dress cut ends of pipe for flexible couplings and flanged coupling adapters as recommended by the coupling or adapter manufacturer.

- B. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer. A sufficient number of selected flange-to-pipe threaded joints shall be hydrostatically shop tested to ensure joint integrity.
- C. Flanged pipe joint assembly shall conform to AWWA C111, Appendix C. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to assure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
- D. Push-On and Restrained Push-on pipe joint assembly shall conform to AWWA C111, Appendix B. Join pipe in accordance with the manufacturer's written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted.
- E. Mechanical and Restrained Mechanical joint assembly shall conform to AWWA C111, Appendix A. Join pipe in accordance with the manufacturer's written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted. Torque-limiting wrenches shall be used to ensure uniform bolt tightening.
- F. Restrained Joint: Join pipe in accordance with the manufacturer's written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted.

3.17 INSTALLATION FABRICATED WELDED STEEL PIPE AND FITTINGS

- A. Provide welding in accordance with the latest editions of Section IX, ASME Boiler and Pressure Vessel Code except as modified by the piping code listed in this Section.

B. Welding Procedure Specifications:

1. Qualify all welding procedure specifications prior to fabrication in accordance with the ASME Boiler and Pressure Vessel Code, Section IX except as modified by the code listed in CODE REQUIREMENTS of this Section.
2. Identify all welding procedure specifications by number and reference the procedure number on all fabrication Drawings.

C. Welding and Welding Operators:

1. Qualify all welders and welding operators prior to fabrication in accordance with the ASME Boiler and Pressure Vessel Code, Section IX except as modified by the code listed in CODE REQUIREMENTS of this Section.
2. Include qualifications for all welding positions to be employed in the fabrication.
3. Make qualification records available for review by the Engineer.

D. Materials:

1. Use welding products within the limits recommended by their manufacturers.
2. Keep electrodes, filler wires, and fluxes clean, dry, and properly stored according to manufacturer's recommendations. Do not use electrodes, filler wires, or fluxes that are damp, greasy, or oxidized.
3. Do not use backing rings.
4. Consumable inserts may be used if included in the qualified welding procedure specification. Match the chemistry of the consumable insert with the base metal and weld metal chemistry.

E. Weld Identification:

1. Assign each qualified welder or welding operator an individual identification number or symbol.
2. Permanently mark each pressure weld with the identification of the welder or welding operator who performed the weld. If more than one welder or welding operator welds a joint, each shall apply their identification in a manner to indicate the part of the weld they completed.

F. Procedure:

1. Clean surfaces to be welded free of paint, oil, dirt, scale, oxides, and other material detrimental to welding. Clean in a manner that will not lead to contamination of the weld or adjoining base metal.
2. No welding shall be performed if there is any rain, snow, sleet, or high wind in contact with the weld area or if the ambient temperature is below 32 degrees F.
3. If the ambient temperature is less than 32 degrees F, local preheating to a temperature warm to the hand is required.
4. Tack Welds:
 - a. Remove completely if not made by a qualified welder using the same procedure as for the completed weld.
 - b. If not removed, make tack weld with an electrode the same as, or equivalent to, the electrode to be used for the first weld pass.
 - c. Completely remove cracked tack welds.
5. Clean each layer of deposited weld metal with a power-driven wire brush, prior to depositing each subsequent layer of weld metal, including the final pass.
6. Chip or grind out surface defects which will affect the soundness of the weld.
7. Weld Passes:
 - a. 4-inch and Under Pipe: Minimum of a full root and second pass.
 - b. 6-inch through 24-inch Pipe: Minimum of three weld passes using the specified electrode.
 - c. Greater Than 24-inch Pipe: Minimum of three weld passes using the specified electrode.
8. Welds: Welds shall be free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of the limits prescribed in the Piping Code.
9. Branch Connections: Branch connections shall fit and groove-weld in accordance with the details described and shown in the Piping Code.
10. Do not field weld epoxy-lined and/or coated pipe except as specifically approved by the Engineer.

G. Fabrication:

1. End Preparation:

- a. Machine shaping of pipe ends is the preferred method.
- b. Oxygen or arc cutting is acceptable only if the cut is smooth and true and all slag is removed either by chipping or grinding.
- c. Beveled ends for butt welding shall meet the requirements of ANSI B16.25.
- d. Grooved Ends: Meet the requirements of the grooved end coupling and fitting manufacturer.

2. Cleaning:

- a. Before Welding: Surfaces shall be clean and free of paints and coatings, oil, rust, scale, slag, or other material detrimental to welding.
- b. After Welding: After completion of shop or field fabrication and after erection, clean all piping inside and outside to remove all loose scale, weld spatter, dirt, loose debris, and foreign material.

3. Alignment and Spacing:

- a. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
- b. Root Opening of the joints shall be as stated in the welding procedure specification.

H. Required Examinations:

1. Perform examinations in accordance with the Piping Code.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this Section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each examination found to be unsatisfactory.

- I. Inspection: Provide access to the Engineer for inspection of all shop and field work and review of all records of examinations.

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 402300

409200 VARIABLE AREA FLOWMETER

PART 1 - GENERAL

- A. Water flow measurement system consisting of a variable area flow meter and a differential pressure regulator to provide constant seal water flow under various outlet pressures.

PART 2 - PRODUCTS

- A. VARIABLE AREA FLOWMETER
 1. 2.5% Accuracy
 2. Stainless steel head and foot pieces
 3. Maximum Operating Range: 145 psig
 4. Measuring Tube: glass
 5. Float: Aluminum
 6. Seals: EPDM
 7. 0.5-5 GPM measuring range

The application of this Section will proceed per the PUMP STATION MECHANICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 409200

Schedule of Values:

- 1.1 A Schedule of Values shall be submitted as payment basis for PUMP STATION MECHANICAL WORK.
- 1.2 The Contractor shall submit a Schedule of Values, as specified herein, at the Pre-Construction Meeting and shall provide information as requested to substantiate the prices included in the Schedule of Values.

- 1.3 The Schedule of Values must be approved by the Engineer and District 8, Bureau Electrical Operations, prior to any project payments.
- 1.4 Complete Schedule of Values
- (a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.
 - (b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.
 - (c) The Schedule of Values shall have each item further itemized by Specification Division as listed in the Specification index.
 - (d) For the item Pump Station Mechanical Work, each item which has an installed value of over \$10,000, a list of the costs for the major products or operations shall be indicated under each item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

Method of Measurement: Pump Station Mechanical Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract lump sum price for PUMP STATION MECHANICAL WORK.

PUMP STATION ELECTRICAL WORK

Description:

This work shall include furnishing, installing, constructing, and all other necessary work for the electrical systems inside and outside the new Well House Building and the Existing Pump Station building as shown in the plans and specified herein.

The Pump Station Electrical Work shall include, but not be limited to, the following:

1. **Common work for electrical** as shown in the plans and as described in Sections 260100 and 260553 of this Special Provision.
2. **Low voltage electrical power conductors and cables** and related items as shown in the plans and as described in Section 260519 of this Special Provision.
3. **Grounding and bonding for electrical systems** as shown in the plans and as described in Section 260526 of this Special Provision.

4. **Hangers and supports for electrical systems** and related items as shown in the plans and as described in Section 260529 of this Special Provision.
5. **Raceway and boxes for electrical systems** including fittings, enclosures, and cabinets as shown in the plans and as described in Section 260533 of this Special Provision.
6. **Vibration and seismic controls for electrical systems** including isolation pads, isolation and spring mounts, hangers, supports, guides, and related items as shown in the plans and as described in Section 260548 of this Special Provision
7. **Fault current, overcurrent protective device coordination, and arc flash hazard studies** and related items as shown in the plans and as described in Section 260574 of this Special Provision.
8. **Low voltage transformers** and related items as shown in the plans and as described in Section 262200 of this Special Provision.
9. **Switchboards** and related items as shown in the plans and as described in Section 262413 of this Special Provision.
10. **Panelboards** and related items as shown in the plans and as described in Section 262416 of this Special Provision.
11. **Motor-control centers** for use on ac circuits as shown in the plans and as described in Section 262419 of this Special Provision.
12. **Wiring devices** including receptacles, GFCI, associated device plates, snap switches, and related items as shown in the plans and as described in Section 262726 of this Special Provision.
13. **Enclosed switches and circuit breakers** as shown in the plans and as described in Section 262816 of this Special Provision.
14. **Variable frequency motor controllers** and related items as shown in the plans and as described in Section 262923 of this Special Provision.
15. **Engine generators** and related items as shown in the plans and as described in Section 263213 of this Special Provision.
16. **Transfer switches** and related items as shown in the plans and as described in Section 263600 of this Special Provision.
17. **Building lighting** and related items as shown in the plans and as described in Section 265000 of this Special Provision.

18. **Gas detection system** with alarm annunciator panel, remote mounted fixed installation, and related accessories as shown in the plans and as described in Section 284700 of this Special Provision.
19. **Automatic telephone dialer monitoring system** and related accessories as shown in the plans and as described in Section 284800 of this Special Provision.

OPERATION AND MAINTENANCE DATA

1.1 Operation and Maintenance Data

- 1.1.1 Five copies of an Operation and Maintenance Data shall be furnished to the ENGINEER for all equipment and associated control systems furnished and installed.
- 1.1.2 Prior to the Work Reaching 75 Percent Completion, two copies of the data shall be submitted to the ENGINEER for approval with all specified material. The approval copies shall be submitted with the partial payment request for the specified completion. Submit final revised 3 copies within 14 days after field testing and start up of the pump station. Space shall be provided in the manual for additional material. Any missing material for the manual shall be submitted prior to requesting certification of substantial completion.
- 1.1.3 Each copy of the data shall consist of the following and shall be prepared and arranged as follows:
 - (a) A section of an equipment data summary (see sample form at page 1A-19) for each item of equipment.
 - (b) A section of an equipment preventive maintenance data summary (see sample form at page 1A-20) for each item of equipment. A 5 year maintenance schedule for all installed equipment shall also contain in the manual.
 - (c) A section of the equipment manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.
 - (d) List of electrical relay settings and control and alarm contact settings.
 - (e) Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.

- (f) One valve schedule giving valve number, location, fluid, and fluid destination for each valve installed. All valves in same piping systems shall be grouped together in the schedule. A sample of the valve numbering system shall be obtained from the ENGINEER.
- (g) 5 year maintenance schedule for all equipment furnished and installed.
- (h) The record of the initial performance of the equipment from the Field Testing.
- (i) All O&M Data material shall be on 8-1/2 inch by 11 inch commercially printed or typed forms or an acceptable alternative format.

1.1.4 Each data shall be organized into sections paralleling the equipment specifications. Each section shall be identified using heavy section dividers with reinforced holes and numbered plastic index tabs. The data shall be compiled in high-quality heavy-weight, hard cover binders with piano-style metal hinges or in an alternate approved format. Large drawings and other materials which would be opened or removed for reading shall be provided with heavy clear plastic pouches within the binders. The number of binders shall be as required to hold all required material without over-filling. Various sections, as appropriate shall have suitable dividers. All volumes shall be labeled. All loose data shall be punched for binding. Composition and printing shall be arranged so that punching does not obliterate any data. The project title, and manual title, as furnished and approved by the ENGINEER shall be printed on the cover and binding edge of each manual.

1.1.5 All operating and maintenance material that comes bound by the equipment manufacturer shall be left in its original bound STATE. The appropriate sections of the CONTRACTOR's O&M data shall be cross-referenced to the manufacturers' bound manuals.

1.1.6 O & M Equipment Data Summary and Preventive Maintenance Summary shall be as follows:

STATE OF ILLINOIS DEPARTMENT
OF TRANSPORTATION
DIVISION OF HIGHWAYS

MISSOURI AVENUE PUMP STATION

Operation and Maintenance Data

Equipment Data Summary

Equipment Name: _____
Specification Reference: _____

Manufacturer
Name: _____
Address: _____
Telephone: _____

Number Supplied: _____
Location/Service: _____
Model No: _____
Serial No: _____
Type: _____

Size/Speed/Capacity/Range (as applicable):
Power Requirement (Phase/Volts/Hertz):

Local Representative
Name: _____
Address: _____
Telephone: _____

NOTES:

STATE OF ILLINOIS DEPARTMENT
OF TRANSPORTATION
DIVISION OF HIGHWAYS

MISSOURI AVENUE PUMP STATION

Operation and Maintenance Data

Preventive Maintenance Summary

Equipment Name: _____
Location / Service: _____
O&M Data Reference: _____

Manufacturer
Name: _____
Address: _____
Telephone: _____

Number Supplied: _____
Model No: _____
Serial No: _____
Type: _____

Maintenance Task Lubricant/Part * D W M Q SA A

NOTES:

** D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual*

- 1.1.7 Binders shall be labeled Volume 1, 2, and so on, where more than one binder is required. The table of contents for the entire set, identified by volume number, shall be included in each binder.

260100 COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying drawings.
- B. Include any minor items of work necessary to provide a complete and fully operative electrical system which meets all required codes.

1.2 WORK DESCRIBED ELSEWHERE

- A. The Contractor for this work is referred to Bidding Requirements, General Conditions, Special Conditions, Temporary Services and other pertinent Sections of these Specifications. These sections describe work which is a part of this Contract. The following General Provisions amplify and supplement these Sections of Specifications. In cases of conflicting requirements, the stipulations set forth in Division 1 supersede and must be satisfied by the Contractor.

1.3 GENERAL REQUIREMENTS

- A. Contractor must read the entire Specifications covering other branches of Work. Contractor is responsible for coordination of his (her) work with work performed by other trades.
- B. Consult all Contract Documents which may affect the location of any equipment or apparatus furnished under this Work and make minor adjustments in location as necessary to secure coordination.
- C. System layout is schematic and exact locations shall be determined by structural and other conditions. This shall not be construed to mean that the design of the system may be arbitrarily changed. The equipment layout is to fit into the building as constructed and to coordinate with equipment included under other Divisions of Work.
- D. Contractor shall contact the Owner's Representative immediately if he (she) notices any discrepancies or omissions in either the Drawings or Specifications, or if there are any questions regarding the meaning or intent thereof.
- E. Submit all changes, other than minor adjustments, to the Engineer/Architect for approval before proceeding with the work.

- F. The Contractor is required to visit the site and fully familiarize himself or herself concerning all conditions affecting the scope of work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his or her Work.
- G. All workmanship to be of the highest quality in accordance with the best practices of the trade by craftsmen/ craftswomen skilled in this particular work.

1.4 PERMITS, INSPECTIONS AND CODES

- A. File all drawings, pay all fees, and obtain permits and certificate of inspection relative to this Work.
- B. Complete installation shall conform with all applicable Federal, State and Local laws, Codes and Ordinances including, but not limited to the latest approved editions of the following:
 - 1. State Building Codes.
 - 2. Specific Construction Safety Requirements, State Industrial Commission.
 - 3. National Electrical Code (NFPA-70).
 - 4. Life Safety Code, NFPA-101.
 - 5. Occupational Safety and Health Act (OSHA) of 1971 and all amendments thereto.
 - 6. Standard for Fire Protection in Wastewater Treatment and Collection Facilities, NFPA 820.
- C. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are hereby included in these specifications.

1.5 DRAWINGS

- A. Drawings are schematic and show approximate locations of electrical equipment. Exact location should be coordinated by Contractor and verified in field prior to rough-in.
- B. Significant deviations from drawings must be approved by the Owner's Representative.
- C. Owner's Representative reserves the right to make minor changes in the location of outlets and equipment, up to the time of rough-in, without additional cost.

1.6 RECORD DRAWINGS

- A. Record any changes in location of concealed boxes, service runs, and similar construction on a set of prints and deliver them to the Owner and Owner's Representative upon completion of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Furnish new, undeteriorated materials of a quality not less than what is specified.
- B. Contractor to furnish and install only those brands of equipment mentioned specifically or accepted as substitutes.
- C. All circuit breaker panels shall have copper or tin-plated copper bus.

2.2 EQUIPMENT SELECTION AND APPROVAL

- A. The selection of materials and equipment to be furnished shall be governed by the following:
 - 1. Where trade names, brands of manufacturer of equipment or materials are listed in the specification, the exact equipment listed shall be used in the bid or the contractor shall submit the necessary literature to show the alternative product meets the performance characteristics of that which has been called for. Where more than one name is listed, Contractor may select any one of the various brands specified.
- B. Within ten (10) days after the award of contracts, the Contractor must submit a list to the Owner's Representative showing the names of subcontractors he (she) intends to use.

2.3 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.4 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: NBR Insert other interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, or as needed to facilitate installation of modular sealing device. Unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION AND CLEANING

- A. Protect all fixtures against damage from leaks or abuse and pay the cost of repair or replacement of fixtures or equipment made necessary by failure to provide suitable safeguards or protection.
- B. After all fixtures have been set, thoroughly clean all fixtures with manufacturers recommended cleaning agents, removing stickers and other foreign matter and leave every part in acceptable condition, clean and ready for use. Install all new lamps and check for satisfactory operation.
- C. Repair all dents and scratches in factory prime finish coats on all electrical equipment. If damage is excessive replacement may be required.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260500

260519 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 STANDARDS

- A. Insulation types, ratings and usage shall be in accordance with the National Electrical Code requirements.
- B. All conductors shall be copper
- C. Unless otherwise noted , minimum wire size for lighting and power branch circuits shall be No. 12 AWG. For control and auxiliary systems the minimum size shall be No. 14 AWG.
- D. Conductors for emergency power and exit wiring shall be a minimum No. 12 AWG.

2.2 CONDUCTORS AND CABLES

- A. All wire and cable shall be UL listed.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW (90 Deg C Rating).
- D. Twisted Shielded Pairs and Ethernet cable: Comply with NEMA WC 63.1.

2.3 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. All components used at wiring terminations, connections and splices shall be UL listed.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway .
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- K. Feeders for VFDs: Type XHHW single conductors, in raceway

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, tap conductor and equipment termination for copper conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260519

260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bonding and grounding type bushings for rigid or IMC conduit shall be T & B Series 3870/3880, or equal, UL listed.
- E. Where required, EMT connectors or flexible conduit fittings shall be bonded using a bonding lockout, T & B Series 106, or equal, UL listed.
- F. Grounding fittings for bonding pipes or conduits shall be UL listed, equal to T & B Series 2 or Series 3902
- G. Grounding Pigtailes for receptacles shall be Steel City GSC-12 or equal.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 inch by 10 feet in diameter or as noted on the Drawings.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. A separate equipment grounding conductor, minimum size per NEC, shall be installed in each feeder, branch circuit, and control circuit conduit. Conductor insulation shall be green. DO NOT use conduit as a means for grounding of receptacles or any other such devices.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.

7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Conduit system shall be electrically continuous. All enclosures and non-current carrying metals to be grounded. All locknuts must cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps.
- D. All new receptacles shall be bonded to a ground conductor using a #12 AEG min. bonding jumper between receptacle terminal and ground conductor. Metal-to-metal contact between the device yoke and the outlet box is not acceptable for either surface mounted boxes or flush type boxes.
- E. Junction boxes and pull boxes shall be bonded by the use of UL listed ground screws or lugs.
- F. Lighting fixtures shall be grounded by the use of a pigtail fastened on bare metal that is free of paint.
- G. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- H. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- I. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- J. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260526

260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. Hangers and supports for electrical equipment and systems.
 2. Construction requirements for concrete bases.

1.2 SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Welding certificates.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260529

260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1. Heavy wall, threaded, hot dipped galvanized steel. Each section of conduit furnished shall be free from blisters and other surface defects. Galvanizing shall not crack or flake when conduit is bent.
 - a. Where noted, provided with PVC coating. PVC coating shall:
 - i. Bear ETL verified PVC-001 label
 - ii. Have 2 mil thickness urethane coating on inside and outside of conduit.
 - iii. PVC coating at fitting shall have longitudinal ribs with a minimum of 40 mils thickness to protect coating from tools during installation
 - iv. All conduit, fittings, and supporting products to be from the same manufacturer.

- B. LFMC: Flexible steel conduit with PVC jacket. Made from a continuous length of galvanized cold rolled steel strip, spirally wound. Adjacent strips shall have locked typed construction with all the edges turned in. With an extruded PVC jacket.
- C. Fittings for Conduit (Including all Types and Flexible and Liquidtight) and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. All fittings shall be UL Listed, insulated-throat type
 - 3. No die cast connectors will be allowed.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. PVC conduit shall be heavy wall, Schedule 40 ultra-violet resistant, UL listed under Standard 651. Conduit shall be suitable for use with 90 degree C insulated wire. Conduit fittings and cement shall be of the same manufacturer.
- B. LFNC: UL 1660.
- C. Fittings for Schedule 40 PVC: Match to conduit or tubing type and material.
- D. Fittings for LFNC: UL 514B.

2.3 BOXES AND ENCLOSURES

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1,
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit
 3. Underground Conduit: Schedule 40 PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: Rigid steel conduit
 2. Exposed and Subject to Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: Rigid steel conduit
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: Rigid steel conduit.
 6. Hazardous Locations: Rigid steel conduit
 7. Raceways for Optical Fiber or Communications Cable: Rigid steel conduit
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size (1/2" may be used if acceptable with Owner and Local Codes)

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. In finished areas, conduit must be concealed above accessible ceilings, within the building structure, or within chases. Exposed conduits to be run tight to wall or ceiling and installed in a neat workmanlike manner, ready for painting.
- B. Install conduit parallel or perpendicular to building lines (except where run in or below floor slabs). Keep conduit runs as closed to underside of structure as possible.
- C. Exercise necessary precautions to prevent accumulation of water, dirt, or concrete in conduits during execution of electrical work. Conduit in which water or foreign material has been permitted to accumulate shall be thoroughly cleaned, or replaced where such accumulations cannot be removed.
- D. Do not run conduit in floor slabs under boiler, hot water heaters or other heat-producing equipment.
- E. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- F. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- I. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- J. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- K. Conceal conduit within finished walls, ceilings, and floors, unless otherwise indicated.

- L. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 240-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- O. Raceways for Optical Fiber and Communications Cable: Install as follows:
1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- P. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- Q. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.
- R. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

- S. Set metal floor boxes level and flush with finished floor surface.
- T. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- U. Metal boxes cast in concrete shall be designed for concrete installation.
- V. Weather-proof boxes shall be die cast aluminum.
- W. Boxes for exposed work in finished area to be Type FS with threaded hubs and rigid conduit risers.
- X. Flush wall boxes in tile, marble, brick or other finished masonry wall to be Steel City GW-135 Series or Raco 690.
- Y. Install expansion fittings at all locations where conduits cross building expansion joints.
- Z. Secure rigid conduit at cabinets and boxes using insulated throat type grounding and bonding bushings. Locknuts shall be tightened to cut through painted surfaces.
- AA. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers or unistrut racks tight to the building structure.
- BB. Mount junction and pull boxes securely to building structure in a location that meets the requirements of the National Electrical Code for accessibility and work space clearance. Coordinate exact locations of work with other trades. Unless noted otherwise, mounting heights shall be (all measurements are to the top of the box):

Switches, receptacles, or telephone/data shown above a countertop	12" above countertop
Dedicated receptacles (i.e. refrigerator, microwave, etc.)	To suit equipment (see equipment/cabinetry elevation drawings where applicable)
Other interior receptacles	16" AFF
Exterior receptacles	20" above finished grade
Other switches	48" AFF
Telephone/data shown next to a doorway	56" AFF
Other telephone/data	16" AFF

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260533

260548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Isolation pads
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Field quality-control test reports.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. See structural general notes on Sheet S001 for seismic parameters
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.

- B. Restrained Spring Isolators : Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti Inc.
 5. Loos & Co.; Seismic Earthquake Division.
 6. Mason Industries.
 7. TOLCO Incorporated; a brand of NIBCO INC.
 8. Unistrut; Tyco International, Ltd.

- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- I. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260548

260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 1. Identification for conductors and communication and control cable.
 2. Warning labels and signs.
 3. Equipment identification labels.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."
 - 3. As noted on drawings.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for fasteners, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Fasteners for Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.4 CONDUIT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
 - 2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

- C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
 - c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. High resistance ground systems
 - e. Medium voltage vacuum breakers
 - f. Generators
 - g. Variable frequency drives
 - h. Motor-control centers.
 - i. Disconnect switches.
 - j. Enclosed circuit breakers.
 - k. Motor starters.
 - l. Push-button stations.
 - m. Power transfer equipment.
 - n. Contactors.
- D. Conduit Labels: On each end of conduit provide label identifying equipment or junction box on the opposite end of the conduit.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
- G. Record control wiring labeling on project record documents.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260553

260574 FAULT CURRENT, OVERCURRENT PROTECTIVE DEVICE COORDINATION, AND ARC FLASH HAZARD STUDIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard studies.
- B. The fault current study shall be completed prior to ordering equipment to verify the adequacy of the equipment to meet the available fault current conditions.
- C. Protective devices shall be set based on results of the protective device coordination study.

- D. Arc flash warning labels shall be installed on equipment based on the results of the arc flash hazard study.

1.2 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination, fault-current, and arc flash hazard-study computer software programs, certifying compliance with IEEE 399 and IEEE 1584.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process and the studies have been completed. Submit (3) hard copies and a digital copy of each report.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.
 - 4. Arc flash hazard report

1.3 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 1584 and NFPA 70E for arc flash hazard calculations

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399 and IEEE1584.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.2 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Electric utility's supply termination point
 - 2. Main switchboard
 - 3. Generators and transfer switches
 - 4. Motor-control center.
 - 5. Branch circuit panelboard.
 - 6. Local motor disconnect
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.22.
 - b. IEEE C57.12.00.
 - c. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. Equipment evaluation report shall be completed prior to ordering electrical equipment and devices to ensure that the interrupting ratings of the equipment are sufficient for the available fault currents.

3.3 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
- B. Comply with IEEE 241 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Completed data sheets for setting of overcurrent protective devices.

3.4 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all equipment locations shown on the one-line diagram on sheet E700 with the exception of existing equipment that is not modified as part of this project. Additionally, the analysis shall include all new local motor disconnects installed as part of this project.
- C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

- G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- K. Prepare a written report indicating the following results of the incident energy and flash protection boundary calculations including:
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction
 - 9. Tabular Format of Settings Selected for Overcurrent Protective Devices:
- L. Arc Flash Warning Labels
 - 1. The contractor of the Arc Flash Hazard Analysis shall provide and install a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed. Label shall be waterproof and UV-resistant.

2. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
3. The label shall include the following information, at a minimum:
 - a. Location designation
 - b. Nominal voltage
 - c. Flash protection boundary
 - d. Hazard risk category
 - e. Incident energy
 - f. Working distance
 - g. PPE class required
 - h. Engineering report number, revision number and issue date.
4. Labels shall be machine printed, with no field markings.
5. One arc flash label shall be provided for each piece of equipment shown in the one-line diagram on sheet E700 and for each local motor disconnect.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 260574

262200 LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 1. Distribution transformers.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Indicate dimensions and weights.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
 - 3. General Electric Company.
 - 4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
- L. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate. Nameplates are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

3.3 ADJUSTING

- A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltage and tap settings.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262200

262413 SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
 - 3. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.."

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 2.
- C. Comply with NFPA 70.
- D. Comply with UL 891.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Sections front and rear aligned.
- C. Nominal System Voltage: 480Y/277 V.
- D. Main-Bus Continuous: 1600 A.
- E. Enclosure: Steel, NEMA 250, Type 1.
1. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
- F. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- G. Phase and Neutral Buses and Connections: Three phase, four wire unless otherwise indicated. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
1. Ground Bus: 1/4-by-2-inch- minimum size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors.
 2. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 3. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables.

2.2 SURGE PROTECTIVE DEVICES

- A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, with sine-wave tracking suppression and filtering modules, UL 1449, third edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
 2. LED indicator lights for power and protection status.
 3. Audible alarm, with silencing switch, to indicate when protection has failed.
 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device.
 5. Transient-event counter set to totalize transient surges.
- B. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
- C. Withstand Capabilities: 5000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277.
 2. Line to Ground: 800 V for 480Y/277.
 3. Neutral to Ground: 800 V for 480Y/277.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.

2.4 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Switchboard will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262413

262416 PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Field quality-control reports.
- D. Panelboard schedules for installation in panelboards.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.
- B. Mount top of trim 90 inches Insert height above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- G. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Panelboards will be considered defective if they do not pass tests and inspections.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262416

262419 MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor-control center.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. UL listing for series rating of overcurrent protective devices in combination controllers.
 - f. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.
 - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For motor-control centers, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for motor-control centers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Handle motor-control centers according to the following:
 - 1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
 - 2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

1.6 COORDINATION

- A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Indicating Lights: 2 of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Company; GE Industrial Systems.
 - 3. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
 - 4. Square D.

2.2 MOTOR-CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class Type B.
- B. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.

2. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
 3. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.
- C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.3 BUSES

- A. Material: Plated hard-drawn copper, 98 percent conductivity
- B. Ampacity Ratings: As indicated on schedule for horizontal and vertical buses.
- C. Equipment Ground Bus: Noninsulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.
- D. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.
- E. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.
- B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
 1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
 2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
 3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections.

4. Controller Disconnecting Means: Factory-assembled combination disconnect and controller.
 - a. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
- D. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.
- E. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare."

2.5 ACROSS-THE-LINE CONTROLLERS

- A. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
 1. Control Circuit: 24 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

2.6 FEEDER OVERCURRENT PROTECTION

- A. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

2.7 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Control Relays: Auxiliary and adjustable time-delay relays.

2.8 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-control centers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Install motor-control centers on concrete bases.

3.4 IDENTIFICATION

- A. Identify motor-control center, motor-control center components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Each controller shall be labeled with the equipment name and equipment number of the motor controlled.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262419

262726 WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.
- C. Receptacles in Classified locations shall comply with UL Standard: 1203

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Snap switches in stalled in Classified locations shall comply with UL Standard: 1203.

2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262726

262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.

- B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- C. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, Type Heavy Duty Duty, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors. (If required)
3. Auxiliary contacts as shown on the drawings.

2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. As noted in the drawings.

PART 3 - INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Test and inspect as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262816

262923 VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid-state, pulse-width modulated (PWM), variable frequency controllers (VFCs) for speed control of three-phase, squirrel-cage induction motors.
- B. VFC to be provided by Single Source System Supplier.

1.2 SUBMITTALS

- A. Product Data: For each type of VFC.
- B. Shop Drawings: For each VFC.
 - 1. Include wiring diagrams.
 - 2. Spare parts
 - 3. Front of panel layouts
 - 4. Bill of materials
 - 5. Component spec sheets
 - 6. Nameplate legend
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: -10 to 40 deg C.
 - 2. Humidity: Less than 90 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet.

1.5 COORDINATION

- A. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- B. Full responsibility for the functional operation of all new instrumentation and control systems and VFCs shall be assigned to a single supplier. The VFDs, Pump Control Panels, instrumentation and SCADA equipment shall be provided by a Single Source System Supplier. The system supplier shall be responsible for all coordination necessary to select the appropriate equipment, furnishing the equipment, supervising its installation and connections, and startup and calibration required to place the equipment into service.
- C. VFCs shall be provided with pilot devices, bypass equipment and enclosure modifications as shown on the plan sheets.
- D. Entire drive shall carry 65kA short circuit current rating which shall be included on UL nameplate on front of enclosure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Substitution of other manufacturers not permitted:
 - 1. Rockwell Automation, (Allen Bradley) Powerflex 750 Model.
 - 2. Toshiba International Corporation, G9 Series.
 - 3. Yaskawa America, Inc, A1000 Series

2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
 - 1. Provide unit suitable for operation of standard or premium efficiency motor as defined by NEMA MG 1.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

- D. Unit Operating Requirements:
1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 6. Starting Torque: 100 percent of rated torque or as indicated.
 7. Speed Regulation: Plus or minus 1 percent.
- E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
1. Electrical Signal: 4 to 20 mA at 24 V.
- F. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 2 to a minimum of 22 seconds.
 4. Deceleration: 2 to a minimum of 22 seconds.
 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors meeting UL 1449 third edition with 100 KA short circuit current rating and 3,000 V voltage protection rating.
 2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
 3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 20 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

5. Instantaneous line-to-line and line-to-ground overcurrent trips.
 6. Loss-of-phase protection.
 7. Reverse-phase protection.
 8. Short-circuit protection.
 9. Motor overtemperature fault.
- H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- L. Input Line Conditioning: 3% line reactor.
- M. VFC Output Filtering: Provide for VFCs serving stormwater pumps.
- N. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.

- O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- P. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.
3. Output Signal Interface:
- a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- Q. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
- R. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
- S. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ENCLOSURES

- A. NEMA 1

2.4 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Control Relays: Auxiliary and adjustable time-delay relays.
- C. Standard Displays:
 1. Output frequency (Hz).
 2. Set-point frequency (Hz).
 3. Motor current (amperes).
 4. DC-link voltage (VDC).
 5. Motor torque (percent).
 6. Motor speed (rpm).
 7. Motor output voltage (V).

D. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to VFCs before shipping.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of controllers to suit motor controlled. Amperage rating of drive shall be at least 125% of the full load current of the motor.

3.2 IDENTIFICATION

- A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
1. Inspect controllers, wiring, components, connections, and equipment installation.
 2. Assist in field testing of equipment
 3. Report results in writing.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 262923

263213 ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
1. Diesel engine.
 2. Unit-mounted cooling system.
 3. Unit-mounted and Remote-mounted control and monitoring.
- B. Related Sections include the following:
1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.2 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report.
 - 2. Report of sound generation.
 - 3. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

- E. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- F. Warranty: Special warranty specified in this Section.
- G. Manufacturer Sizing Calculations

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.5 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet .

- B. Generator Loads
 - 1. Step 1: 62.5 KW non-motor loads
 - 2. Step 2: 20 HP motor load
 - 3. Step 3: 125 HP motor load on VFD
 - 4. Step 4: 125 HP motor load on VFD
 - 5. Step 5: 250 HP motor load on VFD
 - 6. Step 6: 250 HP motor load on VFD

1.6 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators .
Cast anchor-bolt inserts into bases.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three (3) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar; Engine Div.
 - 2. Cummins Power Generation; Industrial Business Group.
 - 3. MTU Onsite Energy.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.

- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
- C. Capacities and Characteristics:
1. Power Output Ratings: Nominal ratings as indicated.
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 - 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 - 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Mechanical.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

- K. Starting System: 24-V electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30
- B. Comply with NFPA 37.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 1. Tank level indicator.
 2. Capacity: Fuel for twenty-four hours' continuous operation at 100 percent rated power output.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Start-stop switch.
 13. Overspeed shutdown device.
 14. Coolant high-temperature shutdown device.

15. Coolant low-level shutdown device.
 16. Oil low-pressure shutdown device.
- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
 - 5. Sized based on generator full load rating.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1. Generator shall be rated for no less than 2,734 SKVA at 30% instantaneous voltage drop.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.8 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

- A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Load bank testing:
 - a. 60 minutes at 25% load
 - b. 60 minutes at 50% load
 - c. 120 minutes at 75% load
 - d. 120 minutes at 100% load
 3. Voltage regulation.
 4. Transient and steady-state governing.
 5. Safety shutdown.
 6. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
7. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch.
- D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
 - 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.
 - 2. Insulation for interior exhaust piping and muffler
 - a. Calcium silicate minimum of 3" thick
 - b. Cover installed insulation with aluminum jacket 0.16 inch thick.
 - c. Do not insulate flexible exhaust sections
- E. Install Schedule 40, black steel piping with welded joints and connect to emergency and normal vents for fuel tank and rupture basin. Normal vent shall match fill pipe size with a minimum size of 2". Emergency vents shall be 8". Install pipe sleeve with modular sealing device at wall. Provide caps and/or screens on terminations.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Connect engine exhaust pipe to engine with flexible connector.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to the following load bank tests:
 - a. 60 minutes at 25% load
 - b. 60 minutes at 50 % load
 - c. 120 minutes at 75% load
 - d. 120 minutes at 100% load.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
 - D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - H. Remove and replace malfunctioning units and retest as specified above.
 - I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 263213

263600 TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
- D. Manufacturer Seismic Qualification Certification: Submit certification that automatic transfer switch will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 99.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. AC Data Systems, Inc.
 - b. Caterpillar; Engine Div.
 - c. Emerson; ASCO Power Technologies, LP.
 - d. Generac Power Systems, Inc.
 - e. GE Zenith Controls.
 - f. Kohler Power Systems; Generator Division.
 - g. Onan/Cummins Power Generation; Industrial Business Group.
 - h. Russelectric, Inc.
 - i. Spectrum Detroit Diesel.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contactor based switch
 - 4. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal:
- H. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- I. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- G. Automatic Transfer-Switch Features:
 - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

- A. Identify components according to Division 26 Section "Identification for Electrical Systems."
- B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Coordinate this training with that for generator equipment.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 263600

265000 BUILDING LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install lighting fixtures complete with lamps in accordance with the lighting fixture schedule shown on the Drawings and described herein. All units shall be complete with suspension accessories, canopies, sockets, louvers, frames, and rough-in boxes, wired and assembled to furnish a complete workable system.

1.2 SUBMITTALS

- A. Provide manufacturer's product information for all luminaires.

1.3 QUALITY ASSURANCE

- A. All luminaires are to be listed and labeled by Underwriter's Laboratories.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fixture manufacturer, catalog number and lamps are designated in lighting fixture schedule. Electrical Contractor shall be responsible for verifying model number is correct with respect to the voltage, number of ballasts, noted accessories, etc., necessary to complete the project as shown on the Plans.

2.2 LIGHTING FIXTURES

A. Mounting:

1. Electrical Contractor is responsible for reviewing all mounting arrangements prior to ordering any products. Electrical Contractor is responsible for ordering all of the proper fixtures, mounting hardware and misc. to make a complete project. Fixtures to be secured to the structure from a minimum of two points, at opposing ends of the fixture when ceiling recessed or surface mounted. Four points shall be secured where necessary for the fixture to be parallel and tight to underside of ceiling.
2. All recessed fixtures to fit tight to ceiling to eliminate all light leaks.
3. Trim kits, when not secured internally to fixture, shall be secured to structure at a minimum of two points.

B. Finishes:

1. All fixture exposed portions (permanent or adjustable) to be finished by the manufacturer in a finish as specified.

C. Labels and Listings:

1. All fixtures to be UL listed and labeled.

D. Included with Fixture:

1. All fixtures to come preassembled and complete with all sockets (incandescent to be spring supported), lamp ends, ballasts, transformers, fixture ends, trim rings, plates and low density mounting kits (as required) for a complete installation.

E. Lenses:

1. As specified in fixture schedule.

F. Voltage:

1. All fixture voltages are specified on the plans. The electrical contractor is responsible for verifying available voltage(s) and ordering fixtures, ballasts and transformers accordingly.

G. Ordering:

1. It is solely the Electrical Contractor's responsibility to order the fixtures, lamps and mounting equipment so that the fixtures will be installed and operating properly. Purchase order must include date of order, date of manufacture, ship date, and shipping carrier.
2. The Electrical Contractor is responsible for all delays because of his or her lack of effort to order the products in a timely manner.
3. Substitutions may be approved or accepted by the Owner's Representative. Substitutions must be equivalent, in all aspects, to those specified and be accompanied with the necessary literature for comparison of characteristics.

H. Shipping:

1. The light fixture manufacturer shall mark the fixture type as found in the Specifications and/or Shop Drawings on the respective carton when shipping luminaires.
2. The Electrical Contractor shall be responsible for checking each carton immediately upon receipt for verification that fixtures are undamaged and no contents are missing. All discrepancies must be reported to shipper and manufacturer immediately; otherwise the Contractor shall be responsible for items which are lacking or damaged.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. Use only bonderized, galvanized, or sherardized steel for fixture installation for protection against rust and corrosion, and install fixtures straight and true with reference to walls.
- B. Wall-mounted fixtures shall be mounted plumb with building lines and installed with proper box and cover hardware.
- C. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported, either directly or indirectly, by a sound and safe structural member of the building, using adequate number and type of fastenings to assure safe installation. Screwed fastenings, and toggle bolts through ceiling material or wall paneling, are not acceptable.
- D. Wire fixtures with fixture wiring of at least 50°C rating. Where fixtures are mounted in continuous rows, provide conductors in wiring channels of the same size as the circuit wires supplying the row of fixtures.

- E. At completion of installation and before turning over to Owner, clean and remove all dirt and smudges from all lighting fixtures including lenses, louvers and reflectors

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 265000

284700 GAS DETECTION SYSTEM

PART 1 - GENERAL

- A. Gas detection system consisting of a gas alarm control panel and remote mounted fixed installation gas monitors.

PART 2 - PRODUCTS

A. GENERATOR ROOM GAS MONITOR

1. 0-100 ppm carbon monoxide
2. C=0-100% LEL petroleum vapors, IR sensor
3. NEMA 4X Enclosure
4. Red & Amber Strobes
5. 100 Db Piezo Buzzer
6. Mounting Bracket
7. 120V input power
8. Resent button for latched alarms
9. Factory calibrated
10. Sensors shall be externally mounted to the main enclosure
11. Monitor shall operate up to three sensors at a time.
12. Sensors shall be warranted for at least 1 year
13. One fault relay
14. Three adjustable level alarm relays
15. Basis of Design is MSA TriGard

B. STORMWATER PUMP STATION GAS MONITORS

1. Controller
 - a. 6-channel
 - b. NEMA 4X enclosure
 - c. 16 total relays
 - d. 2 relay alarms per channel
 - e. 1 Common fault relay
 - f. Digital display per channel
 - g. Audible Alarm
 - h. Provide with (3) remote mounted red flashing light towers with 100 dB horn
 - i. Basis of design is MSA GasgardXL

2. Remote Mounted Petroleum Vapor Sensor
 - a. C=0-100% LEL petroleum vapors, IR sensor
 - b. Stainless steel, Class 1 Division 2 housing
 - c. 3-wire, 4-20 mA Output
 - d. Mounting bracket
 - e. Sensors shall be warranted for at least 10 years
 - f. Basis of design is MSA UltimaX

3. Remote Mounted Oxygen Sensor
 - a. 0-25% oxygen
 - b. Stainless steel, Class 1 Division 2 housing
 - c. 3-wire, 4-20 mA Output
 - d. Mounting bracket
 - e. Sensor shall be warranted for at least 10 years
 - f. Basis of design is MSA UltimaX

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 284700

284800 AUTOMATIC TELEPHONE DIALER MONITORING SYSTEM

PART 1 – PRODUCTS

1.1 Description and Phone Number Dialing:

The dialer shall be a solid state component capable of dialing up to 16 telephonenumber, each up to 60 digits in length. Phone numbers and Standard pulse dialing or Touch Tone® DTMF dialing are user pro-grammable via the systems keyboard or remotely via Touch Tone telephone. In addition, the dialer shall:

- A. Group Alarm Calls - On alarm, system shall selectively call the correct phone number according to the specific alarm(s).
- B. Detect Telephone Line Fault and indicate condition with Front Panel LED.
- C. Automatically select Tone versus Pulse Dialing.
- D. Monitor Call Progress - Detect Busy and Ringing Signals, Abandon Call if Busy, Wait until phone is answered to Annunciate Voice Reports.
- E. Provide Numeric Pager Support
- F. Provide PBX Support

1.2 Solid State Voice Message Recording and Playback:

The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

A. User Field Recorded Messages:

The user may record and re-record his own voice messages for each input channel and for the Station ID.

1. There shall be no limit on the length of any particular message within the overall available message recording time, which shall vary from 26 to 635 seconds, depending upon the number of input channels selected, and the recording rate used.
2. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
3. The unit shall provide for automatic setting of the optimum speech recording rate for the total set of messages recorder, in order to achieve optimum recording sound quality.
4. Circuit board switches or jumper straps shall not be an acceptable means of manipulating message length or recording rates.

B. User Field Recorded Messages:

Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

1.3. Input Monitoring Function:

The basic unit shall continuously monitor the presence of AC power and the status of four (4) contact closure inputs. AC power failure, or violation of the alarm criteria at any input shall cause the unit to go into alarm status and begin dial-outs. The unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normal Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Closed Circuit" or "Open Circuit" without disturbing any message programming. Each input channel shall also be independently programmable, without the need to manipulate circuit board switches or jumpers, to any of the following:

A. Normally Open, Normally Closed, or for No Alarm (Status Only).

- B. Run Time Meter - to accumulate and report the number of hours a particular input circuit has been closed. Any channel so configured will never cause an alarm call; rather, on inquiry it will recite its message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electromechanical Run Time Meters. Up to a total of eight Run Time Meters may be programmed.
- C. Pulse Totalizer - to count the accumulated number of pulses (momentary contact closures) occurring at the input so programmed. Any input channel may be programmed for a Totalizer Function, up to a maximum of eight. Maximum Input pulse rate is 100 Hz, with a 50% Duty Cycle. The spoken scaled value will not "rollover" to zero until a value of 4,294,967,294 has been exceeded.

1.4. Input/Output Expansion Capability:

The standard unit shall be modular in design, permitting it, therefore, to accept "plug-in" expansion circuit boards to incorporate any of the following:

- A. Contact Closure Expansion Capability to a total of 8, 16, 24, or 32 total dry contact inputs.
- B. Analog Input Capability to a total of 1, 4, 8, or 16 total analog inputs.
- C. Remote Supervisory Control Outputs to manipulate 4 or 8 output relays.

1.5. Modbus Communications:

The unit shall accept an expansion card which enables it to communicate directly with devices utilizing Modbus RTU Protocol. A unit so configured shall be capable of "reading" and "writing" to 32, 64, or 96 data registers via Touch Tone Telephone. No modem or host computer shall be required. Interface shall consist of a single RS-232.

1.6. Printer/Computer Communications:

The unit shall be equipped with a centronics parallel printer port, enabling the user to print alarm reports, download programming data, and generate scheduled status reports as required. Alternatively, the unit shall be able to accept an optional modular, plug-in asynchronous communications card to permit any of the following:

- A. Local Data Logging - Permits a single dialer to communicate with a local Serial printer to log routine status reports, alarm reports, and programming data.
- B. Central Data Logging - Permits one or more dialers to communicate with a single centrally located Serial printer equipped with a suitable modem to log routine status reports, alarm reports, and programming data.

- C. Data Acquisition and Control - Permits one or more dialers to communicate with a centrally located Computer/Printer System equipped with a SCADA software pack-age, thereby functioning as a stand-alone SCADA system.

1.7. Alarm and Inquiry Messages:

Upon initiating an alarm call, the system is to “speak” only those channels which are currently in “alarm status.” Inquiry phone calls can be made directly to the unit at any time for a complete status report.

1.8. Acknowledgement:

Alarms are acknowledged either by pressing a Touch Tone “9” as the call is being received, or by calling the unit back after having received an alarm call.

1.9. Nonvolatile Program Memory Retention:

User-entered programming and voice messages shall be kept intact, even during power fail-ures or when all power has been removed, for up to ten (10) years. This shall be accom-plished through inclusion in the system of a lithium battery separate from the unit’s backup rechargeable gel cell battery.

1.10. Local and Remote Programming Capabilities:

The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone telephone.

- A. Alarm Response Delay: 0.1 to 999.9 seconds, with different delays being assignable to different alarms.
- B. Delay Between Alarm Call-outs: 0.1 to 99.9 minutes.
- C. Alarm Reset Time: 0.1 to 99 hours, or “No Reset”.
- D. Incoming Ring Response (Answer) Delay: 1 to 20 Rings.
- E. Number Of Message Repetitions: 1 to 20 Repetitions.
- F. Autocall Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled, and also at regular subsequent intervals until this function is disabled.
- G. Remote System Microphone Activation.
- H. Remote Arming and Disarming of System.

1.11. Phone Line:

The dialer is to use a standard “dial-up” telephone line (direct leased line is not required), and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ 11).

1.12. Speakerphone:

The unit shall be capable of dialing any phone number on command and functioning as a speakerphone.

1.13. Real Time Clock:

The unit shall be equipped with a real time clock thereby making the following possible:

- A. Alarm Ready Schedule - The dialer shall be user programmable to follow a specific schedule of operations. This shall include the flexibility to set a weekday, weekend, and holiday schedule. With this feature the dialer shall arm and disarm itself according to the schedule programmed.
- B. In the event any of the printer configurations outlined in Section 6 are utilized, all alarm reports will be time and date stamped. Routine scheduled status reports can also be programmed.

1.14. Power/Battery Backup:

Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger", in order to minimize re-charge time and to maximize battery life available.

1.15. Integral Surge Protection:

All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit/3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each line.

1.16. Technical/Customer Support:

All users shall be provided and/or shall have access to the following support resources.

- A. Each autodialer shall be shipped with a CD-ROM which details all features of the product and provides an in-depth step-by-step video programming guide. A superficial marketing overview will not be acceptable.

1.17. Warranty:

The dialer shall be covered by a five (5) year warranty covering parts and labor performed at the factory.

1.18. Additional Features: Sealed Switches. LED Indicators. Alarm Disable Warning. Talkthrough:

All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Call-in Progress, Status for each Channel, AC Power present, AC Power failure, and Low, Discharging, or Recharging Battery. On any inquiry telephone call, or On-Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the unit is in "alarm disabled" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote site to listen to local sounds and to have a two-way conversation with personnel at the dialer.

The application of this Section will proceed per the PUMP STATION ELECTRICAL WORK special provision, which is amongst the accompanying special provisions.

End Section 284800

Schedule of Values:

- 1.1 A Schedule of Values shall be submitted as payment basis for PUMP STATION ELECTRICAL WORK.
- 1.2 The Contractor shall submit a Schedule of Values, as specified herein, at the Pre-Construction Meeting and shall provide information as requested to substantiate the prices included in the Schedule of Values.
- 1.3 The Schedule of Values must be approved by the Engineer and District 8, Bureau Electrical Operations, prior to any project payments.
- 1.4 Complete Schedule of Values
 - (a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.
 - (b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.
 - (c) The Schedule of Values shall have each item further itemized by Specification Division as listed in the Specification index.
 - (d) For the item Pump Station Electrical Work, each item which has an installed value of over \$10,000, a list of the costs for the major products or operations shall be indicated under each item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

Method of Measurement: Pump Station Electrical Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract lump sum price for PUMP STATION ELECTRICAL WORK.

PUMP STATION SCADA EQUIPMENT

Description:

A SCADA (Supervisory Control and Data Acquisition) system shall be provided which shall function as the "Master Control Station" for the Missouri Avenue Pump Station facility. The SCADA system shall consist of, but not be limited to programmable controllers, personal computer, data communication equipment, printers, LED (light emitting diode) digital displays, process instruments and control devices, uninterruptible power system (UPS) and other devices as required and as indicated on Plans.

All materials, equipment, labor, programming, services and incidentals required to achieve a fully integrated and operational system shall be furnished and installed complete by a qualified system integrator with a minimum of 10-year experience. The system integrator shall design and coordinate the instrument and control system for proper operation with related equipment and materials.

Auxiliary and accessory devices necessary for system operation or performance, such as transducers or relays to interface with equipment provided under this Contract shall be included whether they are shown on the drawings or not.

The system integrator shall provide all programming and configuration of equipment and software including development of graphic displays and reports.

The system integrator shall install the control system and perform all on-site testing, start-up, and training of DEPARTMENT's staff.

All necessary coordination required for interfacing the proposed pump station facility with the proposed SCADA system shall be provided by the system integrator.

The Pump Station SCADA Equipment shall include, but not be limited to, the following:

1. **Process instrumentation and controls** as shown in the plans and described Section 409000 of this Special Provision.
2. **Submerged pressure transducer water level measurement system.** Water level measurement system consisting of a submerged pressure transducer and a remote panel mounted digital panel meter as shown in the plans and described Section 409100 of this Special Provision.

3. **Pressure indicator and transmitter.** Pressure measurement, indicator, and transmitter system consisting of a compact pressure indicator/transmitter and a remote panel mounted digital panel meter as shown in the plans and described Section 409150 of this Special Provision.
4. **Programmable logic controller control system.** Programmable logic controller (PLC) control system(s), including software, programming, and training as shown in the plans and described Section 409500 of this Special Provision.
5. **Computer network and human machine interface (hmi) system.** Computer network and HMI hardware requirements which includes LCD flat panel type monitors, HMI computer workstations, network servers, external data storage, field mounted flat face panels, ethernet switches, printers, software, accessories and maintenance materials as shown in the plans and described Section 409510 of this Special Provision.
6. **Configuration requirements: human machine interface (HMI) and reports** as shown in the plans and described Section 409520 of this Special Provision.

409000 PROCESS INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS

GENERAL

1.01 SCOPE OF WORK

1.02 SINGLE SOURCE SYSTEM SUPPLIER

A single source System Supplier (SS) shall furnish all services and equipment as specified herein and in other Specification Sections as listed below. Full responsibility for the functional operation of all new instrumentation and control systems and VFDs shall be assigned to a single supplier. The VFDs, Pump Control Panels, instrumentation and SCADA equipment shall be provided by a Single Source System Supplier. The system supplier shall be responsible for all coordination necessary to select the appropriate equipment, furnishing the equipment, supervising its installation and connections, and startup and calibration required to place the equipment into service.

The Control System Supplier shall be a "certified" member of the Control System Integrators Association. They shall be listed as such on the CSIA web site http://www.controlsys.org/about/registered_members.htm prior to bidding this project.

Custom interconnection diagrams shall be provided. They shall be CAD drawn on the Control System Suppliers title blocked pages. It shall not be acceptable to merely show terminals to another set of schematics provided by a third party.

Instrumentation and control panels shall be fabricated, assembled, installed and placed in proper operating condition in full conformity with the Contract Documents and Drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer.

The work shall include furnishing, installing and testing the equipment and materials detailed in the Drawings and Specifications:

The SS work shall include furnishing and installing the following:

1. Providing all materials, equipment, labor and services required to achieve a fully integrated and operational system. The SS shall design and coordinate the instrument and process control system for proper operation with related equipment and materials furnished by others under other sections of these Specifications and with related existing equipment.
2. All field instrumentation, sensors, analyzers, and devices as shown and as specified for monitoring and control functions, except those shown as furnished by others. All equipment shall be provided in accordance with the area classification in which it is installed, as shown on the Electrical Drawings.
3. Auxiliary and accessory devices necessary for system operation or performance, such as loop isolators on all analog signals or relays on all digital signals, to interface with existing equipment or equipment provided by others under other Sections of these Specifications whether they are shown on the Drawings or not.

Provide all process controller programming and Human Machine Interface (HMI) configuration including development of control programs, database configuration, graphic screens, communication links, historical archiving, as specified herein. The process control system specified herein shall perform the following generalized functions:

1. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.
2. Collect and store accurate, reliable operating information for present and future uses.
3. Assist remote site operating personnel by noting and communicating off normal operating conditions and equipment failures.
4. Accumulate and store equipment running times for use in preventative maintenance.
5. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
6. Provide trending for all analog values.

All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the PLCs. The HMI software shall perform the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.

The system shall allow the operator to manually control equipment such as pumps, valves, etc. (i.e., on off, open close, setpoint value, etc.) by keyboard entry and mouse type pointing device when viewing the appropriate graphic screen on the HMI. Control capability shall be under password protection.

The SS shall use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and process control descriptions in the development of the SS's submittals. The SS shall not deviate from or modify said numbering scheme without the Engineer's approval.

Equipment removed in the course of this work shall remain the property of the DEPARTMENT.

1.03 SUBMITTALS

A. Submittal requirements include:

1. Shop drawings shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these Specifications and shall provide a true and complete record of the equipment as manufactured and delivered.
2. Submittals shall be bound in separate three ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11 inch by 17 inch for inclusion within the binder.

C. The submittal drawings' title block shall include, as a minimum, the SS's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.

D. Separate submittals shall be made as follows:

1. Hardware.
2. Panel Drawings.
3. Loop Drawings.
4. Testing Plan.
5. Training Plan.
6. Spares, Expendables, and Test Equipment Submittal.
7. Certification of Installation Submittal.

E. Project Plan and Deviation List

1. The SS Project Plan shall be submitted and favorably reviewed before any further submittals will be accepted. The Project Plan shall, as a minimum, contain the following:
 - a. Overview of the proposed control system in clear text format describing the SS understanding of the project work, system architecture drawing, interfaces to other systems, schedule, startup, and coordination.
 - b. Approach to work in clear text format describing how the SS intends to execute the work. A discussion of switchover, startup, replacement of existing equipment with new, etc. shall be included as applicable.

Exceptions to the Specifications or Drawings shall be clearly defined by the SS in a separate Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the Engineer. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the specifications shall be at the sole discretion of the Engineer.

F. Hardware Submittal

1. Shop drawings shall be submitted as detailed herein. They shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.
2. Field Instruments
 - a. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete bill of materials or index that lists all instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.

- b. Submit separate data sheets for each instrument including:
 - 1) Plant Equipment Number and ISA tag number per the P&IDs.
 - 2) Product (item) name used herein and on the Contract Drawings
 - 3) Manufacturer's complete model number
 - 4) Location of the device
 - 5) Input output characteristics
 - 6) Range, size, and graduations in engineering units.
 - 7) Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.
 - 8) Materials of construction for enclosure and wetted parts.
 - 9) Instrument or control device sizing calculations where applicable
 - 10) Certified calibration data for all flow metering devices.
 - 11) Two-wire or four-wire device type as applicable.
- c. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word.

3. Digital Equipment Hardware Submittal

Catalog cuts for Programmable Logic Controller (PLC), including central processing units, memory, input modules, output modules, modems, network interface modules, mounting racks, and power supplies. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided. Any deviation of the hardware systems from the preliminary hardware submittal included in the Project Plan shall be described in detail.

Catalog cuts for HMI servers, HMI workstation, laptops, historian servers, memory, printers, mass storage devices, modems, network interface modules, peripherals, and power supplies. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.

Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (engineering units) and equivalent analog to digital "count" conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration. The I/O list shall be sorted in order by

Physical location: Panel, Rack, CPU Name, or Remote I/O Drop

I/O Type: AI, AO, DI, DO, PI, PO, etc.

Loop Number

Device Tag

Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.

UPS and battery sizing calculations to verify compliance with the specified power usage and backup power duration requirements.

A list of all hardware electrical and environmental characteristics and requirements. All planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the Contractor to proceed with the detailed site preparation for all equipment.

G. Software Submittal:

1. Submit details of the controller, local operator graphic panel, and HMI software application packages to be used for each piece of equipment. Indicate all standard and optional features provided. Include copies of license agreements indicating assignment of licenses to the Owner. Any deviation of the software platforms from the preliminary software submittal included in the Process Plan shall be described in detail.

H. Panel Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified in related Sections of this specification.. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. As a minimum, the panel drawings shall include the following:

Interior and exterior panel elevation drawings to scale.

Nameplate schedule.

Panel construction details.

Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.

Fabrication and painting specifications including color (or color samples).

Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.

Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.

Heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.

I. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the Project Bid Price.

J. ISA Loop Wiring Diagrams: Submit detailed loop wiring diagrams showing requirements for each instrument which is furnished under this Section. The diagrams shall identify all device terminal points as well as any intermediate terminal blocks. Power supplies, loop grounds, wire/cable number, etc., shall be detailed. Field device wiring shall be numbered with the device ISA-tag and a unique numeric identifier. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Loop Diagrams shall be prepared in accordance with ISA Standard S5.4 latest edition including optional information.

K. Testing Plan

Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop (per the specifications) with sign-off areas for the SS, Engineer, and Owner. Refer to Part 3 of this section for complete testing requirements. Submit separate procedures for each specified test phase including:

Unwitnessed Factory Test

Witnessed Factory Test

Operational Readiness Test (ORT)

Functional Acceptance Test (FAT)

- L. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including “highlighted” wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.

1.04 REFERENCE STANDARDS

Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

American Society for Testing and Materials (ASTM).

ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

ISA- The Instrumentation, Systems, and Automation Society

ISA S5.2 Binary Logic Diagrams for Process Operations

ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

ISA S5.4 Instrument Loop Diagrams

ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

ISA RP60.3 - Human Engineering for Control Centers

ISA RP60.6 - Nameplates, Labels, and Tags for Control Centers

American National Standards Institute (ANSI)

ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing

National Fire Protection Agency (NFPA)

NFPA 70 - National Electrical Code.

Underwriters Laboratories, Inc. (UL)

UL 508 – Industrial Control Equipment

1.05 PROJECT/SITE REQUIREMENTS

Environmental Requirements. Climate controlled areas require NEMA Type 1 or 12 enclosures as shown in the Specifications and on the Drawings. All other areas above or below grade require NEMA Type 4X stainless steel enclosures unless installation within classified (hazardous) areas is required.

Elevation: Equipment shall be designed to operate at a ground elevation of approximately 400 feet above mean sea level.

Temperature:

Outdoor areas' equipment shall be suitable for 0 to 100 degrees F. ambient.

Equipment located in indoor locations shall be suitable for 50 to 100 degrees F. ambient.

Storage temperatures shall range from 0 to 100 degrees F. ambient.

Additional cooling or heating shall be furnished if required by the equipment as specified herein.

Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 95 percent relative, non condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.

Power Supply: 120 Volts AC sources of electrical power supply shall be from unregulated industrial panel boards (either utility or standby generator) unless a UPS power source is indicated on the Drawings.

1.06 MAINTENANCE

A. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Engineer.

B. As a minimum, the SS shall furnish the following spare parts:

1. I/O modules One of each type (DI, DO, AI and AO) module provided.
2. Timers One of each type provided.
3. Relays One of each type provided.
4. Fuses 10% (minimum of 5) of each type and size provided.

5. Light bulbs 10% (minimum of 5) of each type provided.
6. Two power supplies of each type provided, including process controller power supplies.
7. One process controller CPU of each type provided.
8. One HMI/Touch screen of each type provided
9. One process controller communication module of each type provided.
10. Two of each type cable connector provided.
11. One of each type of process controller PC communication interface expansion card.

1.07 WARRANTY

- A. The Contractor shall provide from the equipment manufacturer, supplying equipment in this Section, an unconditional warranty in accordance with the General Provisions of the Contract.

The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the period of the warranty. The warranty shall remain in effect provided all normal operating and maintenance procedures are followed as instructed by the manufacturer. In the event the equipment fails to perform as specified, the Contractor shall promptly repair or replace the defective equipment without additional cost to the Owner.

1.08 FINAL SYSTEM DOCUMENTATION

- A. The instructions shall be bound in three ring binders with drawings reduced or folded for inclusion and shall provide at least the following as a minimum.
1. A comprehensive index.
 2. A complete "As Built" set of the SS approved hardware, software, and panel fabrication shop drawings.
 3. A complete list and data sheets of the equipment supplied, including serial numbers, ranges and pertinent data.
 4. Full specifications on each item.
 5. System schematic drawings "As Built", illustrating all components.
 6. Detailed service, maintenance and operation instructions for each item supplied.

7. Special maintenance requirements particular to these systems shall be clearly defined, along with special calibration and test procedures.
8. The operation instructions shall also incorporate a functional description of the entire system.

Complete parts lists with stock numbers and name, address and telephone number of the local Supplier.

- B. The SS's final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- C. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- D. Submit original electronic media packs of all software provided under this Contract. Submit original paper based or electronic documentation of all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, etc. All software provided under this Contract shall be licensed to the Owner.
- E. The requirements for the SS's final documentation are as follows:
 1. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:
 - a. Operation Information include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Parts Information include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between system SS's part number and manufacturer's part numbers shall be provided.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. General

Substitutions on functions or type of equipment specified will not be acceptable unless specifically noted. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the SS to coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.

To facilitate the Owner's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

B. Physical

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water industry.

2. All electronic instrumentation shall be of the solid state type and shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1 5V DC (volts direct current).
3. Analog outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
4. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel.
5. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70 and CCR, Title 8, Electrical and General Safety Orders.
6. All indicators shall be linear in engineering process units unless otherwise noted.
7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent or better.
8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
9. All equipment, cabinets and devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

All electronic/digital equipment shall be provided with radio frequency interference protection.

Provide heating, cooling, dehumidifying, and filtering devices in control panel, enclosures, and cabinets as required to maintain internal ambient conditions within the most restrictive requirements of the equipment housed. Submit calculations as part of the panel fabrication submittal process verifying these requirements.

C. Electrical

Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 Volts, plus or minus 10 percent, except where specifically noted. Where possible, all field instruments shall be 24 VDC loop powered. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.

Equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored unless otherwise noted.

All transmitter output signals shall include signal and power source isolation.

D. Nameplates

General: Provide nameplates as specified below.

All panels and field instruments shall be supplied with suitable nameplates that identify the panel and individual devices as required.

Nameplates shall be a 3/32-inch thick, black and white, laminated Bakelite or Lamecoid with engraved inscriptions. The letters shall be white against a black background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

Orient nameplates to facilitate reading the device identifier from a cursory inspection. Do not mount nameplates behind or under equipment.

Nameplate fasteners and mounting shall be:

Stainless steel wire, 0.048-inch diameter with stainless steel crimped clamps for hanging nameplates.

Epoxy adhesive or stainless steel screws for cabinet mounted nameplates

Nameplates shall be as recommended by ISA Recommended Practice RP60.6.

2.02 LIGHTNING/SURGE PROTECTION

- A. General - Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the internal plant electrical distribution system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self restoring.
- B. Field Instrumentation Protection - Provide individual device protection for each field instrument mounted outside of the building or facility housing the control panel. Instruments mounted within the structure as the associated control panel shall not require surge protection. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all instrumentation device surge protectors shall be connected to a good earth ground. Where practical route each ground wire individually and insulated from each other. Device surge protectors shall be mounted within the instrument enclosure or a separate junction box coupled to the enclosure. Provide surge protection devices.
- C. Control Panel Power Supply – Provide protection of all 120 VAC instrument power supply lines. Source voltage to cabinets/panels regardless of location (indoor or outdoor) shall be protected by isolation transformers and surge suppressors. Provide gas tube surge suppressors or metal oxide varistors (MOVs) located at the point where the 120V source supply enters the enclosure. Install the surge device to in strict compliance with the manufacturer's recommendation for maximum allowable circuit length between protective device and incoming circuit. Provide signal surge suppression.
- D. Instrument 120 V Power Supply – Provide protection for 120 VAC power to all 4-wire field instruments (indoor or outdoor). Provide individual gas tube surge suppressors or metal oxide varistors (MOVs) located at the instrument end of the circuit. Provide signal surge suppression devices.
- E. 4-20 mA Signal Lines and Non-Fiber Based Data Highway Circuits – Provide protection on all signal and data highway circuits that leave a building or are routed external to a building. Provide gas tube surge arrestors, and Zener diode protectors. Circuit protection shall be provided at both ends of the signal or data highway lines within the control panel at one end and as close to the instruments or termination device as possible. Provide signal surge suppression devices.
- F. Inductive Loads – At a minimum, provide surge protection or interposing relays on all process controller outputs or switches rated 100 VA or less that drive solenoid, coil, or motor loads. Refer to the detailed requirements for controller output protection in the detailed technical specifications of the related section. Provide interposing relays or signal surge suppression devices.
- G. Telephone Circuits - At a minimum, provide telephone company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 UL LABEL

- A. Each control panel and terminal cabinet shall bear the UL label. The UL Label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.
- B. The UL label requirements shall apply to all panels except where enclosures contain instruments mounted through the enclosure walls or doors. In this case, panel construction shall meet all requirements of UL labeling as described above, but no UL label is required. This exception applies only if UL Recognized instruments or devices for the intended purpose are not made.

2.04 CONTROL PANELS, ENCLOSURES AND CABINETS

- A. All control panel assemblies shall be UL listed. The SS shall be responsible for ensuring final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only.
- B. The drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Exact nature of the final equipment interconnections shall be as determined by the SS during development and fabrication of systems.
- C. The process control system software and hardware shall be configured as required to achieve the functional requirements as specified herein and shown on the Drawings.
- D. Where specific installation details are not specified or shown on the Drawings, installation recommendations from the equipment manufacturers or American Petroleum Institute (API) shall be followed as applicable.
- E. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the Engineer but in no case shall more than one ground point be employed for each shield.
- F. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.

- G. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- H. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required on the Electrical Drawings for the locations.
- I. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing and blowdown service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.
- J. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.
- K. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified in these special provisions.
- L. Provide all brackets, hangers, and miscellaneous metals required for mounting of equipment. Mounting hardware shall be installed in a workmanlike manner and not interfere with any other equipment.
- M. The SS shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the SS shall be required to ship his/her material in sections sized to permit passing through restricted areas in the building. The SS shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).
- N. The SS shall provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. The SS shall certify that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to insure a satisfactory functioning installation.

- O. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare on LED, LCD, or other digital readouts.

- P. Loop Tuning - All electronic control stations incorporating PID controllers shall be tuned following device installation but prior to commencement of the field tests.
 - 1. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, etc. Assigning common PID factors for identical loops following field tuning of a single typical loop is acceptable. However, tuning documentation shall be submitted for each loop individually as specified in Part 1 of these Specifications.
 - 2. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control of field mounted, dedicated PID controllers or software based PID controllers residing as part of the programmable logic controller system. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
 - 3. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve 1/4 amplitude damping or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
 - 4. Loop performance and stability shall be verified in the field following tuning by step changes to setpoint. Submit loop tuning methodology and verification as part of the final system documentation as specified in Part 1.
 - 5. For cascade loops, tune both sets of controllers so that the cascade loop achieves the loop tuning characteristics specified herein.

3.02 TESTING

A. General

As part of the requirement of this specification section it is the responsibility of the SS to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. As part of this Contract the SS shall provide factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation an additional 30-Day Acceptance Test is required.

Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

All tests shall be conducted in accordance with prior Engineer approved procedures, forms and checklist all as submitted by the SS under Part 1 of this Specification. Each test to be performed shall be described and a space provided after it for signoff by the appropriate parties after its satisfactory completion. Include "punchlist" forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the fix and signoff areas for SS, Owner, and Engineer.

Copies of the sign off test procedures, forms and checklists will constitute the required test documentation. The test result forms shall be submitted to the Engineer for approval at the completion of each test.

Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.

The SS shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the Owner.

The SS shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

The Engineer reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Specified requirements shall be performed at no additional cost to the Owner. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

No equipment shall be shipped until the Engineer has received all test results and approved the system is ready for shipment.

All testing shall be phased to meet the requirements of the project schedule.

Factory Testing: Prior to shipment of the equipment the following tests are required:

Unwitnessed Factory Test (UFT).

The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions and control devices/functions.

All panels, consoles and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, Specifications and Drawings. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.

Tests to be performed shall include but not be limited to the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

100% wiring and database address verification of panel components and process controller I/O as applicable.

Demonstrate functionality of the process controls in conformance with the process control loop descriptions. Simulate operating conditions to verify the performance of the monitoring and control functions.

Demonstrate graphical user interfaces (hardware and software) for process controllers, local operator panels, and HMI.

Demonstrate the data communication network and protocol for in-plant and remote site locations

Demonstrate all system software functions specified including clock synchronization.

Generate reports using test data.

Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, process failure, redundancy backup systems,

RAID array operability, historical archiving, etc.

Submit UFT results for review by the Engineer

Field Testing Following installation of the process control system components and prior to plant start up the following tests are required:

Operational Readiness Test (ORT)

General: Prior to startup and the Functional Acceptance Test, the entire system shall be certified (inspected, wired, calibrated, tested, etc, and documented) that it is installed and ready for the ORT as defined below.

Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop by loop and component by component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed as specified herein.

The Loop/Component Inspections and Tests shall be implemented using Engineer approved forms and checklists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the system supplier:

Project Name, Test Date, SS Name, and Lead SS Technician Name
Loop Number
Tag Number for each component.
Checkoffs/signoffs for each component.

Tag/identification
Installation
Termination – wiring and tubing
Scale, Range, and Setpoint as applicable
Calibration/adjustment (4 point for analog, set point for switches) rising and falling

Checkoffs/signoffs for the loop

Panel interface terminations
I/O interface terminations
I/O signal operation
Inputs/outputs operational: received/sent, processed, adjusted
Total loop operation
Process Controller Scaling and Adjustment

Space for comments

The SS shall maintain the Loop Status Reports sheets at the job site and make them available to the Engineer/Owner at any time.

These inspections, calibrations, and tests do not require witnessing. However, the Engineer shall review Loop Status Sheets and spot check the SS test process periodically. Any deficiencies found shall be corrected by the SS prior to commencement of the Functional Acceptance Test.

Submit ORT results for review by the Engineer.

Functional Acceptance Test (FAT).

General: Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. A witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.

Each specified function and process control shall be demonstrated on a paragraph by paragraph, loop by loop, and site by site basis.

Loop specific and non loop specific tests shall be the same as specified under Factory Tests except that the entire installed system shall be tested and all functions demonstrated using live field based data to the greatest extent possible.

Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available to the Engineer at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.

Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the SS shall perform repairs, replacement, and/or retest within 10 days.

Submit FAT results for review by the Engineer.

3.03 TRAINING

- A. The cost of training programs to be conducted with plant personnel shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The SS is responsible for training associated with the control panels, hardware, and software.
- B. The following training classes are required:
 - System operation (4 hours)
 - Basic System level troubleshooting (4 hours)
 - System Maintenance (4 hours)
- C. The SS shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
- D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- E. All training schedules shall be coordinated with, and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

- F. Each training class shall be a minimum of 4 hours in duration. Separate classes shall be conducted for the Owner's maintenance and operating personnel. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the HMI system. Operator classes shall stress operational theory and use of the HMI display screens.
- G. The training classes shall be scheduled a minimum of 2 weeks in advance of when they are to be given. Proposed training material, including a detailed outline of each lesson, shall be submitted to the Engineer.
- H. On site Training: On site (field) training shall be conducted at the plant site and shall provide detailed hands on instruction to plant personnel covering; system debugging, troubleshooting, tools, test equipment, maintenance procedures, calibration procedures and system operation. The training shall run at times chosen by the Owner. The training shall be conducted over a period of three months as follows:

3.04 PROCESS CONTROLLER I/O LIST

- A. Process controller I/O List itemizes the process controller Local and Remote I/O associated with the hardware provided under this contract. Provide additional I/O signals and hardware as required to furnish a complete and functional system.
- B. Develop the list based on Plan Sheet PID drawings.

End Section 409000

409100 SUBMERGED PRESSURE TRANSDUCER WATER LEVEL MEASUREMENT SYSTEM

PART 1 - GENERAL

- A. Water level measurement system consisting of a submerged pressure transducer and a remote panel mounted digital panel meter.

PART 2 - PRODUCTS

- A. Submerged Pressure Transducer
 1. Wetted Parts: 316L stainless steel
 2. Cable length: As required to reach remote panel mounted meter without splices
 3. Output: 4-20mA, 2-wire loop powered
 4. Supply Voltage: 10-28 VDC
 5. 0-120' pressure range

6. +/- 0.10% accuracy
 7. Operating temperature: 14-176 deg F
 8. Temperature compensation: digital over entire operating range
- B. Digital Panel Meter
1. Input: 4-20 mA
 2. Programmable Display: (2) lines of 6 digits
 3. 120 Vac input power
 4. Isolated transmitter power supply: 24Vdc @ 200 mA
 5. NEMA 4X front panel
 6. Isolated 4-20 mA transmitter output

The application of this Section will proceed per the PUMP STATION SCADA EQUIPMENT special provision, which is amongst the accompanying special provisions.

End Section 409100

409150 PRESSURE INDICATORS AND TRANSMITTER

PART 1 - GENERAL

- A. Pressure measurement, indicator, and transmitter system consisting of a compact pressure indicator/transmitter and a remote panel mounted digital panel meter.

PART 2 - PRODUCTS

- A. Pressure Indicator/Transmitter
 - 1. Wetted Parts: 316L stainless steel
 - 2. Output: 4-20mA, 2-wire
 - 3. Supply Voltage: 12-32 VDC
 - 4. 0-300 psi pressure range
 - 5. Rangeability/Adjustments
 - a. Zero: -10 to 110% of upper range limit
 - b. Span: -10 to 110% of upper range limit
 - 6. Accuracy: +/- 0.25% upper range limit
 - 7. Display: 4 digit, 10 mm LCD
 - 8. Pressure Connection: ¼" NPT female
 - 9. Electrical Connection: ½" NPT female
 - 10. NEMA 4X enclosure
 - 11. Operating temperature: 14-140 deg F
- B. Digital Panel Meter
 - 1. Input: 4-20 mA
 - 2. Programmable Display: (2) lines of 6 digits
 - 3. 120 Vac input power
 - 4. Isolated transmitter power supply: 24Vdc @ 200 mA
 - 5. NEMA 4X front panel
 - 6. Isolated 4-20 mA transmitter output

The application of this Section will proceed per the PUMP STATION SCADA EQUIPMENT special provision, which is amongst the accompanying special provisions.

End Section 409150

409500 PROGRAMMABLE LOGIC CONTROLLER CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Specification Section Includes:

1. Programmable logic controller (PLC) control system(s), including software, programming, and training.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - b. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
2. National Electrical Manufacturers Association (NEMA):
 - a. ICS 1, General Standards for Industrial Control and Systems.

B. Qualifications:

1. Installation supervisor shall have had experience in overseeing installation and startup of at least three (3) similar installations.
2. Programmer(s) shall have had experience in programming PLCs for at least two (2) projects of similar size and complexity.

1.3 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:

- a. Annotated hard copies of PLC software programs:
 - 1) Submit program for logic in ladder diagram format as used for the specific PLC system.
 - 2) Annotate program listing to include the following:
 - a) Written description of each rung's function.
 - b) Reference to control loop number for each rung where applicable.
 - c) Reference to instrumentation tag number of I/O devices for each rung where applicable.
 - 3) Provide written descriptions completely defining all function blocks used in program.
 - 4) Provide list of all addresses referenced in logic diagram with description of data associated with each address.
- b. Results of factory testing procedures.
- c. Drawings containing the following information:
 - 1) Arrangement drawings for PLC system components.
 - 2) Panel and enclosure plans, sections, and details.
 - 3) Access opening locations and required clearances for each panel and enclosure.
 - 4) Enclosure internal wiring and terminal blocks.
- d. Catalog cut sheets containing information on PLC components to be submitted as part of submittals of this Specification Section.

B. Operation and Maintenance Manuals:

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 1. Rockwell Automation, Allen-Bradley. (Controllogix)
- 2. General Electric Company.(RX3i)
- 3. ICS Healy-Ruff VPAC
- 4. Evoqua LC Controllers
- 5. Or approved equal.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The PLC system shall accomplish the control requirements of the loop descriptions, Drawings, and Specifications.
- B. PLC programming shall be documented and factory tested.
- C. The PLC system shall operate in ambient conditions of 32 to 140 DegF temperature and five (5) to 95 percent relative humidity without the need for purging or air conditioning.
- D. Environmental Controls:
 - 1. Furnish circulation fans in solid-state control system enclosures.
 - 2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
 - 3. Air conditioning applications shall include means of preventing moisture condensation.
- F. Where the PLC is utilized to control multiple trains of equipment and where the equipment in each train operates as a unit relatively independent of other equipment trains (e.g., facility with multiple filter trains), the PLC components (I/O modules, power supplies, etc.) shall be assigned so that the failure of any one (1) component does not affect equipment on all trains:
 - 1. I/O modules shall be segregated on a train basis unless required otherwise for safety reasons.
 - 2. Where several equipment units operate in parallel, but are not considered assigned to a particular equipment train (e.g., multiple raw water pumps or chemical feed pumps all discharging into a common system), the PLC I/O modules associated with each equipment unit shall be assigned so that the failure of any one (1) I/O module does not affect all of the parallel operating equipment units.
- G. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per IEEE C37.90.2.

- H. Incorporate the following minimum safety measures:
1. Watchdog function to monitor:
 - a. Internal processor clock failure.
 - b. Processor memory failure.
 - c. Loss of communication between processor and I/O modules.
 - d. Processor ceases to execute logic program.
 2. Safety function wiring:
 - a. Emergency shutdown switches shall not be wired into the controller.
 3. Safe wiring:
 - a. Unless otherwise specified, activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.
 - b. Low voltage control signal wires:
 - 1) Place in conduit segregated for that purpose only.
 - 2) Twisted shielded wire pair.
 - 3) Not located in the same conduit or bundle with power wiring.
 4. Initial safety conditions:
 - a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
 - b. Utilize program each time PLC is re-initiated and the control program activated.
 5. Monitoring of internal faults and display:
 - a. Internal PLC system status and faults shall be monitored and displayed:
 - 1) Monitored items shall include:
 - a) Memory ok/loss of memory.
 - b) Processor ok/processor fault.
 - c) Scan time overrun.
 6. Control of programs:
 - a. Protect access to PLC program loading with password protection or with locked, key operated selector switches.
 7. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.

8. Operator intervention:
 - a. Logic system failure shall not preclude proper operator intervention.
 - b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

2.3 COMPONENTS

- A. PLC System Central Processor Unit (CPU):
 1. CPU shall provide communications with other control systems and man-machine interfaces as specified.
 2. Memory:
 - a. Battery-backed RAM.
 - b. EEPROM program back-up:
 - 1) Automatically download to RAM in the event RAM is corrupted.
 3. Memory battery backup shall be capable of 60 days memory retention with fresh battery:
 - a. Provide visual indication of battery status and alarm low battery voltage.
 - b. Memory battery backup shall be capable of 14 days memory retention after the "Battery Low" indicating LED is on.
 4. Plug-in card design to allow quick field replacement of faulty devices:
 - a. Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.
 5. 20 percent minimum spare useable memory capacity after all required programming is in place and operating.
 6. Capable of executing all control functions required by the Specifications and Drawings.
 7. Built-in three-mode (proportional-integral-derivative) control capabilities:
 - a. As directly selectable algorithms requiring no user knowledge of programming languages.
 8. On-line reconfigurable.
 9. Lighted status indicators for "RUN" and "FAILURE."

10. Maximum scan times:
 - a. Program scan:
 - 1) 200 mSec/K.
 11. Capable of manual or automatic control mode transfer from the operating console stations.
 - a. Transfer shall be bumpless.
- B. Input/output (I/O) Modules:
1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
 2. Provide I/O system with:
 - a. I/O solid state boards with status lights indicating I/O status.
 - b. Electric isolation between logic and field device.
 - c. Capability of withstanding low energy common mode transient to 1,000V without failure.
 - d. Incorporate noise suppression design.
 - e. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
 - f. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.
 - g. Install 20 percent spare I/O modules.
 3. Input/output connection requirements:
 - a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
 - b. Prewire I/O modules to terminal blocks.
 - c. Provide terminal blocks with continuous marking strip.
 - d. Size terminals to accommodate all active data base points and spares.
 - e. Provide terminals for individual termination of each signal shield.
 - f. Field wiring shall not be disturbed when removing or replacing an I/O module.
 4. Discrete I/O modules:
 - a. Interface to ON/OFF devices.
 - b. I/O status indicator on module front.
 - c. Voltage rating to match circuit voltage.
 - d. Output module current rating:
 - 1) Match maximum circuit current draw.
 - 2) Minimum 1.0 continuous A/point for 120 Vac applications.
 - e. Isolated modules for applications where one (1) module interfaces with devices utilizing different sources of power.

5. Discrete outputs shall be fused:
 - a. Provide one (1) fuse per common or per isolated output.
 - b. Provide blown fuse indication.
 - c. External fusing shall be provided if output module does not possess internal fusing.
 - d. Fuses provided external to output model shall:
 - 1) Be in accordance with module manufacturer's specifications.
 - 2) Be installed at terminal block.

6. Analog I/O modules:
 - a. Input modules to accept signals indicated on Drawings or Specifications.
 - b. Minimum 12 bit resolution.
 - c. I/O chassis supplied power for powering connected field devices.
 - d. Differential inputs and outputs.
 - e. Each loop shall be individually fused.
 - f. User configurable for desired fault-response state.
 - g. Provide output signals as indicated on Drawings and Specifications.
 - h. Individual D/A converter for each output module.
 - i. Individual A/D converter for each input module.

C. Network Cards:

1. Ethernet module.
2. 100 base.
3. Modbus and TCP/IP network protocol compatible:
 - a. All software upgrades required for a complete and operational system.

D. Power Supply Units:

1. Provide regulated power units:
 - a. Designed to operate with PLC system and shall provide power to:
 - 1) All components of PLC system.
 - 2) All two-wire field instruments.
 - 3) Other devices as indicated on Drawings or Specifications.
 - b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
 - c. Each power supply shall be sized such that it will carry no more than 75 percent of capacity under normal loads.

2. Electrical service to PLC system is 105 to 125V, 60 Hz, +1 percent, 1 PH power.
3. Separate AC circuit breakers shall be provided for each power supply.
4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room for power supply modification in the PLC system enclosure.
5. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
6. Power distribution:
 - a. Immune to transients and surges resultant from noisy environment.
 - b. Shall provide constant voltage level DC distribution to all devices.
7. Provide uninterruptible power supply (UPS) to sustain full power to UPS powered loads listed below for a minimum of 30 minutes following loss of primary power and to ensure that the transient power surges and dips do not affect the operation of the PLC system:
 - a. UPS powered loads:
 - 1) All rack mounted PLC components.
 - 2) Local operator consoles.
 - 3) All power supplies furnished with the PLC and associated loads.
 - b. Input:
 - 1) 120 Vac +10 percent.
 - 2) 60 Hz.
 - 3) Line fuse protection.
 - c. Output:
 - 1) 120 Vac (5 percent).
 - 2) 60 Hz.
 - 3) Short circuit protected.
 - 4) Instantaneous transfer time.
 - d. IEEE C62.41 Class A voltage surges of 6,000V attenuated to less than 50V on the output.
 - e. Battery:
 - 1) Maintenance free lead acid.

E. PLC System Enclosure:

1. Component placement:

- a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.
- b. Either install power supplies above all other equipment with at least 10 IN of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
- c. Do not place I/O racks directly above the CPU or power supply.
- d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
- e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 IN of separation between the magnetic area and the control area.
- f. Place circulating fans close to major heat generating devices.
- g. Segregate input/output modules into groups of identical type.

2. Termination requirements:

- a. In accordance with Specification Section 13448.
- b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.
- c. Prewire I/O modules to terminal blocks.
- d. Size terminals to accommodate all active database points and spares.
- e. Provide terminals for individual termination of each signal shield.
- f. Field wiring shall not be disturbed when removing or replacing an I/O module.

F. PLC System Software and Programming:

1. Provide all hardware and programming required to provide communication between the PLC and the man-machine interface.
2. Provide programming to accomplish all control and monitoring requirements of the Drawings and Specifications.
3. Provide two (2) copies of control logic program on CD or flash drive.
4. IBM compatible software.
5. Full documentation capability:
 - a. Provide description for each rung.

6. On/off line programming.
7. Offline simulation prior to download.
8. Two-step commands requiring operator verification prior to deletion of any programming.

2.4 ACCESSORIES

- A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.5 SOURCE QUALITY CONTROL

- A. Provide a performance test after factory completion and prior to shipment:
 1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control.
 2. Conduct testing with dummy I/O to verify each control loop operation.
 3. Allow for Owner and Engineer representatives to witness testing program:
 - a. Provide minimum of 15 days notice prior to testing.
 4. Do not ship prior to successful completion of this testing program.

2.6 MAINTENANCE MATERIALS

- A. Furnish Owner with the following extra materials:
 1. One (1) spare I/O card of each card type for every 10 cards or fraction thereof installed.
 2. One (1) spare power supply for each model PLC provided.
 3. One (1) spare expansion communication card for each type provided.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install PLC control system in accordance with manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise adjustments and installation checks.
 - 3. Maintain and submit an accurate daily or weekly log of all commissioning functions:
 - a. All commissioning functions may be witnessed by the Engineer.
 - b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
 - 4. Conduct startup of equipment and perform operational checks.
 - 5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.3 DEMONSTRATION

- A. On-Site Training:
 - 1. Provide suitable trained manufacturer employee experienced in training or certified representative to provide three (3) days of operating and maintenance training at the Project Site after the system has successfully undergone all field-testing and acceptance procedures:
 - a. Training shall include both classroom sessions and hands on training with actual installed equipment:
 - 1) As a minimum, training shall cover:
 - a) Hardware overview.
 - b) Software overview.
 - c) Maintenance.
 - d) Trouble shooting.
 - e) Operation, e.g., changing set points, passwords, etc.

The application of this Section will proceed per the PUMP STATION SCADA EQUIPMENT special provision, which is amongst the accompanying special provisions.

End Section 409500

409510 COMPUTER NETWORK AND HUMAN MACHINE INTERFACE (HMI) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Specification Section Includes:

1. Computer network and HMI hardware requirements which includes but is not necessarily limited to:
 - a. LCD flat panel type monitors.
 - b. HMI computer workstations.
 - c. Network servers.
 - d. External data storage.
 - e. Field mounted flat face panels.
 - f. Ethernet switches.
 - g. Printers.
 - h. Software.
 - i. Accessories and maintenance materials.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 802.3, Information Technology - Local and Metropolitan Area Networks - Part 3:
 - 1) Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - 2) 802.3u:
 - a) IEEE Standards for Local and Metropolitan Area Networks:
 - (1) Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T.
 - 3) 802.3x:
 - a) IEEE Standards for Local and Metropolitan Area Networks:
 - (1) Specification for 802.3 Full Duplex Operation.

1.3 DEFINITIONS

A. HMI:

1. Human Machine Interface.

B. LCD:

1. Liquid Crystal Display.

C. OPC:

1. "OLE for Process Control", a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.

D. PC:

1. Personal Computer.

E. RAID:

1. Redundant Array of Independent Disks, a method of storing the same data in different places on multiple hard disks.

F. RAM:

1. Random Access Memory.

G. SCSI:

1. Short for Small Computer System Interface, a parallel interface standard used for attaching peripheral devices to computers.

H. SDRAM:

1. Synchronous Dynamic RAM.

I. SNMP:

1. Simple Network Management Protocol, a set of protocols for managing complex networks.

J. TFT:

1. Thin-Film Transistor, a technology for building LCD screens.

1.4 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.

B. Operation and Maintenance Manuals:

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed within the following Articles are acceptable or approved equal.

2.2 LCD FLAT PANEL TYPE MONITORS

A. Acceptable Manufacturers:

- 1. Dell.
- 2. Hewlett-Packard.

B. Design Requirements:

1. Type of display:

- a. Color TFT active matrix LCD.

2. Native Resolution:

- a. 27 IN:
 - 1) 1920 x 1080.

3. Image brightness:

- a. Minimum 250 cd/m².

4. Display image contrast ratio:

- a. 800:1 or higher.

5. Maximum sync rate (vertical scan rate x horizontal scan rate):

- a. At least 75 Hz x 80 KHz.

6. Viewing angle:
 - a. 170 degrees both vertical and horizontal.
7. Adjustable tilt and swivel.
8. Anti-glare flat screen.
9. Power input:
 - a. 120 Vac.

2.3 HMI COMPUTER WORKSTATIONS

- A. Acceptable Manufacturers:
 1. Dell.
 2. Hewlett Packard.
- B. PCs shall be in accordance with the following minimum requirements:
 1. Minimum 2.8 GHz processing speed and 12 MB cache.
 2. Minimum 4 GB RAM.
 3. Minimum 1TB hard drive.
 4. Chip:
 - a. Quad-core.
 5. Hard disk drive:
 - a. SATA 6.0 GB/s, 7,200 RPM with 32 MB cache.
 6. DVD+/-RW drive.
 - a. Read speed:
 - 1) 40x CD.
 - 2) 16x DVD.
 7. Accelerated graphics port video card with minimum 4 MB.

8. Communication ports as listed below:
 - a. All communication ports as required by functional requirements of Contract Documents.
 - b. Minimum four (4) USB 3.0.
 - c. Ethernet 10/100/1000 MB/s.
9. Ethernet networking cards for LAN communication.
10. Case style:
 - a. Tower.
 - b. Rail mount

C. Keyboards:

1. Incorporate Standard IBM-QWERTY design with numeric keypad and assigned function keys.
2. Sculptured keys.
3. Tactile feedback.

D. High performance mouse with laser sensor and tilt wheel.

E. External Speakers.

F. Minimum Software:

1. Operating System:
 - a. Windows 7.
2. Productivity Software:
 - a. Microsoft Office Suite Professional 2010.
3. Browser:
 - a. Microsoft Internet Explorer 11.

2.4 HMI NETWORK SERVERS

A. Acceptable Manufacturers:

1. Dell.
2. Hewlett Packard.

- B. Provide HMI Network servers as shown on the Drawings and as scheduled herein.
- C. HMI Network Servers:
1. Maintain cache of data for a configurable time period, such that requests from multiple display station clients minimize unnecessary requests to field controllers by reading from the Control Network Server cache rather than directly polling the field devices.
 2. Design and fabrication:
 - a. Rack mounted.
 - b. Minimum 2.83 GHz processing speed.
 - c. SDRAM:
 - 1) Size as required to meet performance requirements of the Contract Documents or minimum 8 GB, whichever is greater.
 - 2) Expandable.
 - 3) Utilize ECC (Error Correcting Code) memory.
 - d. Hot-swappable redundant power supplies and cooling fans.
 - e. Hard drives:
 - 1) RAID 1 configuration.
 - 2) Hot-swappable SCSI drives.
 - 3) Total memory:
 - a) Minimum dual 1TB.
- D. Historical Data Server(s):
1. Provide an Historical Data Server.
 2. Design and fabrication:
 - a. Rack mounted.
 - b. Minimum 2.83 GHz processing speed.
 - c. SDRAM:
 - 1) Size as required to meet performance requirements of the Contract Documents or minimum 4 GB, whichever is greater.
 - 2) Expandable.
 - 3) Utilize ECC (Error Correcting Code) memory.
 - d. Hot-swappable redundant power supplies and cooling fans.
 - e. Hard drives:
 - 1) RAID 1 configuration.
 - 2) Hot-swappable SCSI drives.
 - 3) Total memory:
 - a) Minimum dual 1TB.

2.5 ETHERNET SWITCHES

A. Acceptable Manufacturers:

1. Sixnet.
2. N-TRON.
3. Allen-Bradley/Cisco.

B. Managed Ethernet Switches:

1. All SCADA PLC and Remote I/O control panels denoted on the Contract Drawings shall utilize managed Ethernet switches.
2. Design and fabrication:
 - a. Support Ethernet 100/1,000 MBit/s.
 - b. Support SNMP and Web based management.
 - c. Rapid Spanning Tree Protocol.
 - d. IGMP (Internet Group Management Protocol) support for IP multicast filtering to enable switches to automatically route messages only to appropriate ports.
 - e. Backbone ports for connection to multimode fiber via Type SC connectors.
 - f. Quantity as required for communication with devices as depicted in the Contract Documents.
 - g. 10/100/1,000 MBit/s twisted pair ports (RJ45) as required for communication with devices as depicted in the Contract Documents:
 - 1) Unless otherwise noted, provide at least two (2) spare 10/100/1,000 MBit/s port (twisted pair) at each Ethernet switch.
 - h. Check all received data for validity:
 - 1) Discard invalid and defective frames or fragments.
 - i. Monitor connected TP/TX line segments for short-circuit or interrupt using regular link test pulses in accordance with IEEE 802.3.
 - j. Monitor attached fiber optic lines for open circuit conditions in accordance with IEEE 802.3.
 - k. As applicable, meet requirements of IEEE 802.3.
 - l. Power switch with 24 Vdc power input.
 - m. Provide LED status lights to indicate:
 - 1) Power:
 - a) Supply voltage present.
 - 2) Fault.
 - 3) Port status.

- n. Environmental rating:
 - 1) Operating temperature:
 - a) 32 Deg F to 122 Deg F.
 - 2) Humidity:
 - a) 95 percent relative humidity, non-condensing.
- 3. Function in self-healing ring structure.
 - a. If one section in the ring fails, the ring structure changes to a line structure within 0.5 seconds.

2.6 PRINTERS

A. Color Laser Printers:

- 1. Acceptable manufacturers:
 - a. Dell.
 - b. Hewlett Packard.
 - c. Lexmark.
 - d. Oki Data.
- 2. Rated engine speed:
 - a. Monochrome:
 - 1) 24 pages per minute.
 - b. Color:
 - 1) 16 pages per minute.
- 3. Printer engine resolution:
 - a. Up to 1200 x 1200 dpi.
- 4. Minimum input paper tray capacity:
 - a. 500 sheets.
- 5. Capable of printing on standard bond paper, glossy paper, and transparency film.
- 6. Capable of printing:
 - a. Letter size paper.
 - b. Legal size paper.
- 7. Memory:
 - a. Minimum 64 MB.

8. Integral interfaces:
 - a. Ethernet.
 - b. USB.
9. Minimum toner or cartridge capacity:
 - a. 10,000 pages based on five (5) percent coverage.
10. Operating temperature:
 - a. 50 to 90 DegF.
11. Operating humidity:
 - a. 20 to 80 percent (non-condensing).

2.7 SOFTWARE

- A. Provide all software and associated programming/configuration required to meet performance requirements of the Contract Documents:
 1. At substantial completion of the Project:
 - a. Turn current licenses for all software over to the Owner in the Owner's name and install the latest version, upgrade or service pack for all software.
 - b. Provide the respective software supplier's Comprehensive Support Contract for all software covering a full three (3) year warranty period following substantial completion which shall provide no cost software upgrades, service packs and tech support from the software supplier.
- B. HMI Software:
 1. Subject to compliance with the Contract Documents, the following HMI software packages are acceptable:
 - a. SCADA PLC and Remote I/O control panels denoted on the Contract Drawings:
 - 1) Rockwell Automation:
 - a) PlantPAX.
 - 2) Inductive Automation:
 - a) Ignition.
 - 3) Wonderware ArchestraA.
 - 4) Wonderware InTouch.

- C. Ethernet Network Management Software:
1. Software to include an OPC Server, capable of integrating real-time SNMP tag data into OPC client enabled HMI software databases.
 2. Software shall allow control of polling rate for SNMP requests, as well as limit access to write SNMP data on each SNMP tag.
 3. Software shall have pre-developed tag databases for several manufacturer's Ethernet network devices, as well as generic MIB (Management Information Base) tag databases.
 4. Software shall have integrated OPC client data viewer software, so that SNMP data may be viewed without having to create HMI tags.
- D. Provide each PC with the latest edition of the following software:
1. Operating system:
 - a. Microsoft Windows 7.
 2. Microsoft Office Suite Professional 2010.
 3. Anti Virus software:
 - a. Norton Internet Software.
- E. All software must be latest edition and licensed to the Owner.

2.11 ACCESSORIES AND MAINTENANCE MATERIALS

- A. Provide all accessories required to furnish a complete computer-based network for the control system to accomplish the requirements of the Drawings and Specifications.
- B. Furnish Owner with the following extra materials:
1. One (1) spare Ethernet switch of each type utilized.
 2. One (1) spare toner cartridge per laser printer provided.

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. On-Site Training:

1. Provide manufacturer employee or certified representative for one (1) full day of training on system operation and maintenance after system successfully field tested and accepted:
 - a. As a minimum, training shall cover:
 - 1) Hardware overview.
 - 2) Software overview.
 - 3) Maintenance.
 - 4) Trouble shooting.
 - 5) Operation:
 - a) Setpoint modification, password use, etc.

The application of this Section will proceed per the PUMP STATION SCADA EQUIPMENT special provision, which is amongst the accompanying special provisions.

End Section 409510

409520 CONFIGURATION REQUIREMENTS: HUMAN MACHINE INTERFACE (HMI) AND REPORTS

PART 1 - GENERAL

1.1 SUMMARY

1. Specification Section Includes:
 - a. Specific software functional descriptions.
 - b. Graphics requirements.
 - c. HMI functionality requirements.
 - d. Plant overview screens.
 - e. Process overview screens.
 - f. Detail displays.
 - g. Trend displays.
 - h. PLC hardware/HMI status screen.
 - i. Alarm monitoring.
 - j. Report generation.
 - k. Configuration standards and conventions.
 - l. Screen configuration review meetings.
 - m. Report configuration review meetings.
 - n. Coordination.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Programmer(s) shall have had experience in software configuration and installation for at least two (2) projects of similar size and complexity.

1.3 DEFINITIONS

A. HMI:

1. Human Machine Interface.

B. I/O:

1. Input/Output.

C. OLE:

1. Object Linking and Embedding, a document standard developed by Microsoft that enables the creation of an object with one application and the linking or embedding of the object in a second application.

D. OPC:

1. "OLE for Process Control"; a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.

E. PC"

1. Personal Computer.

F. PLC:

1. Programmable Logic Controller.

1.4 SUBMITTALS

A. Shop Drawings:

1. Software Configuration Standards and Conventions document.
2. Graphic screen displays; provide in actual colors utilized.
3. Sample reports.
4. Certifications:
 - a. Qualifications of programmer(s).

- B. Operation and Maintenance Manuals:
- C. Miscellaneous Submittals:
 - 1. Results of factory testing procedures.
 - 2. Proposed training agendas and schedule.

1.5 GENERAL FUNCTIONAL REQUIREMENTS

- A. Software Functional Requirements:
 - 1. PRO General functional requirements for system configuration are indicated on the Drawings and described in the Specifications.
 - 2. The information presented herein and indicated on the Drawings illustrates the general functional intent of the system and may not be sufficient to fully configure the system.
 - 3. The Contractor is responsible for determining what additional information may be required to complete the configuration tasks, and for obtaining this information from the Owner. DUCTS
- B. Available Process Values:
 - 1. All process alarm, equipment status, and process variable values shall be available at any HMI.
 - 2. If communications to a particular I/O point has failed for any reason, then wherever that data is displayed, the software shall post a visual indication that the point is not valid.
- C. Provide comprehensive on-line help for all development functions.
- D. Manual Entry of Data:
 - 1. All PC-based HMIs must allow manual entry of surrogate data and other variables, which must then be available for display and use in reports:
 - a. Operator-entered commands from any of the operator workstations must be logged by the computer servers.
- E. System Failure:
 - 1. Failure of any PLC, remote I/O hardware, or network communication link must be individually alarmed at HMIs.
 - 2. Unless otherwise specified, each alarm must be specific to a single point of failure.

- F. Software licensing shall allow all plant HMIs to be active simultaneously.
- G. All process related functions, calculations, timers, and numeric manipulations, shall be accomplished in the PLC hardware and not in the HMI:
 - 1. The HMI shall function as a monitoring system, not as a process controller.
 - 2. The HMI shall transfer data to the PLC system and the PLC system shall perform all control algorithms.

1.6 SECURITY

- A. Fully integrate security into the SCADA system to allow only users with appropriate security levels access to individual parts of the system.

PART 2 - PRODUCTS

2.1 SPECIFIC SOFTWARE FUNCTIONAL DESCRIPTIONS

- A. Specific functional requirements for various software control blocks within the computer system are as follows.
- B. Descriptions are general and are not intended to fully indicate the complete functionality of the system:
 - 1. Monitoring of process values:
 - a. Process values derived from analog process variable signals must be historically archived:
 - 1) Store all historical data with time and date of occurrence.
 - 2) Make values available for use in reports.
 - 3) Assign high and low alarms to process values as defined below and otherwise deemed appropriate.
 - b. Provide capability for computer server(s) to retrieve real-time values from the PLC system at adjustable time periods.
 - c. Alarm limits:
 - 1) Set per direction from the Owner.
 - 2) An operator having proper security authorization must be able to enable, disable, and adjust the setpoint of any individual alarm.

- C. Utilize graphic screen displays at the HMI(s) to provide monitoring and control functionality:
1. Hierarchy of HMI screens is in descending order as follows:
 - a. Plant overview screen(s).
 - b. Process overview screens.
 - c. Process screens.
 - d. Pop-up/control screens.
- D. HMI operator interface functionality shall include:
1. Indication of process variables.
 2. Configuration of control loop parameters (e.g., setpoints, gains, etc.).
 3. Adjustment of controller output.
 4. Display of real time and historical process trends.
 5. Selector switch and pushbutton station controls.
 6. System and process status indicators.
 7. Graphic representation of plant operations with interactive status and measurement symbols.
 8. Annunciation.
- E. Graphics:
1. Utilize dynamic variables with unique tags per graphic.
 2. Dragging the mouse over designated process areas of screen shall allow the operator to select predetermined processes or equipment and drill down to site-specific detail screens.
 3. Critical "overview" information such as tank levels, flows and pressures shall be indicated through data fields or animation effects such as level fills or color change.
 4. All monitored and or controlled process equipment shall be animated or color-highlighted to indicate status changes:
 - a. For example, a pump "running" or "valve open" condition shall be signified by the pump color changing to bright green.
 5. Tank and vessel levels shall be indicated with a tabular data field and by graphic "fill" simulating a rising or falling level within the tank or vessel.

6. Provide the ability to "drill down" to detail screens or graphics.
 - a. Clicking on a device or process area shall generate a detail graphic or pop-up window to access specific data or control functions.
 - b. All operator adjustments (e.g., set point adjustment, mode selection) shall be accomplished via a pop-up display, and shall not be allowed on the process screen.
 7. Standard symbol library:
 - a. User defined.
 - b. Must not require software programming.
 8. Single keystroke access from graphic to group display or other custom graphic displays.
 9. Capable of being edited by moving, copying, or grouping user defined areas of screen.
 10. Utilize a navigation bar:
 - a. Navigation bar utilized on every screen.
 - b. Navigation bar to include navigation functions, active alarm notification, security functions, current date/time display, "PRINT SCREEN" pushbutton, and other functions as required and as agreed upon at the Screen Configuration Review Meetings.
- F. Plant Overview Screens:
1. As a minimum, provide Plant Overview screens as listed below:
 - a. This list is meant to serve as an initial guide; final determination of overview screen requirements will be made during the Configuration Conferences:
 - 1) Collector Well Pump Station
 - 2) Stormwater Pump Station
 - 3) Vertical Well System

2. At a plant overview screen, the operator shall be able to select a specific process screen for monitoring/control purposes:
 - a. Monitoring and control functions available at the selected process screen include but are not limited to the following:
 - 1) Select individual equipment items for monitoring and control.
 - 2) Select a control loop or point for control action.
 - 3) Change control mode of loop selected (manual, automatic, cascade).
 - 4) Change setpoint.
 - 5) Issue commands to start/stop and open/close two-state equipment.
 - 6) For manual loading output stations, the operator shall be able to manipulate analog output values.
 - 7) Select a loop and initiate further display, such as the detail display, trend, or hourly averaging.
 - 8) Display and change ratio and bias values.
 - 9) Control field equipment such as motor-operated valves and switches.

G. Detail Display:

1. Provide separate display for each point:
 - a. Representations of each analog and digital point shall be single user configured faceplate.
 - b. Display shall include alphanumeric representations of all variables and parameters for single loops including but not limited to:
 - 1) Alarm points.
 - 2) Limits.
 - 3) Constants.
 - 4) Interconnections to other loops.
 - 5) Calculating functions.

H. Trend Displays:

1. Real time historical trend displays.
2. Real time on-line trend displays.
3. Capable of displaying multiple points per display.
4. Operator shall be able to select any desired sample time interval.

5. Provide flexibility and easy access to real time and historical trend information for any variable TAG defined within the SCADA application:
 - a. As a minimum, provide the following:
 - 1) Provide capability for the user to define trend scenarios.
 - 2) Provide a button to open a dialog window to select multiple variable TAGS and save them as a trend scenario for future use.
 - 3) Provide a pull-down menu to allow the user to open saved trend scenarios.
 - 4) Provide a button to allow the user to select real-time or historical trends.
 - 5) Provide a button to save displayed trend info to a file for export to external software applications (such as Microsoft Excel).
 - 6) Provide a Print Trend button to allow user to print current trend.
 6. Utilize Historical Data Server(s) to collect and manage data.
- I. PLC Hardware/HMI Status Screen:
1. Provide a status screen to depict status conditions and diagnostic information for all major networked equipment.
 2. Depict communication status for all networked communicating devices, such as PLC processors, Ethernet switches, PCs, and radios, etc.
- J. Alarm Monitoring:
1. Provide standard alarm screen functionality to ensure flexibility and quick access to live alarms, alarm history and alarm grouping parameters:
 - a. As a minimum, include the following features and functionality:
 - 1) An Alarm Screen header bar to head all alarm pages and reside below the Navigation Bar.
 - 2) Buttons to dynamically switch between Alarm Summary and Alarm History.
 - 3) A menu to allow user to select and open historical alarm archives.
 - a) Utilize a time-date stamp file structure.
 - 4) Pull-down menu bar to select operator configured alarm groups.
 - 5) Capability to sort alarms by priority and to define priority for all system alarms.
 - 6) Capability to filter or group alarms.

2. Analog alarms:
 - a. The SCADA software shall monitor analog and discrete variables and calculated conditions, and determine if the variable is in an alarm condition.
 - b. For each Analog Tag, an alarm for each of the following conditions shall be assignable:
 - 1) Low-low.
 - 2) Low.
 - 3) High.
 - 4) High-high.
 - 5) Deviation low.
 - 6) Deviation high.
 - 7) Rate of change.
 - c. Provide adjustable dead bands and delay timers for all analog alarms.
3. Present alarms in order of:
 - a. Priority.
 - b. Time of occurrence.
 - c. Non-acknowledged presented ahead of acknowledged.
4. Utilize single keystroke or pushbutton to:
 - a. Acknowledge alarms.
5. Alarm list presented to operator shall include:
 - a. Time of occurrence.
 - b. Time of acknowledgement.
 - c. Description.
 - d. Acknowledgement status.
6. Alarm list printed by either of the following:
 - a. On command.
 - b. Periodically.
7. Audible alarming capability for user selected alarms.

K. Report Generation:

1. Base bid on the generation of the following reports:
 - a. Minimum of four (4) formatted reports:
 - 1) Report form and content shall be determined at the Report Configuration Review Meetings.
 - 2) Each report shall contain daily, weekly, and monthly average calculated values.
 - 3) Each report shall contain between 10 and 15 measured parameters.

- b. List of all entries initiated by operator including the following:
 - 1) Console key changes.
 - 2) Beginning and final values of setpoint and output changes.
 - 3) Mode changes (i.e., auto to manual).
 - 4) Time change was made.
 - c. Event list:
 - 1) Description of selected events.
 - 2) Time of event.
2. Custom report capabilities:
- a. User configurable.
 - b. Contain selected information from any log, event, or alarm list.
 - c. Capable of producing custom log report for periodic and on-demand printing of a list of process or calculated variables.
 - d. Reports shall not require software programming by the user to setup.
3. Control of programs:
- a. Protect access to configuration via password protection.

2.2 SOURCE QUALITY CONTROL

- A. Include performance test of HMI software in factory with the overall PLC System test:
 - 1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control:
 - 2. Allow for Owner and Engineer representatives to witness testing program:
 - a. Provide minimum of 15 days notice prior to testing.

PART 3 - EXECUTION

3.1 CONFIGURATION REQUIREMENTS

- A. Provide all programming and configuration required for all HMIs furnished under this Contract:

3.2 CONFIGURATION STANDARDS AND CONVENTIONS

- A. Prepare and submit a "Software Configuration Standards and Conventions":
 - 1. Submit for review and approval prior to commencing with software configuration.

2. Describe and define such items as:
 - a. Proposed graphic display process colors/representations.
 - b. Color standards for "ON," "OFF," and "ALARM" conditions.
 - c. Font type and size.
 - d. Alarm handling conventions.
 - e. Methods for navigation between displays.
 - f. Address usage/naming conventions.
 - g. Security setup.
 3. Prior to submitting the initial draft document, the Contractor must meet with the Owner to review any of the Owner's existing standards and conventions.
 4. In addition to submitting the initial document for review, submit an updated version of the document as part of the O&M Manuals:
 - a. Revise this document to include any additional standards that are established throughout the configuration process.
- B. It is the intent of these specifications to provide the end user with state-of-the-art functionality.
1. Minimum standards are as follows:
 - a. Depict the actual process equipment configuration as accurately as possible.
 2. All overview and site-specific screens shall incorporate a "navigational header bar" similar in function and appearance to Microsoft Internet Explorer:
 - a. The intention of this Specification is to provide a familiar, user-friendly navigation throughout the graphical displays.

3.3 SCREEN CONFIGURATION REVIEW MEETINGS

- A. Conduct a minimum of three configuration conferences with the Owner to review and discuss system configuration programming and related topics:
1. The purpose of the conferences will be to discuss, in detail, how each I/O point will be handled and the types, quantities, hierarchies, and functioning of display screens.
 2. Review of the Owner's existing systems, standards, conventions, file and tag naming requirements, font type and size requirements, and reporting requirements must be part of each conference.
 3. Review the navigation bar to be utilized.

4. Conferences will be held at the District Headquarters in Collinsville, Illinois.
 5. Each screen will be reviewed at each conference.
 - a. If required, to review all screens, each conference will occur on multiple days.
 6. Submit 10 color copies of printed screens via shop drawing submittal process 10 calendar days before each conference.
 7. Bring equipment to project screens on wall or provide multiple monitors for viewing by attendees.
- B. Proposed graphic screens and report formats must be reviewed with the Owner throughout the configuration process.

3.4 REPORT CONFIGURATION REVIEW MEETINGS

- A. Conduct a configuration conference with the Owner to review and discuss the reports and report formats:
1. Review of the Owner's existing systems, standards, conventions, and reporting requirements must be part of each conference.
 2. The conference(s) will be held at the District Headquarters in Collinsville, Illinois
 3. Each report will be reviewed at each conference:
 - a. If required, to review all reports, each conference will occur on multiple days.
 4. Provide 10 copies of printed sample reports via shop drawing submittal process 10 calendar days before each conference.
- B. Proposed report formats must be reviewed with the Owner throughout the configuration process.

3.5 COORDINATION

- A. Coordinate as required with other contractors and vendors to seamlessly integrate all HMI monitoring and control functions.
1. To the greatest extent possible, integrate graphics presentation for all systems into screens utilizing one common HMI software.

3.6 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
 2. Supervise adjustments and installation checks.
 3. Maintain and submit an accurate daily or weekly log of all commissioning functions:
 - a. All commissioning functions may be witnessed by the Engineer.
 - b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.
 4. Conduct startup of equipment and perform operational checks.
 5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.7 DEMONSTRATION

- A. On-Site Training:
1. Provide employee of the manufacturer or certified representative to provide one (1) days of operating and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures.
 - a. As a minimum, training shall cover:
 - 1) Hardware overview.
 - 2) Software overview.
 - 3) Maintenance.
 - 4) Trouble shooting.
 - 5) Operation, e.g., changing set points, passwords, etc.

The application of this Section will proceed per the PUMP STATION SCADA EQUIPMENT special provision, which is amongst the accompanying special provisions.

End Section 409520

Schedule of Values:

- 1.1 A Schedule of Values shall be submitted as payment basis for PUMP STATION SCADA EQUIPMENT.

- 1.2 The Contractor shall submit a Schedule of Values, as specified herein, at the Pre-Construction Meeting and shall provide information as requested to substantiate the prices included in the Schedule of Values.
- 1.3 The Schedule of Values must be approved by the Engineer and District 8, Bureau Electrical Operations, prior to any project payments.
- 1.4 Complete Schedule of Values
- (a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.
 - (b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.
 - (c) The Schedule of Values shall have each item further itemized by Specification Division as listed in the Specification index.
 - (d) For the item Pump Station SCADA Equipment, each item which has an installed value of over \$10,000, a list of the costs for the major products or operations shall be indicated under each item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

Method of Measurement: Pump Station SCADA Equipment installed complete in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract lump sum price for PUMP STATION SCADA EQUIPMENT.

BUILDING REMOVAL - CASE IV (NO ASBESTOS) (BDE)

Effective: September 1, 1990

Revised: April 1, 2010

BUILDING REMOVAL: This work shall consist of the removal and disposal of 1 building, together with all foundations, retaining walls, and piers, down to a plane 1 ft (300 mm) below the ultimate or existing grade in the area and also all incidental and collateral work necessary to complete the removal of the building(s) in a manner approved by the Engineer. Any holes, such as basements, shall be filled with a suitable granular material. The building(s) are identified as follows:

<u>Bldg. No.</u>	<u>Parcel No.</u>	<u>Location</u>	<u>Description</u>
1		2 nd Street 13+84 70' RT	Stone foundation

Discontinuance of Utilities: The Contractor shall arrange for the discontinuance of all utility services and the removal of the metering devices that serve the building(s) according to the respective requirements and regulations of the City, County, or utility companies involved. The Contractor shall disconnect and seal, in an approved manner, all service outlets that serve any building(s) he/she is to remove.

Signs: Immediately upon execution of the contract and prior to the wrecking of any structures, the Contractor shall be required to paint or stencil, in contrasting colors of an oil base paint, on all four sides of each residence and two opposite sides of other structures, the following sign:

PROPERTY ACQUIRED FOR
HIGHWAY CONSTRUCTION
TO BE DEMOLISHED BY THE

VANDALS WILL BE PROSECUTED

The signs shall be positioned in a prominent location on the structure so that they can be easily seen and read and at a sufficient height to prevent defacing. The Contractor shall not paint signs nor start demolition of any building(s) prior to the time that the State becomes the owner of the respective building(s).

Basis of Payment: This work will be paid for at the contract lump sum unit price for BUILDING REMOVAL, numbers as listed above, which price shall be payment in full for complete removal of the buildings and structures, including any necessary backfilling material as specified herein. The lump sum unit price(s) for this work shall represent the cost of demolition. Any salvage value shall be reflected in the contract unit price for this item.

Notifications: The "Demolition/Renovation Notice" form, which can be obtained from the IEPA office, shall be completed and submitted to the address listed below at least ten days prior to commencement of any demolition activity.

Asbestos Demolition/Renovation Coordinator
Illinois Environmental Protection Agency
Division of Air Pollution Control
P. O. Box 19276
Springfield, Illinois 62794-9276
(217)785-1743

Notices shall be updated if there is a change in the starting date or the amount of asbestos changes by more than 20 percent.

Submittals:

- A. All submittals and notices shall be made to the Engineer except where otherwise specified herein.
- B. Prior to starting work, the Contractor shall submit proof of written notification and compliance with the "Notifications" paragraph.

CLEANING AND PAINTING EXISTING STEEL STRUCTURES

Effective: October 2, 2001

Revised: April 19, 2012

Description. This work shall consist of the preparation of all designated metal surfaces by the method(s) specified on the plans. This work also includes the painting of those designated surfaces with the paint system(s) specified on the plans. The Contractor shall furnish all materials, equipment, labor, and other essentials necessary to accomplish this work and all other work described herein and as directed by the Engineer.

Materials. All materials to be used on an individual structure shall be produced by the same manufacturer.

The Bureau of Materials and Physical Research has established a list of all products that have met preliminary requirements. Each batch of material, except for the penetrating sealer, must be tested and approved before use. The specified colors shall be produced in the coating manufacturer's facility. Tinting of the coating after it leaves the manufacturer's facility is not allowed.

The paint materials shall meet the following requirements of the Standard Specification and as noted below:

<u>Item</u>	<u>Article</u>
(a) Waterborne Acrylic	1008.04
(b) Aluminum Epoxy Mastic	1008.03
(c) Organic Zinc Rich Primer	1008.05
(d) Epoxy/ Aliphatic Urethane	1008.05
(e) Penetrating Sealer (Note 1)	
(f) Moisture Cured Zinc Rich Urethane Primer (Note 2)	
(g) Moisture Cured Aromatic/Aliphatic Urethane (Note 2)	
(h) Moisture Cured Penetrating Sealer (Note 3)	

Note 1: The Epoxy Penetrating Sealer shall be a cross-linked multi component sealer. The sealer shall have the following properties:

- (a) The volume solids shall be 98 percent (plus or minus 2 percent).
- (b) Shall be clear or slightly tinted color.

Note 2: These material requirements shall be according to the Special Provision for the Moisture Cured Urethane Paint System.

Note 3: The Moisture Cured Penetrating Sealer manufacturer's certification will be required.

Submittals. The Contractor shall submit for Engineer review and acceptance, the following plans and information for completing the work. The submittals shall be provided within 30 days of execution of the contract unless given written permission by the Engineer to submit them at a later date. Work cannot proceed until the submittals are accepted by the Engineer. Details for each of the plans are presented within the body of this specification.

- a) Contractor/Personnel Qualifications. Evidence of Contractor qualifications and the names and qualifications/experience/training of the personnel managing and implementing the Quality Control program and conducting the quality control tests.
- b) Quality Control (QC) Program. The QC Program shall identify the following; the instrumentation that will be used, a schedule of required measurements and observations, procedures for correcting unacceptable work, and procedures for improving surface preparation and painting quality as a result of quality control findings. The program shall incorporate at a minimum, the IDOT Quality Control Daily Report form as supplied by the Engineer.
- c) Inspection Access Plan. The inspection access plan for use by Contractor QC personnel for ongoing inspections and by the Engineer during Quality Assurance (QA) observations.

- d) Surface Preparation/Painting Plan. The surface preparation/painting plan shall include the methods of surface preparation and type of equipment to be utilized for washing, hand/power tool cleaning, removal of rust, mill scale, paint or foreign matter, abrasive blast or water jetting, and remediation of chloride. If detergents, additives, or inhibitors are incorporated into the water, the Contractor shall include the names of the materials and Material Safety Data Sheets (MSDS). The Contractor shall identify the solvents proposed for solvent cleaning together with MSDS.

The plan shall also include the methods of coating application and equipment to be utilized.

If the Contractor proposes to heat or dehumidify the containment, the methods and equipment proposed for use shall be included in the Plan for the Engineer's consideration.

- e) Paint Manufacturer Certifications and Letters. When a sealer is used, the Contractor shall provide the manufacturer's certification of compliance with IDOT testing requirements listed under "Materials" above. A certification regarding the compatibility of the sealer with the specified paint system shall also be included.

When rust inhibitors are used, the Contractor shall provide a letter from the coating manufacturer indicating that the inhibitor is compatible with, and will not adversely affect the performance of the coating system.

If the use of a chemical soluble salt remover is proposed by the Contractor, provide a letter from the coating manufacturer indicating that the material will not adversely effect the performance of the coating system.

The paint manufacturer's application and thinning instructions, MSDS and product data sheets shall be provided, with specific attention drawn to storage temperatures, and the temperatures of the material, surface and ambient air at the time of application. A letter or written instructions from the coating manufacturer shall be provided indicating the length of time that each coat must be protected from cold or inclement weather (e.g., exposure to rain) during its drying period.

- f) Abrasives. Abrasives to be used for abrasive blast cleaning, including MSDS. For expendable abrasives, the Contractor shall provide certification from the abrasive supplier that the abrasive meets the requirements of SSPC-AB1. For steel grit abrasives, the certification shall indicate that the abrasive meets the requirements of SSPC-AB3.
- g) Protective Coverings. Plan for containing or controlling paint debris (droplets, spills, overspray, etc.). Any tarpaulins or protective coverings proposed for use shall be fire retardant. For submittal requirements involving the containment used to remove lead paint, the Contractor shall refer to Special Provision for Containment and Disposal of Lead Paint Cleaning Residues.

- h) Progress Schedule. Progress schedule shall be submitted per Article 108.02 and shall identify all major work items (e.g., installation of rigging/containment, surface preparation, and coating application).

When the Engineer accepts the submittals, the Contractor will receive written notification. The Contractor shall not begin any paint removal work until the Engineer has accepted the submittals. The Contractor shall not construe Engineer acceptance of the submittals to imply approval of any particular method or sequence for conducting the work, or for addressing health and safety concerns. Acceptance of the programs does not relieve the Contractor from the responsibility to conduct the work according to the requirements of Federal, State, or Local regulations and this specification, or to adequately protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor remains solely responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

Contractor Qualifications. Unless indicated otherwise on the contract plans, for non lead abatement projects, the painting Contractor shall possess current SSPC-QP1 certification. Unless indicated otherwise on the plans, for lead abatement projects the Contractor shall also possess current SSPC-QP2 certification. The Contractor shall maintain certified status throughout the duration of the painting work under the contract. The Department reserves the right to accept Contractors documented to be currently enrolled in the SSPC-QP7, Painting Contractor Introductory Program, Category 2, in lieu of the QP certifications noted above.

Quality Control (QC) Inspections. The Contractor shall perform first line, in process QC inspections. The Contractor shall implement the submitted and accepted QC Program to insure that the work accomplished complies with these specifications. The designated Quality Control inspector shall be onsite full time during any operations that affect the quality of the coating system (e.g., surface preparation and chloride remediation, coating mixing and application, and evaluations between coats and upon project completion). The Contractor shall use the IDOT Quality Control Daily Report form supplied by the Engineer to record the results of quality control tests. The completed reports shall be turned into the Engineer before work resumes the following day. The Engineer or designated representative will sign the report. The signature is an acknowledgment that the report has been received, but should not be construed as an agreement that any of the information documented therein is accurate.

Contractor QC inspections shall include, but not be limited to the following:

- Suitability of protective coverings and the means employed to control project debris and paint spills, overspray, etc.
- Ambient conditions
- Surface preparation (solvent cleaning, pressure washing including chalk tests, hand/power tool or abrasive blast cleaning, etc.)
- Chloride remediation
- Coating application (specified materials, mixing, thinning, and wet/dry film thickness)
- Recoat times and cleanliness between coats
- Coating continuity and coverage (freedom from runs, sags, overspray, dryspray, pinholes, shadow-through, skips, misses, etc.)

The personnel managing the Contractor's QC Program shall possess a minimum classification of Society of Protective Coatings (SSPC) BCI certified, National Association of Corrosion Engineers (NACE) Coating Inspector Level 2 - Certified, or shall provide evidence of successful inspection of 3 projects of similar or greater complexity and scope that have been completed in the last 2 years. Copies of the certification and/or experience shall be provided. References for experience shall be provided and shall include the name, address, and telephone number of a contact person employed by the bridge owner.

The personnel performing the QC tests shall be trained in coatings inspection and the use of the testing instruments. Documentation of training shall be provided. The QC personnel shall not perform hands on surface preparation or painting activities. Painters shall perform wet film thickness measurements, with QC personnel conducting random spot checks of the wet film. The Contractor shall not replace the QC personnel assigned to the project without advance notice to the Engineer, and acceptance of the replacement(s), by the Engineer.

The Contractor shall supply all necessary equipment to perform the QC inspections. Equipment shall include the following at a minimum:

- Psychrometer or comparable equipment for the measurement of dew point and relative humidity, together with all necessary weather bureau tables or psychrometric charts.
- Surface temperature thermometer
- SSPC Visual Standards VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning; SSPC-VIS 3, Visual Standard for Power and Hand-Tool Cleaned Steel; SSPC-VIS 4, Guide and Reference Photographs for Steel Prepared by Water Jetting, and/or SSPC-VIS 5, Guide and Reference Photographs for Steel Prepared by Wet Abrasive Blast Cleaning, as applicable.
- Commercially available putty knife of a minimum thickness of 40 mils (1mm) and a width between 1 and 3 in. (25 and 75 mm). Note that the putty knife is only required for projects in which the existing coating is being feathered and must be tested with a dull putty knife.
- Testex Press-O-Film Replica Tape and Spring Micrometer
- Bresle Cell Kits or CHLOR*TEST kits for chloride determinations, or equivalent
- Wet Film Thickness Gage
- Blotter paper for compressed air cleanliness checks
- Type 2 Electronic Dry Film Thickness Gage per SSPC - PA2, Measurement of Dry Coating Thickness with magnetic Gages
- Calibration standards for dry film thickness gage
- Light meter for measuring light intensity during paint removal, painting, and inspection activities
- All applicable ASTM and SSPC Standards used for the work (reference list attached)

The instruments shall be calibrated by the Contractor's personnel according to the equipment manufacturer's recommendations and the Contractor's QC Program. All inspection equipment shall be made available to the Engineer for QA observations on an as needed basis.

Hold Point Notification. Specific inspection items throughout this specification are designated as Hold Points. Unless other arrangements are made at the project site, the Contractor shall provide the Engineer with a minimum 4-hour notification before a Hold Point inspection will be reached. If the 4-hour notification is provided and the Work is ready for inspection at that time, the Engineer will conduct the necessary observations. If the Work is not ready at the appointed time, unless other arrangements are made, an additional 4-hour notification is required. Permission to proceed beyond a Hold Point without a QA inspection will be granted solely at the discretion of the Engineer, and only on a case by case basis.

Quality Assurance (QA) Observations. The Engineer will conduct QA observations of any or all phases of the work. The presence or activity of Engineer observations in no way relieves the Contractor of the responsibility to provide all necessary daily QC inspections of his/her own and to comply with all requirements of this Specification.

The Engineer has the right to reject any work that was performed without adequate provision for QA observations.

Inspection Access and Lighting. The Contractor shall facilitate the Engineer's observations as required, including allowing ample time to view the work. The Contractor shall furnish, erect and move scaffolding or other mechanical equipment to permit close observation of all surfaces to be cleaned and painted. This equipment shall be provided during all phases of the work. Examples of acceptable access structures include:

- Mechanical lifting equipment, such as, scissor trucks, hydraulic booms, etc.
- Platforms suspended from the structure comprised of trusses or other stiff supporting members and including rails and kick boards.
- Simple catenary supports are permitted only if independent life lines for attaching a fall arrest system according to Occupational Safety and Health Administration (OSHA) regulations are provided.

When the surface to be inspected is more than 6 ft. (1.8 m) above the ground or water surface, and fall prevention is not provided (e.g., guardrails are not provided), the Contractor shall provide the Engineer with a safety harness and a lifeline according to OSHA regulations. The lifeline and attachment shall not direct the fall into oncoming traffic. The Contractor shall provide a method of attaching the lifeline to the structure independent of the inspection facility or any support of the platform. When the inspection facility (e.g., platform) is more than 2 1/2 ft. (800 mm) above the ground, the Contractor shall provide an approved means of access onto the platform.

The Contractor shall provide artificial lighting in areas both inside and outside the containment where natural light is inadequate, as determined by the Engineer, to allow proper cleaning, inspection, and painting. Illumination for inspection shall be at least 30 foot candles (325 LUX). Illumination for cleaning and painting, including the working platforms, access and entryways shall be at least 20 foot candles (215 LUX). General work area illumination outside the containment shall be employed at the discretion of the Engineer and shall be at least 5 foot candles. The exterior lighting system shall be designed and operated so as to avoid glare that interferes with traffic, workers, and inspection personnel.

Surface Preparation and Painting Equipment. All cleaning and painting equipment shall include gages capable of accurately measuring fluid and air pressures and shall have valves capable of regulating the flow of air, water or paint as recommended by the equipment manufacturer. The equipment shall be maintained in proper working order.

Diesel or gasoline powered equipment shall be positioned or vented in a manner to prevent deposition of combustion contaminants on any part of the structure.

Hand tools, power tools, pressure washing, water jetting, abrasive blast cleaning equipment, brushes, rollers, and spray equipment shall be of suitable size and capacity to perform the work required by this specification. All power tools shall be equipped with vacuums and High Efficiency Particulate Air (HEPA) filtration. Appropriate filters, traps and dryers shall be provided for the compressed air used for abrasive blast cleaning and conventional spray application. Paint pots shall be equipped with air operated continuous mixing devices unless prohibited by the coating manufacturer.

Test Sections. Prior to surface preparation, the Contractor shall prepare a test section(s) on each structure to be painted in a location(s) which the Engineer considers to be representative of the existing surface condition and steel type for the structure as a whole. More than one test section may be needed to represent the various design configurations of the structure. The purpose of the test section(s) is to demonstrate the use of the tools and degree of cleaning required (cleanliness and profile) for each method of surface preparation that will be used on the project. Each test section shall be approximately 10 sq. ft. (0.93 sq m). The test section(s) shall be prepared using the same equipment, materials and procedures as the production operations. The Contractor shall prepare the test section(s) to the specified level of cleaning according to the appropriate SSPC visual standards, modified as necessary to comply with the requirements of this specification. The written requirements of the specification prevail in the event of a conflict with the SSPC visual standards. Only after the test section(s) have been approved shall the Contractor proceed with surface preparation operations. Additional compensation will not be allowed the Contractor for preparation of the test section(s).

For the production cleaning operations, the specifications and written definitions, the test section(s), and the SSPC visual standards shall be used in that order for determining compliance with the contractual requirements.

Protective Coverings and Damage. All portions of the structure that could be damaged by the surface preparation and painting operations (e.g., utilities), including any sound paint that is allowed to remain according to the contract documents, shall be protected by covering or shielding. Tarpaulins drop cloths, or other approved materials shall be employed. The Contractor shall comply with the provisions of the Illinois Environmental Protection Act. Paint drips, spills, and overspray are not permitted to escape into the air or onto any other surfaces or surrounding property not intended to be painted. Containment shall be used to control paint drips, spills, and overspray, and shall be dropped and all equipment secured when sustained wind speeds of 40 mph (64 kph) or greater occur, unless the containment design necessitates action at lower wind speeds. The contractor shall evaluate project-specific conditions to determine the specific type and extent of containment needed to control the paint emissions and shall submit a plan for containing or controlling paint debris (droplets, spills, overspray, etc.) to the Engineer for acceptance prior to starting the work. Acceptance by the Engineer shall not relieve the Contractor of their ultimate responsibility for controlling paint debris from escaping the work zone.

When the protective coverings need to be attached to the structure, they shall be attached by bolting, clamping, or similar means. Welding or drilling into the structure is prohibited unless approved by the Engineer in writing. When removing coatings containing lead the containment and disposal of the residues shall be as specified in the Special Provision for Containment and Disposal of Lead Paint Cleaning Residues contained elsewhere in this Contract. When removing coatings not containing lead the containment and disposal of the residues shall be as specified in the Special Provision for Containment and Disposal of Non-Lead Paint Cleaning Residues contained elsewhere in this Contract.

The Contractor shall be responsible for any damage caused to persons, vehicles, or property, except as indemnified by the Response Action Contractor Indemnification Act. Whenever the intended purposes of the controls or protective devices used by the Contractor are not being accomplished, as determined by the Engineer, work shall be immediately suspended until corrections are made. Damage to vehicles or property shall be repaired by the Contractor at the Contractor's expense. Painted surfaces damaged by any Contractor's operation shall be repaired, removed and/or repainted, as directed by the Engineer, at the Contractor's expense.

Weather Conditions. Surfaces to be painted after cleaning shall remain free of moisture and other contaminants. The Contractor shall control his/her operations to insure that dust, dirt, or moisture do not come in contact with surfaces cleaned or painted that day.

- a) The surface temperature shall be at least 5°F (3°C) above the dew point during final surface preparation operations. The manufacturers' published literature shall be followed for specific temperature, dew point, and humidity restrictions during the application of each coat.
- b) If the Contractor proposes to control the weather conditions inside containment, proposed methods and equipment for heating and/or dehumidification shall be included in the work plans for the Engineer's consideration. Any heating/dehumidification proposals accepted by the Engineer shall be implemented at no additional cost to the department.

- c) Cleaning and painting shall be done between April 15 and October 31 unless authorized otherwise by the Engineer in writing.

The Contractor shall monitor temperature, dew point, and relative humidity every 4 hours during surface preparation and coating application in the specific areas where the work is being performed. The frequency of monitoring shall increase if weather conditions are changing. If the weather conditions after application and during drying are forecast to be outside the acceptable limits established by the coating manufacturer, coating application shall not proceed. If the weather conditions are forecast to be borderline relative to the limits established by the manufacturer, monitoring shall continue at a minimum of 4-hour intervals throughout the drying period. The Engineer has the right to reject any work that was performed, or drying that took place, under unfavorable weather conditions. Rejected work shall be removed, recleaned, and repainted at the Contractor's expense.

Compressed Air Cleanliness. Prior to using compressed air for abrasive blast cleaning, blowing down the surfaces, and painting with conventional spray, the Contractor shall verify that the compressed air is free of moisture and oil contamination according to the requirements of ASTM D 4285. The tests shall be conducted at least one time each shift for each compressor system in operation. If air contamination is evident, the Contractor shall change filters, clean traps, add moisture separators or filters, or make other adjustments as necessary to achieve clean, dry air. The Contractor shall also examine the work performed since the last acceptable test for evidence of defects or contamination caused by the compressed air. Effected work shall be repaired at the Contractor's expense.

Low Pressure Water Cleaning and Solvent Cleaning (HOLD POINT). The Contractor shall notify the Engineer 24 hours in advance of beginning surface preparation operations.

- a) Water Cleaning of Lead Containing Coatings Prior to Overcoating. Prior to initiating any mechanical cleaning such as hand/power tool cleaning on surfaces that are painted with lead, all surfaces to be prepared and painted, and the tops of pier and abutment caps shall be washed. Washing is not required if the surfaces will be prepared by water jetting.

Washing shall involve the use of potable water at a minimum of 1000 psi (7 MPa) and less than 5000 psi (34 MPa) according to "Low Pressure Water Cleaning" of SSPC-SP12. Paint spray equipment shall not be used to perform the water cleaning. The cleaning shall be performed in such a manner as to remove dust, dirt, chalk, insect and animal nests, bird droppings, loose paint and other foreign matter prior to solvent cleaning. The water, debris, and any loose paint removed by water cleaning shall be collected for proper disposal. The washing shall be completed no more than 2 weeks prior to surface preparation.

If detergents or other additives are added to the water, the detergents/additives shall be included in the submittals and not used until accepted by the Engineer. When detergents or additives are used, the surface shall be rinsed with potable water before the detergent water dries.

After washing has been accepted by the Engineer, all traces of asphaltic cement, oil, grease, diesel fuel deposits, and other soluble contaminants which remain on the steel surfaces to be painted shall be removed by solvent cleaning according to SSPC – SP1, supplemented with scraping (e.g., to remove large deposits of asphaltic cement) as required. The solvent(s) used for cleaning shall be compatible with the existing coating system. The Contractor shall identify the proposed solvent(s) in the submittals. If the existing coating is softened, wrinkled, or shows other signs of attack from the solvents, the Contractor shall immediately discontinue their use. The name and composition of replacement solvents, together with MSDS, shall be submitted for Engineer acceptance prior to use.

Under no circumstances shall subsequent hand/power tool cleaning be performed in areas containing surface contaminants or in areas where the Engineer has not accepted the washing and solvent cleaning. Surfaces prepared by hand/power tool cleaning without approval of the washing and solvent cleaning may be rejected by the Engineer. Rejected surfaces shall be recleaned with both solvent and the specified mechanical means at the Contractor's expense.

After all washing and mechanical cleaning are completed, representative areas of the existing coating shall be tested to verify that the surface is free of chalk and other loose surface debris or foreign matter. The testing shall be performed according to ASTM D4214. Cleaning shall continue until a chalk rating of 6 or better is achieved in every case.

- b) Water Cleaning of Non-Lead Coatings Prior to Overcoating. Thoroughly clean the surfaces according to the steps defined above for "Water Cleaning of Lead Containing Coatings Prior to Overcoating," except that the wash water does not need to be collected, and if the shop primer is inorganic zinc, the chalk rating does not apply. All other provisions are applicable.
- c) Water Cleaning/Debris Removal Prior to Total Coating Removal. When total coating removal is specified, water cleaning of the surface prior to coating removal is not required by this specification and is at the option of the Contractor. If the Contractor chooses to use water cleaning, and the existing coating contains lead, all water and debris shall be collected for proper disposal.

Whether or not the surfaces are pre-cleaned using water, the tops of the pier caps and abutments shall be cleaned free of dirt, paint chips, insect and animal nests, bird droppings and other foreign matter and the debris collected for proper disposal.

Prior to mechanical cleaning, oil, grease, and other soluble contaminants on bare steel or rusted surfaces shall be removed by solvent cleaning according to SSPC-SP1.

- d) Water Cleaning Between Coats. When foreign matter has accumulated on a newly applied coat, washing shall be performed prior to the application of subsequent coats. The water does not need to be collected unless it contacts existing lead containing coatings.

Laminar and Stratified Rust. All laminar and stratified rust that has formed on the existing steel surfaces shall be removed. Pack rust formed along the perimeter of mating surfaces of connected plates or shapes of structural steel shall be removed to the extent feasible without mechanically detaching the mating surface. Any pack rust remaining after cleaning the mating surfaces shall be tight and intact when examined using a dull putty knife. The tools used to remove these corrosion products shall be identified in the submittals and accepted by the Engineer. If the surface preparation or removal of rust results in nicks or gouges, the work shall be suspended, and the damaged areas repaired to the satisfaction of the Engineer, at the Contractor's expense. The Contractor shall also demonstrate that he/she has made the necessary adjustments to prevent a reoccurrence of the damage prior to resuming work.

Surface Preparation (HOLD POINT). One or more of the following methods of surface preparation shall be used as specified on the plans. When a method of surface preparation is specified, it applies to the entire surface, including areas that may be concealed by the containment connection points. In each case, as part of the surface preparation process, soluble salts shall be remediated as specified under "Soluble Salt Remediation". The Contractor shall also note that the surface of the steel beneath the existing coating system may contain corrosion and/or mill scale. Removal of said corrosion and/or mill scale, when specified, shall be considered included in this work and no extra compensation will be allowed.

When a particular cleaning method is specified for use in distinct zones on the bridge, the cleaning shall extend into the existing surrounding paint until a sound border is achieved. The edge of the existing paint is considered to be sound and intact if it can not be lifted by probing the edge with a dull putty knife. The sound paint shall be feathered for a minimum of 1 1/2 in. (40 mm) to achieve a smooth transition between the prepared steel and the existing coatings. Sanders with vacuum attachments, which have been approved by the Engineer, shall be used as necessary to accomplish the feathering.

- a) Limited Access Areas: A best effort with the specified methods of cleaning shall be performed in limited access areas such as the backsides of rivets inside built up box members. The equipment being used for the majority of the cleaning may need to be supplemented with other commercially available equipment, such as angle nozzles, to properly clean the limited access areas. The acceptability of the best effort cleaning in these areas is at the sole discretion of the Engineer.
- b) Near White Metal Blast Cleaning: This surface preparation shall be accomplished according to the requirements of Near White Metal Blast Cleaning SSPC-SP 10. Unless otherwise specified in the contract, the designated surfaces shall be prepared by dry abrasive blast cleaning, wet abrasive blast cleaning, or water jetting with abrasive injection. A Near White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining.

Random staining shall be limited to no more than 5 percent of each 9 sq. in. (58 sq. cm) of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. With the exception of crevices as defined below, surface discoloration is considered to be a residue that must be removed, rather than a stain, if it possesses enough mass or thickness that it can be removed as a powder or in chips when scraped with a pocketknife.

A surface profile shall be created on the steel as defined later under "Surface Profile."

At the discretion of the Engineer, after a best effort cleaning, slight traces of existing coating may be permitted to remain within crevices such as those created between rivets, bolts, and plates, and the underlying steel. When traces of coating are permitted to remain, the coating shall be tightly bonded when examined by probing with a dull putty knife. The traces of coating shall be confined to the bottom portion of the crevices only, and shall not extend onto the surrounding steel or plate or onto the outer surface of the rivets or bolts. Pitted steel is excluded from exemption considerations and shall be cleaned according to SSPC-SP10.

If hackles or slivers are visible on the steel surface after cleaning, the Contractor shall remove them by grinding followed by reblast cleaning. At the discretion of the Engineer, the use of power tools to clean the localized areas after grinding, and to establish a surface profile acceptable to the coating manufacturer, can be used in lieu of blast cleaning.

If the surfaces are prepared using wet abrasive methods, attention shall be paid to tightly configured areas to assure that the preparation is thorough. After surface preparation is completed, the surfaces, surrounding steel, and containment materials/scaffolding shall be rinsed to remove abrasive dust and debris. Potable water shall be used for all operations. An inhibitor may be added to the supply water and/or rinse water to prevent flash rusting. If a rust inhibitor is proposed, the Contractor shall provide a sample of the proposed inhibitor together with a letter from the coating manufacturer indicating that the inhibitor is suitable for use with their products. The surfaces shall be allowed to completely dry before the application of any coating.

- c) Commercial Grade Power Tool Cleaning: This surface preparation shall be accomplished according to the requirements of Commercial Grade Power Tool Cleaning, SSPC-SP15. The designated surfaces shall be completely cleaned with power tools. A Commercial Grade Power Tool Cleaned surface, when viewed without magnification, is free of all visible oil, grease, dirt, rust, coating, oxides, mill scale, corrosion products, and other foreign matter, except for staining. In previously pitted areas, slight residues of rust and paint may also be left in the bottoms of pits.

Random staining shall be limited to no more than 33 percent of each 9 sq. in. (58 sq. cm) of surface area. Allowable staining may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Surface discoloration is considered to be a residue that must be removed, rather than a stain, if it possesses enough mass or thickness that it can be removed as a powder or in chips when scraped with a pocketknife.

A surface profile shall be created on the steel as defined later under "Surface Profile."

At the Contractor's option, Near White Metal Blast Cleaning may be substituted for Power Tool Cleaning – Commercial Grade, as long as containment systems appropriate for abrasive blast cleaning are utilized and there is no additional cost to the Department.

- d) Power Tool Cleaning – Modified SP3: This surface preparation shall be accomplished according to the requirements of SSPC-SP3, Power Tool Cleaning except as modified as follows. The designated surfaces shall be cleaned with power tools. A power tool cleaned surface shall be free of all loose rust, loose mill scale, loose and peeling paint, and loose rust that is bleeding through and/or penetrating the coating. All locations of visible corrosion and rust bleed, exposed or lifting mill scale, and lifting or loose paint shall be prepared using the power tools.

Upon completion of the cleaning, rust, rust bleed, mill scale and surrounding paint are permitted to remain if they can not be lifted using a dull putty knife.

Power Tool Cleaning of Shop Primed Steel. When steel coated with only a prime coat of inorganic or organic zinc is specified to be cleaned, this work shall be accomplished as follows. After cleaning the surface as specified under "Water Cleaning of Non-Lead Coatings Prior to Overcoating," damaged and rusted areas shall be spot cleaned according Power Tool Cleaning -Modified SSPC-SP3. The edges of the coating surrounding the spot repairs shall be feathered.

Abrasives. Unless otherwise specified in the contract, when abrasive blast cleaning is specified, it shall be performed using either expendable abrasives (other than silica sand) or recyclable steel grit abrasives. Expendable abrasives shall be used one time and disposed of. Abrasive suppliers shall certify that the expendable abrasives meet the requirements of SSPC-AB1 and that recyclable steel grit abrasives meet AB3. On a daily basis, the Contractor shall verify that recycled abrasives are free of oil contamination by conducting oil content tests according to SSPC-AB2.

All surfaces prepared with abrasives not meeting the SSPC-AB1, AB2, or AB3 requirements, as applicable, shall be solvent cleaned or low pressure water cleaned as directed by the Engineer, and reblast cleaned at the Contractor's expense.

Surface Profile (HOLD POINT). The abrasives used for blast cleaning shall have a gradation such that the abrasive will produce a uniform surface profile of 1.5 to 4.5 mils (38 to 114 microns). If the profile requirements of the coating manufacturer are more restrictive, advise the Engineer and comply with the more restrictive requirements. For recycled abrasives, an appropriate operating mix shall be maintained in order to control the profile within these limits.

The surface profile for the Power Tool Cleaning - Commercial Grade shall be within the range specified by the coating manufacturer, but not less than 2.0 mils (50 microns).

The surface profile produced by the Contractor's surface preparation procedures shall be determined by replica tape and spring micrometer at the beginning of the work, and each day that surface preparation is performed. Areas having unacceptable measurements shall be further tested to determine the limits of the deficient area. The replica tape shall be attached to the daily report.

When unacceptable profiles are produced, work shall be suspended. The Contractor shall submit a plan for the necessary adjustments to insure that the correct surface profile is achieved on all surfaces. The Contractor shall not resume work until the new profile is verified by the QA observations, and the Engineer confirms, in writing, that the profile is acceptable.

Soluble Salt Remediation (HOLD POINT). The Contractor shall implement surface preparation procedures and processes that will remove chloride from the surfaces. Surfaces that may be contaminated with chloride include, but are not limited to, expansion joints and all areas that are subject to roadway splash or run off such as fascia beams and stringers.

Methods of chloride removal may include, but are not limited to, steam cleaning or pressure washing with or without the addition of a chemical soluble salt remover as approved by the coating manufacturer, and scrubbing before or after initial paint removal. The Contractor may also elect to clean the steel and allow it to rust overnight followed by recleaning, or by utilizing blends of fine and coarse abrasives during blast cleaning, wet abrasive/water jetting methods of preparation, or combinations of the above. If steam or water cleaning methods of chloride removal are utilized over surfaces where the coating has been completely removed, and the water does not contact any lead containing coatings, the water does not have to be collected. The Contractor shall provide the proposed procedures for chloride remediation in the Surface Preparation/Painting Plan.

Upon completion of the chloride remediation steps, the Contractor shall use cell methods of field chloride extraction and test procedures (e.g., silver dichromate) accepted by the Engineer, to test representative surfaces that were previously rusted (e.g., pitted steel) for the presence of remaining chlorides. Remaining chloride levels shall be no greater than 7 μ g/sq cm as read directly from the surface without any multiplier applied to the results. The testing must be performed, and the results must be acceptable, prior to painting each day.

A minimum of 5 tests per 1000 sq. ft. (93 sq. m) or fraction thereof completed in a given day, shall be conducted at project start up. If results greater than 7 μ g/sq cm are detected, the surfaces shall be recleaned and retested at the same frequency. If acceptable results are achieved on three consecutive days in which testing is conducted, the test frequency may be reduced to 1 test per 1000 sq. ft. (93 sq. m) prepared each day provided the chloride remediation process remains unchanged. If unacceptable results are encountered, or the methods of chloride remediation are changed, the Contractor shall resume testing at a frequency of 5 tests per 1000 sq. ft. (93 sq. m).

Following successful chloride testing the chloride test areas shall be cleaned. Commercial Grade Power Tool Cleaning can be used to clean the test locations when the specified degree of cleaning is SSPC-SP10.

Surface Condition Prior to Painting (HOLD POINT). Prepared surfaces, shall meet the requirements of the respective degrees of cleaning immediately prior to painting, and shall be painted before rusting appears on the surface. If rust appears or bare steel remains unpainted for more than 12 hours, the affected area shall be prepared again at the expense of the Contractor.

All loose paint and surface preparation cleaning residue on bridge steel surfaces, scaffolding and platforms, containment materials, and tops of abutments and pier caps shall be removed prior to painting. When lead paint is being disturbed, cleaning shall be accomplished by HEPA vacuuming unless it is conducted within a containment that is designed with a ventilation system capable of collecting the airborne dust and debris created by sweeping and blowing with compressed air.

The quality of surface preparation and cleaning of surface dust and debris must be accepted by the Engineer prior to painting. The Engineer has the right to reject any work that was performed without adequate provision for QA observations to accept the degree of cleaning. Rejected coating work shall be removed and replaced at the Contractor's expense.

General Paint Requirements. Paint storage, mixing, and application shall be accomplished according to these specifications and as specified in the paint manufacturer's written instructions and product data sheets for the paint system used. In the event of a conflict between these specifications and the coating manufacturers' instructions and data sheets, the Contractor shall advise the Engineer and comply with the Engineer's written resolution. Until a resolution is provided, the most restrictive conditions shall apply.

Unless noted otherwise, If a new concrete deck or repair to an existing deck is required, painting shall be done after the deck is placed and the forms have been removed.

- a) **Paint Storage and Mixing.** All Paint shall be stored according to the manufacturer's published instructions, including handling, temperatures, and warming as required prior to mixing. All coatings shall be supplied in sealed containers bearing the manufacturers name, product designation, batch number and mixing/thinning instructions. Leaking containers shall not be used.

Mixing shall be according to the manufacturer's instructions. Thinning shall be performed using thinner provided by the manufacturer, and only to the extent allowed by the manufacturer's written instructions. In no case shall thinning be permitted that would cause the coating to exceed the local Volatile Organic Compound (VOC) emission restrictions. For multiple component paints, only complete kits shall be mixed and used. Partial mixing is not allowed.

The ingredients in the containers of paint shall be thoroughly mixed by mechanical power mixers according to the manufacturer's instructions, in the original containers before use or mixing with other containers of paint. The paint shall be mixed in a manner that will break up all lumps, completely disperse pigment and result in a uniform composition. Paint shall be carefully examined after mixing for uniformity and to verify that no unmixed pigment remains on the bottom of the container. Excessive skinning or partial hardening due to improper or prolonged storage will be cause for rejection of the paint, even though it may have been previously inspected and accepted.

Multiple component coatings shall be discarded after the expiration of the pot life. Single component paint shall not remain in spray pots, painters buckets, etc. overnight. It shall be stored in a covered container and remixed before use.

The Engineer reserves the right to sample field paint (individual components and/or the mixed material) and have it analyzed. If the paint does not meet the product requirements due to excessive thinning or because of other field problems, the coating shall be removed from that section of the structure and replaced as directed by the Engineer.

- b) Application Methods. Unless prohibited by the coating manufacturer's written instructions, paint may be applied by spray methods, rollers, or brushes. If applied with conventional or airless spray methods, paint shall be applied in a uniform layer with overlapping at the edges of the spray pattern.

The painters shall monitor the wet film thickness of each coat during application. The wet film thickness shall be calculated based on the solids by volume of the material and the amount of thinner added. When the new coating is applied over an existing system, routine QC inspections of the wet film thickness shall be performed in addition to the painter's checks in order to establish that a proper film build is being applied.

When brushes or rollers are used to apply the coating, additional applications may be required to achieve the specified thickness per layer.

- c) Painting Shop Primed Steel. After cleaning, rusted and damaged areas shall be touched up using the same primer specified for painting the existing structure. The intermediate and finish coats specified for painting the existing structure shall be applied to the steel. When inorganic zinc has been used as the shop primer, a mist coat of the intermediate coat shall be applied first in order to prevent pinholing and bubbling.
- d) Recoating and Film Continuity (HOLD POINT for each coat). Paint shall be considered dry for recoating according to the time/temperature/humidity criteria provided in the manufacturer's instructions and when an additional coat can be applied without the development of film irregularities; such as lifting, wrinkling, or loss of adhesion of the under coat. If surfaces are contaminated, washing shall be accomplished prior to intermediate and final coats. Wash water does not have to be collected unless the water contacts existing lead containing coatings.

Painting shall be done in a neat and workmanlike manner. Each coat of paint shall be applied as a continuous film of uniform thickness free of defects including, but not limited to, runs, sags, overspray, dryspray, pinholes, voids, skips, misses, and shadow-through. Defects such as runs and sags shall be brushed out immediately during application.

Paint Systems. The paint system(s) from the list below shall be applied as specified.

The paint manufacturer's relative humidity, dew point, and material, surface, and ambient temperature restrictions shall be provided with the submittals and shall be strictly followed. Written recommendations from the paint manufacturer for the length of time each coat must be protected from cold or inclement weather (e.g., exposure to rain), during the drying period shall be included in the submittals. Upon acceptance by the Engineer, these times shall be used to govern the duration that protection must be maintained during drying.

Where stripe coats are indicated, the Contractor shall apply an additional coat to edges, rivets, bolts, crevices, welds, and similar surface irregularities. The stripe coat shall be applied by brush and/or spray to thoroughly work the coating into or on the irregular surfaces, and shall extend onto the surrounding steel a minimum of 1 in. (25 mm) in all directions. The purpose of the stripe coat is to build additional thickness and to assure complete coverage of these areas.

The stripe coat may be applied as part of the application of the full coat unless prohibited by the coating manufacturer. If applied as part of the application process of the full coat, the stripe coat shall be allowed to dry for a minimum of 10 minutes in order to allow Contractor QC personnel to verify that the coat was applied. If a wet-on-wet stripe coat is prohibited by the coating manufacturer or brush or roller application of the full coat pulls the underlying stripe coat, the stripe coat shall dry according to the manufacturers' recommended drying times prior to the application of the full coat. In the case of the prime coat, the full coat can also be applied first to protect the steel, followed by the stripe coat after the full coat has dried.

- a) System 1 – OZ/E/U – for Bare Steel: System 1 shall consist of the application of a full coat of organic (epoxy) zinc-rich primer, a full intermediate coat of epoxy, and a full finish coat of aliphatic urethane. Stripe coats of the prime and finish coats shall be applied. The film thicknesses of the full coats shall be as follows, measured according to SSPC-PA2:
- One full coat of organic zinc-rich primer between 3.5 and 5.0 mils (90 and 125 microns) dry film thickness. The prime coat shall be tinted to a color that contrasts with the steel surface.
 - One full intermediate coat of epoxy between 3.0 and 6.0 mils (75 and 150 microns) dry film thickness. The intermediate coat shall be a contrasting color to both the first coat and finish coat.
 - One full finish coat of aliphatic urethane between 2.5 and 4.0 mils (65 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of areas receiving the stripe coats, shall be between 9.0 and 15.0 mils (225 and 375 microns).

- b) System 2 – PS/EM/U – for Overcoating an Existing System: System 2 shall consist of the application of a full coat of epoxy penetrating sealer, a spot intermediate coat of aluminum epoxy mastic and a stripe and full finish coat of aliphatic urethane.

A full coat of epoxy penetrating sealer shall be applied to all surfaces following surface preparation. A spot intermediate coat shall consist of the application of one coat of the aluminum epoxy mastic on all areas where rust is evident and areas where the old paint has been removed, feathered and/or damaged prior to, during or after the cleaning and surface preparation operations. After the spot intermediate, a stripe coat and full finish coat of aliphatic urethane shall be applied. The film thicknesses shall be as follows, measured according to SSPC-PA2:

- One full coat of epoxy penetrating sealer between 1.0 and 2.0 mils (25 and 50 microns) dry film thickness.
- One spot coat of aluminum epoxy mastic between 5.0 and 7.0 mils (125 and 175 microns) dry film thickness. The color shall contrast with the finish coat.
- One full finish coat of aliphatic urethane between 2.5 and 4.0 mils (65 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of the stripe coat, shall be between 8.5 and 13.0 mils (215 and 325 microns). The existing coating thickness to remain under the overcoat must be verified in order to obtain accurate total dry film thickness measurements.

c) System 3 – EM/EM/AC – for Bare Steel: System 3 shall consist of the application of two full coats of aluminum epoxy mastic and a full finish coat of waterborne acrylic. Stripe coats for first coat of epoxy mastic and the finish coat shall be applied. The film thicknesses of the full coats shall be as follows, measured according to SSPC-PA2:

- One full coat of aluminum epoxy mastic between 5.0 and 7.0 mils (125 and 175 microns) dry film thickness. The first coat of aluminum epoxy mastic shall be tinted a contrasting color with the blast cleaned surface and the second coat.
- One full intermediate coat of aluminum epoxy mastic between 5.0 and 7.0 mils (125 and 175 microns) dry film thickness. The intermediate coat shall be a contrasting color to the first coat and the finish coat.
- A full finish coat of waterborne acrylic between 2.0 and 4.0 mils (50 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of areas receiving the stripe coats, shall be between 12.0 and 18.0 mils (360 and 450 microns).

- d) System 4 – PS/EM/AC – for Overcoating an Existing System: System 4 shall consist of the application of a full coat of epoxy penetrating sealer, a spot intermediate coat of aluminum epoxy mastic and a stripe and full finish coat of waterborne acrylic.

A full coat of epoxy penetrating sealer shall be applied to all surfaces following surface preparation. A spot intermediate coat shall consist of the application of one coat of the aluminum epoxy mastic on all areas where rust is evident and areas where the old paint has been removed, feathered and/or damaged prior to, during or after the cleaning and surface preparation operations. After the spot intermediate, a stripe coat and full finish coat of waterborne acrylic shall be applied. The film thicknesses shall be as follows, measured according to SSPC-PA2:

- One full coat of epoxy penetrating sealer between 1.0 and 2.0 mils (25 and 50 microns) dry film thickness.
- One spot coat of aluminum epoxy mastic between 5.0 and 7.0 mils (125 and 175 microns) dry film thickness. The color shall contrast with the finish coat.
- One full finish coat of waterborne acrylic between 2.0 and 4.0 mils (50 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of the stripe coat, shall be between 8.0 and 13.0 mils (200 and 325 microns). The existing coating thickness to remain under the overcoat must be verified in order to obtain accurate total dry film thickness measurements.

- e) System 5 – MCU – for Bare Steel: System 5 shall consist of the application of a full coat of moisture cure urethane (MCU) zinc primer, a full coat of MCU intermediate, and a full coat of MCU finish. Stripe coats of the prime and finish coats shall be applied. The contractor shall comply with the manufacturer's requirements for drying times between the application of the stripe coats and the full coats. The film thicknesses of the full coats shall be as follows, measured according to SSPC-PA2:

- One full coat of MCU zinc primer between 3.0 and 5.0 mils (75 and 125 microns) dry film thickness. The prime coat shall be tinted to a color that contrasts with the steel surface.
- One full MCU intermediate coat between 3.0 and 4.0 mils (75 and 100 microns) dry film thickness. The intermediate coat shall be a contrasting color to both the first coat and finish coat.
- One full MCU finish coat between 2.0 and 4.0 mils (50 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of areas receiving the stripe coats, shall be between 8.0 and 13.0 mils (200 and 325 microns).

- f) System 6 – MCU – for Overcoating an Existing System: System 6 shall consist of the application of a full coat of moisture cure urethane (MCU) penetrating sealer, a spot coat of MCU intermediate, and a stripe and full coat of MCU finish.

A full coat of MCU penetrating sealer shall be applied to all surfaces following surface preparation. A spot intermediate coat shall consist of the application of one coat of MCU intermediate on all areas where rust is evident and areas where the old paint has been removed, feathered and/or damaged prior to, during or after the cleaning and surface preparation operations. After the spot intermediate, a stripe coat and full coat of MCU finish shall be applied. The contractor shall comply with the manufacturer's requirements for drying time between the application of the stripe coat and the full finish coat. The film thicknesses shall be as follows, measured according to SSPC-PA2:

- One full coat of MCU sealer between 1.0 and 2.0 mils (25 and 50 microns) dry film thickness.
- One full MCU intermediate coat between 3.0 and 4.0 mils (75 and 100 microns) dry film thickness. The color shall contrast with the finish coat.
- One full MCU finish coat 2.0 and 4.0 mils (50 and 100 microns) dry film thickness. Finish coat color shall be according to contract plans.

The total dry film thickness for this system, exclusive of areas receiving the stripe coats, shall be between 6.0 and 10.0 mils (150 and 250 microns). The existing coating thickness to remain under the overcoat must be verified in order to obtain accurate total dry film thickness measurements.

Repair of Damage to New Coating System and Areas Concealed by Containment. The Contractor shall repair all damage to the newly installed coating system and areas concealed by the containment/protective covering attachment points, at no cost to the Department. If the damage extends to the substrate and the original preparation involved abrasive blast cleaning, the damaged areas shall be prepared to Power Tool Cleaning - Commercial Grade. If the original preparation was other than blast cleaning or the damage does not extend to the substrate, the loose, fractured paint shall be cleaned to Power Tool Cleaning – Modified SP3.

The surrounding coating at each repair location shall be feathered for a minimum distance of 1 1/2 in. (40 mm) to achieve a smooth transition between the prepared areas and the existing coating.

If the bare steel is exposed, all coats shall be applied to the prepared area. If only the intermediate and finish coats are damaged, the intermediate and finish shall be applied. If only the finish coat is damaged, the finish shall be applied.

Special Instructions.

- a) At the completion of the work, the Contractor shall stencil the painting date and the paint code on the bridge. The letters shall be capitals, not less than 2 in. (50 mm) and not more than 3 in. (75 mm) in height.

The stencil shall contain the following wording "PAINTED BY (insert the name of the Contractor)" and shall show the month and year in which the painting was completed, followed by the appropriate code for the coating material applied, all stenciled on successive lines:

CODE U (for field applied System 3 or System 4).

CODE Z (for field applied System 1 or System 2).

CODE AA (for field applied System 5 or System 6).

This information shall be stenciled on the cover plate of a truss end post near the top of the railing, or on the outside face of an outside stringer near one end of the bridge, or at some equally visible surface near the end of the bridge, as designated by the Engineer.

b) All surfaces painted inadvertently shall be cleaned immediately.

It is understood and agreed that the cost of all work outlined above, unless otherwise specified, has been included in the bid, and no extra compensation will be allowed.

Basis of Payment. This work shall be paid for at the contract Lump Sum price for CLEANING AND PAINTING STEEL BRIDGE, at the designated location, or for CLEANING AND PAINTING the structure or portions thereof described. Payment will not be authorized until all requirements for surface preparation and painting have been fulfilled as described in this specification, including the preparation and submittal of all QC documentation. Payment will also not be authorized for non-conforming work until the discrepancy is resolved in writing.

Appendix 1 – Reference List

The Contractor shall maintain the following regulations and references on site for the duration of the project:

- Illinois Environmental Protection Act
- ASTM D 4214, Standard Test Method for Evaluating Degree of Chalking of Exterior Paint Films
- ASTM D 4285, Standard Test Method for Indicating Oil or Water in Compressed Air
- SSPC-AB 1, Mineral and Slag Abrasives
- SSPC-AB 2, Specification for Cleanliness of Recycled Ferrous Metallic Abrasives
- SSPC-AB 3, Newly Manufactured or Re-Manufactured Steel Abrasives
- SSPC-PA 2, Measurement of Dry Coating Thickness with Magnetic Gages
- SSPC-QP 1, Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Structures)
- SSPC-QP 2, Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint
- SSPC-SP 1, Solvent Cleaning
- SSPC-SP 3, Power Tool Cleaning
- SSPC-SP 10/NACE No. 2, Near White Metal Blast Cleaning
- SSPC-SP 12/NACE No. 5, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating

- SSPC-SP15, Commercial Grade Power Tool Cleaning
- SSPC-VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
- SSPC-VIS 3, Visual Standard for Power- and Hand-Tool Cleaned Steel
- SSPC-VIS 4, Guide and Reference Photographs for Steel Cleaned by Water Jetting
- SSPC-VIS 5, Guide and Reference Photographs for Steel Prepared by Wet Abrasive Blast Cleaning
- The paint manufacturer's application instructions, MSDS and product data sheets

STRUCTURAL REPAIR OF CONCRETE

Effective: March 15, 2006

Revised: April 18, 2014

Description. This work shall consist of structurally repairing concrete.

Materials. Materials shall be according to the following.

Item	Article/Section
(a) Portland Cement Concrete (Note 1)	1020
(b) R1 or R2 Concrete (Note 2)	
(c) Normal Weight Concrete (Notes 3 and 4)	
(d) Shotcrete (High Performance) (Note 5 and 6)	
(e) Reinforcement Bars	1006.10
(f) Anchor Bolts	1006.09
(g) Water	1002
(h) Curing Compound (Type I)	1022.01
(i) Cotton Mats	1022.02
(j) Protective Coat	1023.01
(k) Epoxy (Note 7)	1025
(l) Mechanical Bar Splicers	508.06(c)

Note 1. The concrete shall be Class SI, except the cement factor shall be a minimum 6.65 cwt/cu yd (395 kg/cu m), the coarse aggregate shall be a CA 16, and the strength shall be a minimum 4000 psi (27,500 kPa) compressive or 675 psi (4650 kPa) flexural at 14 days. A high range water-reducing admixture shall be used to obtain a 5-7 in. (125-175 mm) slump, but a cement factor reduction according to Article 1020.05(b)(8) is prohibited. A self-consolidating concrete mixture is also acceptable per Article 1020.04, except the mix design requirements of this note regarding the cement factor, coarse aggregate, strength, and cement factor reduction shall apply.

- Note 2. The R1 or R2 concrete shall be from the Department's approved list of Packaged, Dry, Rapid Hardening, Cementitious Materials for Concrete Repairs. The R1 or R2 concrete shall comply with the air content and strength requirements for Class SI concrete as indicated in Note 1. Mixing shall be per the manufacturer's recommendations, except the water/cement ratio shall not exceed the value specified for Class SI concrete as indicated in Note 1. A high range water-reducing admixture shall be used to obtain a 5-7 in. (125-175 mm) slump, and a retarder may be required to allow time to perform the required field tests. The admixtures shall be per the manufacturer's recommendation, and the Department's approved list of Concrete Admixtures shall not apply.
- Note 3. The "high slump" packaged concrete mixture shall be from the Department's approved list of Packaged, Dry, Formed, Concrete Repair Mixtures. The materials and preparation of aggregate shall be according to ASTM C 387. The cement factor shall be 6.65 cwt/cu yd (395 kg/cu m) minimum to 7.05 cwt/cu yd (418 kg/cu m) maximum. Cement replacement with fly ash or ground granulated blast-furnace slag shall be according to Section 1020. The "high slump" packaged concrete mixture shall have a water soluble chloride ion content of less than 0.40 lb/cu yd (0.24 kg/cu m). The test shall be performed according to ASTM C 1218, and the "high slump" packaged concrete mixture shall have an age of 28 to 42 days at the time of test. The ASTM C 1218 test shall be performed by an independent lab a minimum of once every two years, and the test results shall be provided to the Department. The coarse aggregate shall be a maximum size of 1/2 in. (12.5 mm). The packaged concrete mixture shall comply with the air content and strength requirements for Class SI concrete as indicated in Note 1. Mixing shall be per the manufacturer's recommendations, except the water/cement ratio shall not exceed the value specified for Class SI concrete as indicated in Note 1. A high range water-reducing admixture shall be used to obtain a 5-7 in. (125-175 mm) slump. The admixture shall be per the manufacturer's recommendation, and the Department's approved list of Concrete Admixtures shall not apply. A maximum slump of 10 in. (250 mm) may be permitted if no segregation is observed by the Engineer in a laboratory or field evaluation.

Note 4 The “self-consolidating concrete” packaged concrete mixture shall be from the Department’s approved list of Packaged, Dry, Formed, Concrete Repair Mixtures. The materials and preparation of aggregate shall be according to ASTM C 387. The cement factor shall be 6.65 cwt/cu yd (395 kg/cu m) minimum to 7.05 cwt/cu yd (418 kg/cu m) maximum. Cement replacement with fly ash or ground granulated blast-furnace slag shall be according to Section 1020. The “self-consolidating concrete” packaged concrete mixture shall have a water soluble chloride ion content of less than 0.40 lb/cu yd (0.24 kg/cu m). The test shall be performed according to ASTM C 1218, and the “self-consolidating concrete” packaged concrete mixture shall have an age of 28 to 42 days at the time of test. The ASTM C 1218 test shall be performed by an independent lab a minimum of once every two years, and the test results shall be provided to the Department. The concrete mixture should be uniformly graded, and the coarse aggregate shall be a maximum size of 1/2 in. (12.5 mm). The fine aggregate proportion shall be a maximum 50 percent by weight (mass) of the total aggregate used. The packaged concrete mixture shall comply with the air content and strength requirements for Class SI concrete as indicated in Note 1. Mixing shall be per the manufacturer’s recommendations, except the water/cement ratio shall not exceed the value specified for Class SI concrete as indicated in Note 1. The admixtures used to produce self-consolidating concrete shall be per the manufacturer’s recommendation, and the Department’s approved list of Concrete Admixtures shall not apply. The packaged concrete mixture shall meet the following self-consolidating requirements:

- The slump flow range shall be 22 in. (560 mm) minimum to 28 in. (710 mm) maximum and tested according to Illinois Test Procedure SCC-2.
- The visual stability index shall be a maximum of 1 and tested according to Illinois Test Procedure SCC-2.
- The J-Ring value shall be a maximum of 2 in. (50 mm) and tested according to Illinois Test Procedure SCC-3. The L-Box blocking ratio shall be a minimum of 80 percent and tested according to Illinois Test Procedure SCC-4. The Manufacturer has the option to select either the J-Ring or L-Box test.
- The hardened visual stability index shall be a maximum of 1 and tested according to Illinois Test Procedure SCC-6.

Note 5. Packaged shotcrete that includes aggregate shall be from the Department’s approved list of Packaged High Performance Shotcrete, and independent laboratory test results showing the product meets Department specifications will be required. The product shall be a packaged, pre-blended, and dry combination of materials, for the wet-mix shotcrete method according to ASTM C 1480. A non-chloride accelerator may be used according to the shotcrete manufacturer’s recommendations. The shotcrete shall be Type FA or CA, Grade FR, and Class I. The fibers shall be Type III synthetic according to ASTM C 1116.

The packaged shotcrete shall have a water soluble chloride ion content of less than 0.40 lb/cu yd (0.24 kg/cu m). The test shall be performed according to ASTM C 1218, and the hardened shotcrete shall have an age of 28 to 42 days at the time of test. The ASTM C 1218 test shall be performed by an independent lab a minimum of once every two years, and the test results shall be provided to the Department.

Each individual aggregate used in the packaged shotcrete shall have either a maximum ASTM C 1260 expansion of 0.16 percent or a maximum ASTM C 1293 expansion of 0.040 percent. However, the ASTM C 1260 value may be increased to 0.27 percent for each individual aggregate if the cement total equivalent alkali content ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) does not exceed 0.60 percent. As an alternative to these requirements, ASTM C 1567 testing which shows the packaged shotcrete has a maximum expansion of 0.16 percent may be submitted. The ASTM C 1260, C 1293, or C 1567 test shall be performed a minimum of once every two years.

The 7 and 28 day compressive strength requirements in ASTM C 1480 shall not apply. Instead the shotcrete shall obtain a minimum compressive strength of 4000 psi (27,500 kPa) at 14 days.

The packaged shotcrete shall be limited to the following proportions:

The portland cement and finely divided minerals shall be 6.05 cwt/cu yd (360 kg/cu m) to 8.50 cwt/cu yd (505 kg/cu m) for Type FA and 6.05 cwt/cu yd (360 kg/cu. m) to 7.50 cwt/cu yd (445 kg/cu m) for Type CA. The portland cement shall not be below 4.70 cwt/cu yd (279 kg/cu m) for Type FA or CA.

The finely divided mineral(s) shall constitute a maximum of 35 percent of the total cement plus finely divided mineral(s).

Class F fly ash is optional and the maximum shall be 20 percent by weight (mass) of cement.

Class C fly ash is optional and the maximum shall be 25 percent by weight (mass) of cement.

Ground granulated blast-furnace slag is optional and the maximum shall be 30 percent by weight (mass) of cement.

Microsilica is required and shall be a minimum of 5 percent by weight (mass) of cement, and a maximum of 10 percent. As an alternative to microsilica, high-reactivity metakaolin may be used at a minimum of 5 percent by weight (mass) of cement, and a maximum of 10 percent.

Fly ash shall not be used in combination with ground granulated blast-furnace slag. Class F fly ash shall not be used in combination with Class C fly ash. Microsilica shall not be used in combination with high-reactivity metakaolin. A finely divided mineral shall not be used in combination with a blended hydraulic cement, except for microsilica or high-reactivity metakaolin.

The water/cement ratio as defined in Article 1020.06 shall be a maximum of 0.42.

The air content as shot shall be 4.0 – 8.0 percent.

Note 6 Packaged shotcrete that does not include pre-blended aggregate shall be from the Department's approved list of Packaged High Performance Shotcrete, and independent laboratory test results showing the product meets Department specifications will be required. The shotcrete shall be according to Note 5, except the added aggregate shall also be according to Articles 1003.02 and 1004.02. The aggregate gradation shall be according to the manufacturer. The shotcrete shall be batched and mixed with added aggregate according to the manufacturer.

Note 7. In addition ASTM C 881, Type IV, Grade 2 or 3, Class A, B, or C may be used.

Equipment. Equipment shall be according to Article 503.03 and the following.

Chipping Hammer – The chipping hammer for removing concrete shall be a light-duty pneumatic or electric tool with a 15 lb. (7 kg) maximum class or less.

Blast Cleaning Equipment – Blast cleaning equipment for concrete surface preparation shall be the abrasive type, and the equipment shall have oil traps.

Hydrodemolition Equipment – Hydrodemolition equipment for removing concrete shall be calibrated, and shall use water according to Section 1002.

High Performance Shotcrete Equipment – The batching, mixing, pumping, hose, nozzle, and auxiliary equipment shall be for the wet-mix shotcrete method, and shall meet the requirements of ACI 506R.

Construction Requirements

General. The repair methods shall be either formed concrete repair or shotcrete. The repair method shall be selected by the Contractor with the following rules.

- (a) Rule 1. For formed concrete repair, a subsequent patch to repair the placement point after initial concrete placement will not be allowed. As an example, this may occur in a vertical location located at the top of the repair.
- (b) Rule 2. Formed concrete repair shall not be used for overhead applications.
- (c) Rule 3. If formed concrete repair is used for locations that have reinforcement with less than 0.75 in. (19 mm) of concrete cover, the concrete mixture shall contain fly ash or ground granulated blast-furnace slag at the maximum cement replacement allowed.
- (d) Rule 4. Shotcrete shall not be used for any repair greater than 6 in. (150 mm) in depth, except in horizontal applications, where the shotcrete may be placed from above in one lift.

- (e) Rule 5. Shotcrete shall not be used for repairs greater than 4 in. (100 mm) in depth unless the shotcrete mixture contains 3/8 in. (9.5 mm) aggregate.

Temporary Shoring or Cribbing. When a temporary shoring or cribbing support system is required, the Contractor shall provide details and computations, prepared and sealed by an Illinois licensed Structural Engineer, to the Department for review and approval. When ever possible the support system shall be installed prior to starting the associated concrete removal. If no system is specified, but during the course of removal the need for temporary shoring or cribbing becomes apparent or is directed by the Engineer due to a structural concern, the Contractor shall not proceed with any further removal work until an appropriate and approved support system is installed.

Concrete Removal. The Contractor shall provide ladders or other appropriate equipment for the Engineer to mark the removal areas. Repair configurations will be kept simple, and squared corners will be preferred. The repair perimeter shall be sawed a depth of 1/2 in. (13 mm) or less, as required to avoid cutting the reinforcement. Any cut reinforcement shall be repaired or replaced at the expense of the Contractor. If the concrete is broken or removed beyond the limits of the initial saw cut, the new repair perimeter shall be recut. The areas to be repaired shall have all loose, unsound concrete removed completely by the use of chipping hammers, hydrodemolition equipment, or other methods approved by the Engineer. The concrete removal shall extend along the reinforcement bar until the reinforcement is free of bond inhibiting corrosion. Reinforcement bars with 50 percent or more exposed shall be undercut to a depth of 3/4 in. (19 mm) or the diameter of the reinforcement bar, whichever is larger.

If sound concrete is encountered before existing reinforcement bars are exposed, further removal of concrete shall not be performed unless the minimum repair depth is not met.

The repair depth shall be a minimum of 1 in. (25 mm). The substrate profile shall be $\pm 1/16$ in. (± 1.5 mm). The perimeter of the repair area shall have a vertical face.

If a repair is located at the ground line, any excavation required below the ground line to complete the repair shall be included in this work.

The Contractor shall have a maximum of 14 calendar days to complete each repair location with concrete or shotcrete, once concrete removal has started for the repair.

The Engineer shall be notified of concrete removal that exceeds 6 in. (150 mm) in depth, one fourth the cross section of a structural member, more than half the vertical column reinforcement is exposed in a cross section, more than 6 consecutive reinforcement bars are exposed in any direction, within 1.5 in. (38 mm) of a bearing area, or other structural concern. Excessive deterioration or removal may require further evaluation of the structure or installation of temporary shoring and cribbing support system.

Surface Preparation. Prior to placing the concrete or shotcrete, the Contractor shall prepare the repair area and exposed reinforcement by blast cleaning. The blast cleaning shall provide a surface that is free of oil, dirt, and loose material.

If a succeeding layer of shotcrete is to be applied, the initial shotcrete surface and remaining exposed reinforcement shall be free of curing compound, oil, dirt, loose material, rebound (i.e. shotcrete material leaner than the original mixture which ricochets off the receiving surface), and overspray. Preparation may be by lightly brushing or blast cleaning if the previous shotcrete surface is less than 36 hours old. If more than 36 hours old, the surface shall be prepared by blast cleaning.

The repair area and perimeter vertical face shall have a rough surface. Care shall be taken to ensure the perimeter sawcut is roughened by blast cleaning. Just prior to concrete or shotcrete placement, saturate the repair area with water to a saturated surface-dry condition. Any standing water shall be removed.

Concrete or shotcrete placement shall be done within 3 calendar days of the surface preparation or the repair area shall be prepared again.

Reinforcement. Exposed reinforcement bars shall be cleaned of concrete and corrosion by blast cleaning. After cleaning, all exposed reinforcement shall be carefully evaluated to determine if replacement or additional reinforcement bars are required.

Reinforcing bars that have been cut or have lost 25 percent or more of their original cross sectional area shall be supplemented by new in kind reinforcement bars. New bars shall be lapped a minimum of 32 bar diameters to existing bars. A mechanical bar splicer shall be used when it is not feasible to provide the minimum bar lap. No welding of bars shall be performed.

Intersecting reinforcement bars shall be tightly secured to each other using 0.006 in. (1.6 mm) or heavier gauge tie wire, and shall be adequately supported to minimize movement during concrete placement or application of shotcrete.

For reinforcement bar locations with less than 0.75 in. (19 mm) of cover, protective coat shall be applied to the completed repair. The application of the protective coat shall be according to Article 503.19, 2nd paragraph, except blast cleaning shall be performed to remove curing compound.

The Contractor shall anchor the new concrete to the existing concrete with 3/4 in. (19 mm) diameter hook bolts for all repair areas where the depth of concrete removal is greater than 8 in. (205 mm) and there is no existing reinforcement extending into the repair area. The hook bolts shall be spaced at 15 in. (380 mm) maximum centers both vertically and horizontally, and shall be a minimum of 12 in. (305 mm) away from the perimeter of the repair. The hook bolts shall be installed according to Section 584.

Repair Methods. All repair areas shall be inspected and approved by the Engineer prior to placement of the concrete or application of the shotcrete.

- (a) Formed Concrete Repair. Falsework shall be according to Article 503.05. Forms shall be according to Article 503.06. Formwork shall provide a smooth and uniform concrete finish, and shall approximately match the existing concrete structure. Formwork shall be mortar tight and closely fitted where they adjoin the existing concrete surface to prevent leakage. Air vents may be provided to reduce voids and improve surface appearance. The Contractor may use exterior mechanical vibration, as approved by the Engineer, to release air pockets that may be entrapped.

The concrete for formed concrete repair shall be a Class SI Concrete, or a packaged R1 or R2 Concrete with coarse aggregate added, or a packaged Normal Weight Concrete at the Contractor's option. The concrete shall be placed and consolidated according to Article 503.07. The concrete shall not be placed when frost is present on the surface of the repair area, or the surface temperature of the repair area is less than 40 °F (4 °C). All repaired members shall be restored as close as practicable to their original dimensions.

Curing shall be done according to Article 1020.13.

If temperatures below 45°F (7°C) are forecast during the curing period, protection methods shall be used. Protection Method I according to Article 1020.13(d)(1), or Protection Method II according to Article 1020.13(d)(2) shall be used during the curing period.

The surfaces of the completed repair shall be finished according to Article 503.15.

- (b) Shotcrete. Shotcrete shall be tested by the Engineer for air content according to Illinois Modified AASHTO T 152. The sample shall be obtained from the discharge end of the nozzle by shooting a pile large enough to scoop a representative amount for filling the air meter measuring bowl. Shotcrete shall not be shot directly into the measuring bowl for testing.

For compressive strength of shotcrete, a 18 x 18 x 3.5 in. (457 x 457 x 89 mm) test panel shall be shot by the Contractor for testing by the Engineer. A steel form test panel shall have a minimum thickness of 3/16 in. (5 mm) for the bottom and sides. A wood form test panel shall have a minimum 3/4 in. (19 mm) thick bottom, and a minimum 1.5 in. (38 mm) thickness for the sides. The test panel shall be cured according to Article 1020.13 (a) (3) or (5) while stored at the jobsite and during delivery to the laboratory. After delivery to the laboratory for testing, curing and testing shall be according to ASTM C 1140.

The method of alignment control (i.e. ground wires, guide strips, depth gages, depth probes, and formwork) to ensure the specified shotcrete thickness and reinforcing bar cover is obtained shall be according to ACI 506R. Ground wires shall be removed after completion of cutting operations. Guide strips and formwork shall be of dimensions and a configuration that do not prevent proper application of shotcrete. Metal depth gauges shall be cut 1/4 in. (6 mm) below the finished surface. All repaired members shall be restored as close as practicable to their original dimensions.

For air temperature limits when applying shotcrete in cold weather, the first paragraph of Article 1020.14(b) shall apply. For hot weather, shotcrete shall not be applied when the air temperature is greater than 90°F (32°C). The applied shotcrete shall have a minimum temperature of 50°F (10°C) and a maximum temperature of 90°F (32°C). The shotcrete shall not be applied during periods of rain unless protective covers or enclosures are installed. The shotcrete shall not be applied when frost is present on the surface of the repair area, or the surface temperature of the repair area is less than 40°F (4°C). If necessary, lighting shall be provided to provide a clear view of the shooting area.

The shotcrete shall be applied according to ACI 506R, and shall be done in a manner that does not result in cold joints, laminations, sandy areas, voids, sags, or separations. In addition, the shotcrete shall be applied in a manner that results in maximum densification of the shotcrete. Shotcrete which is identified as being unacceptable while still plastic shall be removed and re-applied.

The nozzle shall normally be at a distance of 2 to 5 ft. (0.6 to 1.5 m) from the receiving surface, and shall be oriented at right angles to the receiving surface. Exceptions to this requirement will be permitted to fill corners, encase large diameter reinforcing bars, or as approved by the Engineer. For any exception, the nozzle shall never be oriented more than 45 degrees from the surface. Care shall be taken to keep the front face of the reinforcement bar clean during shooting operations. Shotcrete shall be built up from behind the reinforcement bar. Accumulations of rebound and overspray shall be continuously removed prior to application of new shotcrete. Rebound material shall not be incorporated in the work.

Whenever possible, shotcrete shall be applied to the full thickness in a single layer. The maximum thickness shall be according to Rules 4 and 5 under the Construction Requirements, General. When two or more layers are required, the minimum number shall be used and shall be done in a manner without sagging or separation. A flash coat (i.e. a thin layer of up to 1/4 in. (6 mm) applied shotcrete) may be used as the final lift for overhead applications.

Prior to application of a succeeding layer of shotcrete, the initial layer of shotcrete shall be prepared according to the surface preparation and reinforcement bar cleaning requirements. Upon completion of the surface preparation and reinforcement bar treatment, water shall be applied according to the surface preparation requirements unless the surface is moist. The second layer of shotcrete shall then be applied within 30 minutes.

Shotcrete shall be cut back to line and grade using trowels, cutting rods, screeds or other suitable devices. The shotcrete shall be allowed to stiffen sufficiently before cutting. Cutting shall not cause cracks or delaminations in the shotcrete. For depressions, cut material may be used for small areas. Rebound material shall not be incorporated in the work. For the final finish, a wood float shall be used to approximately match the existing concrete texture. A manufacturer approved finishing aid may be used. Water shall not be used as a finishing aid. All repaired members shall be restored as close as practicable to their original dimensions.

Contractor operations for curing shall be continuous with shotcrete placement and finishing operations. Curing shall be accomplished using wetted cotton mats, membrane curing, or a combination of both.. Cotton mats shall be applied according to Article 1020.13(a)(5) except the exposed layer of shotcrete shall be covered within 10 minutes after finishing, and wet curing shall begin immediately. Manufacturer approved curing compound shall be applied according to Article 1020.13(a)(4), except the curing compound shall be applied as soon as the shotcrete has hardened sufficiently to prevent marring the surface, and each of the two separate applications shall be applied in opposite directions to ensure coverage. Note 5 of the Index Table in Article 1020.13 shall apply to the membrane curing method.

When a shotcrete layer is to be covered by a succeeding shotcrete layer within 36 hours, the repair area shall be protected with intermittent hand fogging, or wet curing with either burlap or cotton mats shall begin within 10 minutes. Intermittent hand fogging may be used only for the first hour. Thereafter, wet curing with burlap or cotton mats shall be used until the succeeding shotcrete layer is applied. Intermittent hand fogging may be extended to the first hour and a half if the succeeding shotcrete layer is applied by the end of this time.

The curing period shall be for 7 days, except when there is a succeeding layer of shotcrete. In this instance, the initial shotcrete layer shall be cured until the surface preparation and reinforcement bar treatment is started.

If temperatures below 45°F (7°C) are forecast during the curing period, protection methods shall be used. Protection Method I according to Article 1020.13(d)(1), or Protection Method II according to Article 1020.13(d)(2) shall be used during the curing period

Inspection of Completed Work. The Contractor shall provide ladders or other appropriate equipment for the Engineer to inspect the repaired areas. After curing but no sooner than 28 days after placement of concrete or shooting of shotcrete, the repair shall be examined for conformance with original dimensions, cracks, voids, and delaminations. Sounding for delaminations will be done with a hammer or by other methods determined by the Engineer.

The acceptable tolerance for conformance of a repaired area shall be within 1/4 in. (6 mm) of the original dimensions. A repaired area not in dimensional conformance or with delaminations shall be removed and replaced.

A repaired area with cracks or voids shall be considered as nonconforming. Exceeding one or more of the following crack and void criteria shall be cause for removal and replacement of a repaired area.

1. The presence of a single surface crack greater than 0.01 in. (0.25 mm) in width and greater than 12 in. (300 mm) in length.
2. The presence of two or more surface cracks greater than 0.01 in. (0.25 mm) in width that total greater than 24 in. (600 mm) in length.
3. The presence of map cracking in one or more regions totaling 15 percent or more of the gross surface area of the repair.
4. The presence of two or more surface voids with least dimension 3/4 in. (19 mm) each.

A repaired area with cracks or voids that do not exceed any of the above criteria may remain in place, as determined by the Engineer.

If a nonconforming repair is allowed to remain in place, cracks greater than 0.007 in. (0.2 mm) in width shall be repaired with epoxy injection according to Section 590. For cracks less than or equal to 0.007 in. (0.2 mm) in width, the epoxy may be applied to the surface of the crack. Voids shall be repaired according to Article 503.15.

Publications and Personnel Requirements. The Contractor shall provide a current copy of ACI 506R to the Engineer a minimum of one week prior to start of construction.

The shotcrete personnel who perform the work shall have current American Concrete Institute (ACI) nozzle men certification for vertical wet and overhead wet applications, except one individual may be in training. This individual shall be adequately supervised by a certified ACI nozzle men as determined by the Engineer. A copy of the nozzle men certificate(s) shall be given to the Engineer.

Method of Measurement. This work will be measured for payment in place and the area computed in square feet (square meters). For a repair at a corner, both sides will be measured.

Basis of Payment. This work will be paid for at the contract unit price per square foot (square meter) for STRUCTURAL REPAIR OF CONCRETE (DEPTH GREATER THAN 5 IN. (125 MM), STRUCTURAL REPAIR OF CONCRETE (DEPTH EQUAL TO OR LESS THAN 5 IN. (125 MM).

When not specified to be paid for elsewhere, the work to design, install, and remove the temporary shoring and cribbing will be paid for according to Article 109.04.

With the exception of reinforcement damaged by the Contractor during removal, the furnishing and installation of supplemental reinforcement bars, mechanical bar splicers, hook bolts, and protective coat will be paid according to Article 109.04.

CONCRETE END SECTIONS FOR PIPE CULVERTS (BDE)

Effective: January 1, 2013

Description. This work shall consist of constructing cast-in-place concrete and precast concrete end sections for pipe culverts. These end sections are shown on the plans as Highway Standard 542001, 542006, 542011, or 542016. This work shall be according to Section 542 of the Standard Specifications except as modified herein.

Materials. Materials shall be according to the following Articles of Division 1000 – Materials of the Standard Specifications.

Item	Article/Section
(a) Portland Cement Concrete (Note 1)	1020
(b) Precast Concrete End Sections (Note 2)	
(c) Coarse Aggregate (Note 3)	1004.05
(d) Structural Steel (Note 4)	1006.04
(e) Anchor Bolts and Rods (Note 5)	1006.09
(f) Reinforcement Bars	1006.10(a)
(g) Nonshrink Grout	1024.02
(h) Chemical Adhesive Resin System	1027
(i) Mastic Joint Sealer for Pipe	1055
(j) Hand Hole Plugs	1042.16

Note 1. Cast-in-place concrete end sections shall be Class SI, except the 14 day mix design shall have a compressive strength of 5000 psi (34,500 kPa) or a flexural strength of (800 psi) 5500 kPa and a minimum cement factor of 6.65 cwt/cu yd (395 kg/cu m).

Note 2. Precast concrete end sections shall be according to Articles 1042.02 and 1042.03(b)(c)(d)(e) of the Standard Specifications. The concrete shall be Class PC according to Section 1020, and shall have a minimum compressive strength of 5000 psi (34,000 kPa) at 28 days.

Joints between precast sections shall be produced with reinforced tongue and groove ends according to the requirements of ASTM C 1577.

Note 3. The granular bedding placed below a precast concrete end section shall be gradation CA 6, CA 9, CA 10, CA 12, CA 17, CA 18, or CA 19.

Note 4. All components of the culvert tie detail shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable.

Note 5. The anchor rods for the culvert ties shall be according to the requirements of ASTM F 1554, Grade 105 (Grade 725).

CONSTRUCTION REQUIREMENTS

The concrete end sections may be precast or cast-in-place construction. Toe walls shall be either precast or cast-in-place, and shall be in proper position and backfilled according to the applicable paragraphs of Article 502.10 of the Standard Specifications prior to the installation of the concrete end sections. If soil conditions permit, cast-in-place toe walls may be poured directly against the soil. When poured directly against the soil, the clear cover of the sides and bottom of the toe wall shall be increased to 3 in. (75 mm) by increasing the thickness of the toe wall.

- (a) Cast-In-Place Concrete End Sections. Cast-in-place concrete end sections shall be constructed according to the requirements of Section 503 of the Standard Specifications and as shown on the plans.
- (b) Precast Concrete End Sections. When the concrete end sections will be precast, shop drawings detailing the slab thickness and reinforcement layout shall be submitted to the Engineer for review and approval.

The excavation and backfilling for precast concrete end sections shall be according to the requirements of Section 502 of the Standard Specifications, except a layer of granular bedding at least 6 in. (150 mm) in thickness shall be placed below the elevation of the bottom of the end section. The granular bedding shall extend a minimum of 2 ft (600 mm) beyond each side of the end section.

Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional 2/3 turn on one of the nuts. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut.

Method of Measurement. This work will be measured for payment as each, with each end of each culvert being one each.

Basis of Payment. This work will be paid for at the contract unit price per each for CONCRETE END SECTION, STANDARD 542001; CONCRETE END SECTION, STANDARD 542006; CONCRETE END SECTION, 542011; or CONCRETE END SECTION, 542016, of the pipe diameter and slope specified.

CONCRETE GUTTER, CURB, MEDIAN, AND PAVED DITCH (BDE)

Effective: April 1, 2014

Revised: August 1, 2014

Add the following to Article 606.02 of the Standard Specifications:

“(i) Polyurethane Joint Sealant 1050.04”

Revise the fifth paragraph of Article 606.07 of the Standard Specifications to read:

“Transverse contraction and longitudinal construction joints shall be sealed according to Article 420.12, except transverse joints in concrete curb and gutter shall be sealed with polysulfide or polyurethane joint sealant.”

Add the following to Section 1050 of the Standard Specifications:

“1050.04 Polyurethane Joint Sealant. The joint sealant shall be a polyurethane sealant, Type S, Grade NS, Class 25 or better, Use T (T₁ or T₂), according to ASTM C 920.”

CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)

Effective: June 1, 2010

Revised: November 1, 2014

The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The term “equipment” refers to diesel fuel powered devices rated at 50 hp and above, to be used on the jobsite in excess of seven calendar days over the course of the construction period on the jobsite (including rental equipment).

Contractor and subcontractor diesel powered off-road equipment assigned to the contract shall be retrofitted using the phased in approach shown below. Equipment that is of a model year older than the year given for that equipment’s respective horsepower range shall be retrofitted:

Effective Dates	Horsepower Range	Model Year
June 1, 2010 ^{1/}	600-749	2002
	750 and up	2006
June 1, 2011 ^{2/}	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006
June 1, 2012 ^{2/}	50-99	2004
	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006

1/ Effective dates apply to Contractor diesel powered off-road equipment assigned to the contract.

2/ Effective dates apply to Contractor and subcontractor diesel powered off-road equipment assigned to the contract.

The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent and shall be:

- a) Included on the U.S. Environmental Protection Agency (USEPA) *Verified Retrofit Technology List* (<http://www.epa.gov/cleandiesel/verification/verif-list.htm>), or verified by the California Air Resources Board (CARB) (<http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm>); or
- b) Retrofitted with a non-verified diesel retrofit emission control device if verified retrofit emission control devices are not available for equipment proposed to be used on the project, and if the Contractor has obtained a performance certification from the retrofit device manufacturer that the emission control device provides a minimum PM emission reduction of 50 percent.

Note: Large cranes (Crawler mounted cranes) which are responsible for critical lift operations are exempt from installing retrofit emission control devices if such devices adversely affect equipment operation.

Diesel powered off-road equipment with engine ratings of 50 hp and above, which are unable to be retrofitted with verified emission control devices or if performance certifications are not available which will achieve a minimum 50 percent PM reduction, may be granted a waiver by the Department if documentation is provided showing good faith efforts were made by the Contractor to retrofit the equipment.

Construction shall not proceed until the Contractor submits a certified list of the diesel powered off-road equipment that will be used, and as necessary, retrofitted with emission control devices. The list(s) shall include (1) the equipment number, type, make, Contractor/rental company name; and (2) the emission control devices make, model, USEPA or CARB verification number, or performance certification from the retrofit device manufacturer. Equipment reported as fitted with emissions control devices shall be made available to the Engineer for visual inspection of the device installation, prior to being used on the jobsite.

The Contractor shall submit an updated list of retrofitted off-road construction equipment as retrofitted equipment changes or comes on to the jobsite. The addition or deletion of any diesel powered equipment shall be included on the updated list.

If any diesel powered off-road equipment is found to be in non-compliance with any portion of this special provision, the Engineer will issue the Contractor a diesel retrofit deficiency deduction.

Any costs associated with retrofitting any diesel powered off-road equipment with emission control devices shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed. The Contractor's compliance with this notice and any associated regulations shall not be grounds for a claim.

Diesel Retrofit Deficiency Deduction

When the Engineer determines that a diesel retrofit deficiency exists, a daily monetary deduction will be imposed for each calendar day or fraction thereof the deficiency continues to exist. The calendar day(s) will begin when the time period for correction is exceeded and end with the Engineer's written acceptance of the correction. The daily monetary deduction will be \$1,000.00 for each deficiency identified.

The deficiency will be based on lack of diesel retrofit emissions control.

If a Contractor accumulates three diesel retrofit deficiency deductions for the same piece of equipment in a contract period, the Contractor will be shutdown until the deficiency is corrected. Such a shutdown will not be grounds for any extension of the contract time, waiver of penalties, or be grounds for any claim.

CONTRACT CLAIMS (BDE)

Effective: April 1, 2014

Revise the first paragraph of Article 109.09(a) of the Standard Specifications to read:

“(a) Submission of Claim. All claims filed by the Contractor shall be in writing and in sufficient detail to enable the Department to ascertain the basis and amount of the claim. As a minimum, the following information must accompany each claim submitted.”

Revise Article 109.09(e) of the Standard Specifications to read:

“(e) Procedure. The Department provides two administrative levels for claims review.

Level I Engineer of Construction
Level II Chief Engineer/Director of Highways or Designee

- (1) Level I. All claims shall first be submitted at Level I. Two copies each of the claim and supporting documentation shall be submitted simultaneously to the District and the Engineer of Construction. The Engineer of Construction, in consultation with the District, will consider all information submitted with the claim and render a decision on the claim within 90 days after receipt by the Engineer of Construction. Claims not conforming to this Article will be returned without consideration. The Engineer of Construction may schedule a claim presentation meeting if in the Engineer of Construction's judgment such a meeting would aid in resolution of the claim, otherwise a decision will be made based on the claim documentation submitted. If a Level I decision is not rendered within 90 days of receipt of the claim, or if the Contractor disputes the decision, an appeal to Level II may be made by the Contractor.

- (2) Level II. An appeal to Level II shall be made in writing to the Engineer of Construction within 45 days after the date of the Level I decision. Review of the claim at Level II shall be conducted as a full evaluation of the claim. A claim presentation meeting may be scheduled if the Chief Engineer/Director of Highways determines that such a meeting would aid in resolution of the claim, otherwise a decision will be made based on the claim documentation submitted. A Level II final decision will be rendered within 90 days of receipt of the written request for appeal.

Full compliance by the Contractor with the provisions specified in this Article is a contractual condition precedent to the Contractor's right to seek relief in the Court of Claims. The Director's written decision shall be the final administrative action of the Department. Unless the Contractor files a claim for adjudication by the Court of Claims within 60 days after the date of the written decision, the failure to file shall constitute a release and waiver of the claim."

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (DBE)

Effective: September 1, 2000

Revised: August 2, 2011

FEDERAL OBLIGATION. The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR Part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR Part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory.

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department's annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE. The Contractor makes the following assurance and agrees to include the assurance in each subcontract that the Contractor signs with a subcontractor.

The Contractor, subrecipient, or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate.

OVERALL GOAL SET FOR THE DEPARTMENT. As a requirement of compliance with 49 CFR Part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR. This contract includes a specific DBE utilization goal established by the Department. The goal has been included because the Department has determined that the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. The determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates that, in the absence of unlawful discrimination, and in an arena of fair and open competition, DBE companies can be expected to perform **10.00%** of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set for in this Special Provision:

- (a) The bidder documents that enough DBE participation has been obtained to meet the goal: or
- (b) The bidder documents that a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES. Bidders shall consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217)785-4611, or by visiting the Department's website at www.dot.il.gov.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement. The failure of the bidder to comply will render the bid not responsive.

- (a) The bidder shall submit a Disadvantaged Business Utilization Plan on Department forms SBE 2025 and 2026 with the bid.
- (b) The Utilization Plan shall indicate that the bidder either has obtained sufficient DBE participation commitments to meet the contract goal or has not obtained enough DBE participation commitments in spite of a good faith effort to meet the goal. The Utilization Plan shall further provide the name, telephone number, and telefax number of a responsible official of the bidder designated for purposes of notification of plan approval or disapproval under the procedures of this Special Provision.

- (c) The Utilization Plan shall include a DBE Participation Commitment Statement, Department form SBE 2025, for each DBE proposed for the performance of work to achieve the contract goal. For bidding purposes, submission of the completed SBE 2025 forms, signed by the DBEs and faxed to the bidder will be acceptable as long as the original is available and provided upon request. All elements of information indicated on the said form shall be provided, including but not limited to the following:
- (1) The names and addresses of DBE firms that will participate in the contract;
 - (2) A description, including pay item numbers, of the work each DBE will perform;
 - (3) The dollar amount of the participation of each DBE firm participating. The dollar amount of participation for identified work shall specifically state the quantity, unit price, and total subcontract price for the work to be completed by the DBE. If partial pay items are to be performed by the DBE, indicate the portion of each item, a unit price where appropriate and the subcontract price amount;
 - (4) DBE Participation Commitment Statements, form SBE 2025, signed by the bidder and each participating DBE firm documenting the commitment to use the DBE subcontractors whose participation is submitted to meet the contract goal;
 - (5) if the bidder is a joint venture comprised of DBE companies and non-DBE companies, the plan must also include a clear identification of the portion of the work to be performed by the DBE partner(s); and,
 - (6) If the contract goal is not met, evidence of good faith efforts.

GOOD FAITH EFFORT PROCEDURES. The contract will not be awarded until the Utilization Plan submitted by the apparent successful bidder is approved. All information submitted by the bidder must be complete, accurate and adequately document that enough DBE participation has been obtained or document that good faith efforts of the bidder, in the event enough DBE participation has not been obtained, before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan documents sufficient commercially useful DBE work performance to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR Part 26, Appendix A. The Utilization Plan will not be approved by the Department if the Utilization Plan does not document sufficient DBE participation to meet the contract goal unless the apparent successful bidder documented in the Utilization Plan that it made a good faith effort to meet the goal. This means that the bidder must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts that the bidder has made. Mere *pro forma* efforts, in other words, efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

- (a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases, and will be considered by the Department.
- (1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.
 - (2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the prime Contractor might otherwise prefer to perform these work items with its own forces.
 - (3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
 - (4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.
 - b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price difference is excessive or unreasonable.

- (5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.
 - (6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.
 - (7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.
 - (8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.
- (b) If the Department determines that the apparent successful bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided that it is otherwise eligible for award. If the Department determines that the bidder has failed to meet the requirements of this Special Provision or that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification shall include a statement of reasons for the determination.
- (c) The bidder may request administrative reconsideration of a determination adverse to the bidder within the five working days after the receipt of the notification date of the determination by delivering the request to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764 (Telefax: (217)785-1524). Deposit of the request in the United States mail on or before the fifth business day shall not be deemed delivery. The determination shall become final if a request is not made and delivered. A request may provide additional written documentation and/or argument concerning the issues raised in the determination statement of reasons, provided the documentation and arguments address efforts made prior to submitting the bid. The request will be forwarded to the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person in order to consider all issues of documentation and whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for consideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR Part 26.55(c) on questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR Part 26.55, the provisions of which govern over the summary contained herein.

- (a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.
- (b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.
- (c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the prime Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.
- (d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contract. Credit will be given for the following:
 - (1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.
 - (2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission is receives as a result of the lease arrangement.

(e) DBE as a material supplier:

- (1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.
- (2) 100 percent goal credit for the cost of materials of supplies obtained from a DBE manufacturer.
- (3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a regular dealer or manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal. All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the Participation Statement.

- (a) NO AMENDMENT. No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be submitted to the Department of Transportation, Bureau of Small Business Enterprises, Contract Compliance Section, 2300 South Dirksen Parkway, Room 319, Springfield, Illinois 62764. Telephone number (217)785-4611. Telefax number (217)785-1524.
- (b) TERMINATION OR REPLACEMENT. The Contractor shall not terminate or replace a DBE listed on the approved Utilization Plan, or perform with other forces work designated for a listed DBE except as provided in the Special Provision.
- (c) CHANGES TO WORK. Any deviation from the DBE condition-of-award or contract plans, specifications, or special provisions must be approved, in writing, by the Department as provided elsewhere in the Contract. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract. Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A, must be signed and submitted. If the commitment of work is in the form of additional tasks assigned to an existing subcontract, then a new Request for Approval of Subcontractor shall not be required. However, the Contractor must document efforts to assure that the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(d) ALTERNATIVE WORK METHODS. In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

- (1) That the replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or
- (2) That the DBE is aware that its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or
- (3) That the DBE is not capable of performing the replacement work or has declined to perform the work at a reasonable competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) TERMINATION AND REPLACEMENT PROCEDURES. The Contractor shall not terminate or replace a DBE subcontractor listed in the approved Utilization Plan without prior written consent. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Written consent will be granted only if the Bureau of Small Business Enterprises agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate or replace the DBE firm. Before transmitting to the Bureau of Small Business Enterprises any request to terminate and/or substitute a DBE subcontractor, the Contractor shall give notice in writing to the DBE subcontractor, with a copy to the Bureau, of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor shall give the DBE five days to respond to the Contractor's notice. The DBE so notified shall advise the Bureau and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Bureau should not approve the Contractor's action. If required in a particular case as a matter of public necessity, the Bureau may provide a response period shorter than five days.

For purposes of this paragraph, good cause includes the following circumstances:

- (1) The listed DBE subcontractor fails or refuses to execute a written contract;
- (2) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the prime contractor;

- (3) The listed DBE subcontractor fails or refuses to meet the prime Contractor's reasonable, nondiscriminatory bond requirements;
- (4) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;
- (5) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1,200 or applicable state law.
- (6) You have determined that the listed DBE subcontractor is not a responsible contractor;
- (7) The listed DBE subcontractor voluntarily withdraws from the projects and provides to you written notice of its withdrawal;
- (8) The listed DBE is ineligible to receive DBE credit for the type of work required;
- (9) A DBE owner dies or becomes disabled with the result that the listed DBE contractor is unable to complete its work on the contract;
- (10) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the prime Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the prime Contractor can self-perform the work for which the DBE contractor was engaged or so that the prime Contractor can substitute another DBE or non-DBE contractor after contract award.

When a DBE is terminated, or fails to complete its work on the Contract for any reason the Contractor shall make a good faith effort to find another DBE to substitute for the original DBE to perform at least the same amount of work under the contract as the terminated DBE to the extent needed to meet the established Contract goal.

- (f) PAYMENT RECORDS. The Contractor shall maintain a record of payments for work performed to the DBE participants. The records shall be made available to the Department for inspection upon request. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than thirty calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Regional Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes that the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the BDE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (h) of this part.
- (g) ENFORCEMENT. The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.
- (h) RECONSIDERATION. Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may request administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of "Good Faith Effort Procedures" of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department.

GRANULAR MATERIALS (BDE)

Effective: November 1, 2012

Revise the title of Article 1003.04 of the Standard Specifications to read:

“1003.04 Fine Aggregate for Bedding, Trench Backfill, Embankment, Porous Granular Backfill, Sand Backfill for Underdrains, and French Drains.”

Revise Article 1003.04(c) of the Standard Specifications to read:

“(c) Gradation. The fine aggregate gradations for granular embankment, granular backfill, bedding, and trench backfill for pipe culverts and storm sewers shall be FA 1, FA 2, or FA 6 through FA 21.

The fine aggregate gradation for porous granular embankment, porous granular backfill, french drains, and sand backfill for underdrains shall be FA 1, FA 2, or FA 20, except the percent passing the No. 200 (75 µm) sieve shall be 2±2.”

Revise Article 1004.05(c) of the Standard Specifications to read:

“(c) Gradation. The coarse aggregate gradations shall be as follows.

Application	Gradation
Blotter	CA 15
Granular Embankment, Granular Backfill, Bedding, and Trench Backfill for Pipe Culverts and Storm Sewers	CA 6, CA 9, CA 10, CA 12, CA17, CA18, and CA 19
Porous Granular Embankment, Porous Granular Backfill, and French Drains	CA 7, CA 8, CA 11, CA 15, CA 16 and CA 18”

LRFD PIPE CULVERT BURIAL TABLES (BDE)

Effective: November 1, 2013

Revised: November 1, 2014

Revise Article 542.02 of the Standard Specifications to read as follows:

“Item	Article/Section
(a) Galvanized Corrugated Steel Pipe	1006.01
(b) Galvanized Corrugated Steel Pipe Arch	1006.01
(c) Bituminous Coated Corrugated Steel Pipe	1006.01
(d) Bituminous Coated Corrugated Steel Pipe Arch	1006.01
(e) Reserved	
(f) Aluminized Steel Type 2 Corrugated Pipe	1006.01
(g) Aluminized Steel Type 2 Corrugated Pipe Arch	1006.01
(h) Precoated Galvanized Corrugated Steel Pipe	1006.01
(i) Precoated Galvanized Corrugated Steel Pipe Arch	1006.01
(j) Corrugated Aluminum Alloy Pipe	1006.03
(k) Corrugated Aluminum Alloy Pipe Arch	1006.03
(l) Extra Strength Clay Pipe	1040.02
(m) Concrete Sewer, Storm Drain, and Culvert Pipe	1042
(n) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe	1042
(o) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.....	1042
(p) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe	1042
(q) Polyvinyl Chloride (PVC) Pipe	1040.03
(r) Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior	1040.03
(s) Corrugated Polypropylene (CPP) pipe with smooth Interior	1040.07
(t) Corrugated Polyethylene (PE) Pipe with a Smooth Interior	1040.04
(u) Polyethylene (PE) Pipe with a Smooth Interior	1040.04
(v) Rubber Gaskets and Preformed Flexible Joint Sealants for Concrete Pipe	1056
(w) Mastic Joint Sealer for Pipe	1055
(x) External Sealing Band	1057
(y) Fine Aggregate (Note 1)	1003.04
(z) Coarse Aggregate (Note 2)	1004.05
(aa) Packaged Rapid Hardening Mortar or Concrete	1018
(bb) Nonshrink Grout	1024.02
(cc) Reinforcement Bars and Welded Wire Fabric	1006.10
(dd) Handling Hole Plugs	1042.16

Note 1. The fine aggregate shall be moist.

Note 2. The coarse aggregate shall be wet.”

Revise the table for permitted materials in Article 542.03 of the Standard Specifications as follows:

"Class	Materials
A	Rigid Pipes: Extra Strength Clay Pipe Concrete Sewer Storm Drain and Culvert Pipe, Class 3 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C	Rigid Pipes: Extra Strength Clay Pipe Concrete Sewer Storm Drain and Culvert Pipe, Class 3 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe Flexible Pipes: Aluminized Steel Type 2 Corrugated Pipe Aluminized Steel Type 2 Corrugated Pipe Arch Precoated Galvanized Corrugated Steel Pipe Precoated Galvanized Corrugated Steel Pipe Arch Corrugated Aluminum Alloy Pipe Corrugated Aluminum Alloy Pipe Arch Polyvinyl Chloride (PVC) Pipe Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior Polyethylene (PE) Pipe with a Smooth Interior Corrugated Polypropylene (CPP) Pipe with Smooth Interior
D	Rigid Pipes: Extra Strength Clay Pipe Concrete Sewer Storm Drain and Culvert Pipe, Class 3 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe Flexible Pipes: Galvanized Corrugated Steel Pipe Galvanized Corrugated Steel Pipe Arch Bituminous Coated Corrugated Steel Pipe Bituminous Coated Corrugated Steel Pipe Arch Aluminized Steel Type 2 Corrugated Pipe Aluminized Steel Type 2 Corrugated Pipe Arch Precoated Galvanized Corrugated Steel Pipe Precoated Galvanized Corrugated Steel Pipe Arch Corrugated Aluminum Alloy Pipe Corrugated Aluminum Alloy Pipe Arch Polyvinyl Chloride (PVC) Pipe Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior Corrugated Polyethylene (PE) Pipe with a Smooth Interior Polyethylene (PE) Pipe with a Smooth Interior" Corrugated Polypropylene (CPP) Pipe with Smooth Interior

Revise Articles 542.03(b) and (c) of the Standard Specifications to read:

- “(b) Extra strength clay pipe will only be permitted for pipe culverts Type 1, for 10 in., 12 in., 42 in. and 48 in. (250 mm, 300 mm, 1050 mm and 1200 mm), Types 2, up to and including 48 in. (1200 mm), Type 3, up to and including 18 in. (450 mm), Type 4 up to and including 10 in. (250 mm), for all pipe classes.
- (c) Concrete sewer, storm drain, and culvert pipe Class 3 will only be permitted for pipe culverts Type 1, up to and including 10 in (250 mm), Type 2, up to and including 30 in. (750 mm), Type 3, up to and including 15 in. (375 mm); Type 4, up to and including 10 in. (250 mm), for all pipe classes.”

Replace the pipe tables in Article 542.03 of the Standard Specifications with the following:

"Table IA: Classes of Reinforced Concrete Pipe for the Respective Diameters of Pipe and Fill Heights over the Top of the Pipe							
Nominal Diameter in.	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
	Fill Height: 3' and less 1' min cover	Fill Height: Greater than 3' not exceeding 10'	Fill Height: Greater than 10' not exceeding 15'	Fill Height: Greater than 15' not exceeding 20'	Fill Height: Greater than 20' not exceeding 25'	Fill Height: Greater than 25' not exceeding 30'	Fill Height: Greater than 30' not exceeding 35'
12	IV	II	III	IV	IV	V	V
15	IV	II	III	IV	IV	V	V
18	IV	II	III	IV	IV	V	V
21	III	II	III	IV	IV	V	V
24	III	II	III	IV	IV	V	V
30	IV	II	III	IV	IV	V	V
36	III	II	III	IV	IV	V	V
42	II	II	III	IV	IV	V	V
48	II	II	III	IV	IV	V	V
54	II	II	III	IV	IV	V	V
60	II	II	III	IV	IV	V	V
66	II	II	III	IV	IV	V	V
72	II	II	III	IV	V	V	V
78	II	II	III	IV	2020	2370	2730
84	II	II	III	IV	2020	2380	2740
90	II	II	III	1680	2030	2390	2750
96	II	III	III	1690	2040	2400	2750
102	II	III	III	1700	2050	2410	2760
108	II	III	1360	1710	2060	2410	2770

Notes:
A number indicates the D-Load for the diameter and depth of fill and that a special design is required.
Design assumptions; Water filled pipe, Type 2 bedding and Class C Walls

Table IA: Classes of Reinforced Concrete Pipe for the Respective Diameters of Pipe and Fill Heights over the Top of the Pipe (Metric)							
Nominal Diameter mm	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
	Fill Height: 1 m and less 0.3 m min cover	Fill Height: Greater than 1 m not exceeding 3 m	Fill Height: Greater than 3 m not exceeding 4.5 m	Fill Height: Greater than 4.5 m not exceeding 6 m	Fill Height: Greater than 6 m not exceeding 7.5 m	Fill Height: Greater than 7.5 m not exceeding 9 m	Fill Height: Greater than 9 m not exceeding 10.5 m
300	IV	II	III	IV	IV	V	V
375	IV	II	III	IV	IV	V	V
450	IV	II	III	IV	IV	V	V
525	III	II	III	IV	IV	V	V
600	III	II	III	IV	IV	V	V
750	IV	II	III	IV	IV	V	V
900	III	II	III	IV	IV	V	V
1050	II	II	III	IV	IV	V	V
1200	II	II	III	IV	IV	V	V
1350	II	II	III	IV	IV	V	V
1500	II	II	III	IV	IV	V	V
1650	II	II	III	IV	IV	V	V
1800	II	II	III	IV	V	V	V
1950	II	II	III	IV	100	110	130
2100	II	II	III	IV	100	110	130
2250	II	II	III	80	100	110	130
2400	II	III	III	80	100	110	130
2550	II	III	III	80	100	120	130
2700	II	III	70	80	100	120	130

Notes:

A number indicates the D-Load for the diameter and depth of fill and that a special design is required.

Design assumptions; Water filled pipe, Type 2 bedding and Class C Walls

TABLE IB: THICKNESS OF CORRUGATED STEEL PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 2 2/3"x1/2", 3"x1" AND 5"x1" CORRUGATIONS

Nominal Diameter in.*	Type 1			Type 2			Type 3			Type 4			Type 5			Type 6			Type 7		
	Fill Height:			Fill Height:			Fill Height:			Fill Height:			Fill Height:			Fill Height:			Fill Height:		
	3' and less 1' min. cover			Greater than 3' not exceeding 10'			Greater than 10' not exceeding 15'			Greater than 15' not exceeding 20'			Greater than 20' not exceeding 25'			Greater than 25' not exceeding 30'			Greater than 30' not exceeding 35'		
	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"	2 2/3" x 1/2"	3"x1"	5"x1"
12	0.064			0.064			0.064			0.064			0.064			0.064			0.064		
15	0.064			0.064			0.064			0.064			0.064			0.064			0.064		
18	(0.079)			0.064			0.064			0.064			0.064			(0.079)			(0.079)		
21	(0.079)			0.064			0.064			0.064			(0.079)			(0.079)			(0.079)		
24	(0.079)			0.064			0.064			0.064			(0.079)			(0.079)			(0.079)		
30	(0.109E)			0.064			0.064			0.064			(0.079)			(0.109)			(0.109)		
36	(0.109E)			0.064			(0.079)			(0.079)			(0.109)			0.109			(0.138E)		
42	0.079			0.064			(0.079)			(0.079)			(0.109)			(0.109E)			(0.109E)		
48	0.109	(0.109)	0.109	(0.109)	0.079	0.079	(0.109)	0.079	(0.109)	0.109	(0.109)	0.109	(0.138)	(0.109)	0.109	(0.138E)	0.109	0.109	(0.138E)	0.109	(0.138)
54	0.109	(0.109)	0.109	(0.109)	0.079	0.079	0.109	(0.109)	0.109	0.109	(0.109)	0.109	(0.138)	0.109	0.109	(0.138E)	0.109	(0.138)	(0.138E)	0.138	0.138
60	0.109	0.109	0.109	0.109	0.079	(0.109)	0.109	(0.109)	0.109	0.109	(0.109)	0.109	(0.138)	0.109	0.109	(0.138E)	(0.138)	(0.138)	0.138E	(0.138E)	(0.138E)
66	(0.138)	0.109	0.109	0.109	0.079	(0.109)	0.109	(0.109)	0.109	0.109	(0.109)	0.109	(0.138)	0.109	(0.138)	(0.138E)	0.138	0.138	0.138E	(0.138E)	0.138E
72	0.138	0.109	(0.138)	0.138	(0.109)	(0.109)	0.138	(0.109)	0.109	0.138	0.109	0.109	0.138	(0.138)	(0.138)	(0.168E)	(0.138E)	0.138E	(0.168E)	(0.138E)	0.138E
78	0.168	0.109	(0.138)	0.168	(0.109)	0.109	0.168	0.109	0.109	0.168	0.109	(0.138)	0.168	(0.138)	(0.138)	H0.168E	(0.138E)	0.138E	H0.168E	0.138E	(0.168E)
84	0.168	(0.138)	(0.138)	0.168	(0.109)	0.109	0.168	0.109	0.109	0.168	0.109	(0.138)	0.168	(0.138)	0.138	H0.168E	(0.138E)	0.138E	H0.168E	(0.168E)	(0.168E)
90		(0.138)	(0.138)		(0.109)	0.109		0.109	0.109		(0.138)	(0.138)		(0.138)	0.138		0.138E	(0.168E)		(0.168E)	(0.168E)
96		(0.138)	(0.138)		(0.109)	0.109		0.109	0.109		(0.138)	(0.138)		(0.138)	0.138		(0.168E)	(0.168E)		(0.168E)	(0.168E)
102		0.109Z	0.109Z		(0.109)	0.109		0.109	(0.138)		(0.138)	(0.138)		(0.138)	0.138		(0.168E)	(0.168E)		H0.138E	H0.168E
108		0.109Z	(0.138Z)		0.109	0.109		0.109	(0.138)		(0.138)	0.138		0.138	(0.168)		(0.168E)	(0.168E)		H0.138E	H0.168E
114		0.109Z	(0.138Z)		0.109	0.109		0.109	(0.138)		(0.138)	0.138		(0.168)	(0.168)		(0.168E)	0.168E		H0.138E	H0.168E
120		0.109Z	(0.138Z)		0.109	0.109		0.109	(0.138)	(0.138)		0.138		(0.168)	(0.168)		H0.138E	H0.168E		H0.168E	H0.168E
126		0.138Z	0.138Z		0.138	0.138		0.138	0.138		0.138	(0.168)		(0.168)	(0.168)		H0.138E	H0.168E		H0.168E	H0.168E
132		0.138Z	0.138Z		0.138	0.138		0.138	0.138		(0.168)	(0.168)		0.168	0.168		H0.138E	H0.168E		H0.168E	H0.168E
138		0.138Z	0.138Z		0.138	0.138		0.138	0.138		(0.168)	(0.168)		(0.168E)	H0.168E		H0.168E	H0.168E		H0.168E	H0.168E
144		0.168Z	0.168Z		0.168	0.168		0.168	0.168		0.168	0.168		H0.168E	H0.168E		H0.168E	H0.168E		H0.168E	H0.168E

Notes:

- * Aluminized Type 2 Steel or Precoated Galvanized Steel shall be required for diameters up to 42" according to Article 1006.01, 1 1/2" x 1/4" corrugations shall be used for diameters less than 12".
- Thicknesses are based on longitudinal riveted seam fabrication, values in "()" can be reduced by one gage thickness if helical seam fabrication is utilized.
- A thickness preceded by "H" indicates only helical seam fabrication is allowed.
- E Elongation according to Article 542.04(e)
- Z 1'-6" Minimum fill

TABLE IB: THICKNESS OF CORRUGATED STEEL PIPE
FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 68 mm x 13 mm, 75 mm x 25 mm AND 125 mm x 25 mm CORRUGATIONS
(Metric)

Nominal Diameter mm *	Type 1 Fill Height:			Type 2 Fill Height:			Type 3 Fill Height:			Type 4 Fill Height:			Type 5 Fill Height:			Type 6 Fill Height:			Type 7 Fill Height:		
	1 m and less 0.3 m min. cover			Greater than 1 m not exceeding 3 m			Greater than 3 m not exceeding 4.5 m			Greater than 4.5 m not exceeding 6 m			Greater than 6 m not exceeding 7.5 m			Greater than 7.5 m not exceeding 9 m			Greater than 9 m not exceeding 10.5 m		
	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm
300	1.63			1.63			1.63			1.63			1.63			1.63			1.63		
375	1.63			1.63			1.63			1.63			1.63			1.63			(2.01)		
450	(2.01)			1.63			1.63			1.63			1.63			(2.01)			(2.01)		
525	(2.01)			1.63			1.63			1.63			(2.01)			(2.01)			(2.01)		
600	(2.01)			1.63			1.63			1.63			(2.01)			(2.01)			(2.01)		
750	(2.77E)			1.63			1.63			(2.01)			(2.01)			(2.77)			(2.77)		
900	(2.77E)			1.63			(2.01)			(2.01)			(2.77)			2.77			(3.51E)		
1050	2.01			1.63			(2.01)			(2.01)			(2.77)			(2.77E)			(2.77E)		
1200	2.77	(2.77)	2.77	(2.77)	2.01	2.01	(2.77)	2.01	(2.77)	2.77	(2.77)	2.77	(3.51)	(2.77)	2.77	(3.51E)	2.77	2.77	(3.51E)	2.77	(3.51)
1350	2.77	(2.77)	2.77	(2.77)	2.01	2.01	2.77	(2.77)	2.77	2.77	(2.77)	2.77	(3.51)	2.77	2.77	(3.51E)	2.77	(3.51)	(3.51E)	3.51	3.51
1500	2.77	2.77	2.77	2.77	2.01	(2.77)	2.77	(2.77)	2.77	2.77	(2.77)	2.77	(3.51)	2.77	2.77	(3.51E)	(3.51)	(3.51)	(3.51E)	(3.51E)	(3.51E)
1650	(3.51)	2.77	2.77	2.77	2.01	(2.77)	2.77	(2.77)	2.77	2.77	2.77	2.77	(3.51)	2.77	(3.51)	(3.51E)	3.51	3.51	(3.51E)	(3.51E)	(3.51E)
1800	3.51	2.77	(3.51)	3.51	(2.77)	(2.77)	3.51	(2.77)	2.77	3.51	2.77	2.77	3.51	(3.51)	(3.51)	(4.27E)	(3.51E)	3.51E	(4.27E)	(3.51E)	3.51E
1950	4.27	2.77	(3.51)	4.27	(2.77)	2.77	4.27	2.77	2.77	4.27	2.77	(3.51)	4.27	(3.51)	(3.51)	H 4.27E	(3.51E)	3.51E	H 4.27E	3.51E	(4.27E)
2100	4.27	(3.51)	(3.51)	4.27	(2.77)	2.77	4.27	2.77	2.77	4.27	2.77	(3.51)	4.27	(3.51)	3.51	H 4.27E	(3.51E)	3.51E	H 4.27E	(4.27E)	(4.27E)
2250		(3.51)	(3.51)		(2.77)	2.77		2.77	2.77		(3.51)	(3.51)		(3.51)	3.51		3.51E	(4.27E)		(4.27E)	(4.27E)
2400		(3.51)	(3.51)		(2.77)	2.77		2.77	2.77		(3.51)	(3.51)		(3.51)	3.51		(4.27E)	(4.27E)		(4.27E)	(4.27E)
2550		2.77Z	2.77Z		(2.77)	2.77		2.77	(3.51)		(3.51)	(3.51)		(3.51)	3.51		(4.27E)	(4.27E)		H 3.51E	H 4.27E
2700		2.77Z	(3.51Z)		2.77	2.77		2.77	(3.51)		(3.51)	3.51		3.51	(4.27)		(4.27E)	(4.27E)		H 3.51E	H 4.27E
2850		2.77Z	(3.51Z)		2.77	2.77		2.77	(3.51)		(3.51)	3.51		(4.27)	(4.27)		(4.27E)	4.27E		H 3.51E	H 4.27E
3000		2.77Z	(3.51Z)		2.77	2.77		2.77	(3.51)		(3.51)	3.51		(4.27)	(4.27)		H 3.51E	H 4.27E		H 4.27E	H 4.27E
3150		3.51Z	3.51Z		3.51	3.51		3.51	3.51		3.51	(4.27)		(4.27)	(4.27)		H 3.51E	H 4.27E		H 4.27E	H 4.27E
3300		3.51Z	3.51Z		3.51	3.51		3.51	3.51		(4.27)	(4.27)		4.27	4.27		H 3.51E	H 4.27E		H 4.27E	H 4.27E
3450		3.51Z	3.51Z		3.51	3.51		3.51	3.51		(4.27)	(4.27)		(4.27E)	H 4.27E		H 4.27E	H 4.27E		H 4.27E	
3600		4.27Z	4.27Z		4.27	4.27		4.27	4.27		4.27	4.27		H 4.27E	H 4.27E		H 4.27E	H 4.27E		H 4.27E	

Notes:

* Aluminized Type 2 Steel or Precoated Galvanized Steel shall be required for diameters up to 1050 mm according to Article 1006.01, 38 mm x 6.5 mm corrugations shall be used for diameters less than 300 mm.

Thicknesses are based on longitudinal riveted seam fabrication, values in "()" can be reduced by one gage thickness if helical seam fabrication is utilized.

A thickness preceded by an "H" indicates only helical seam fabrication is allowed.

E Elongation according to Article 542.04(e)

Z 450 mm Minimum Fill

TABLE IC: THICKNESS OF CORRUGATED ALUMINUM ALLOY PIPE FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 2 2/3"x1/2" AND 3"x1" CORRUGATIONS														
Nominal Diameter in.	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7	
	Fill Height: 3' and less 1' min. cover		Fill Height: Greater than 3' not exceeding 10'		Fill Height: Greater than 10' not exceeding 15'		Fill Height: Greater than 15' not exceeding 20'		Fill Height: Greater than 20' not exceeding 25'		Fill Height: Greater than 25' not exceeding 30'		Fill Height: Greater than 30' not exceeding 35'	
	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"	2 2/3"x1/2"	3"x1"
12	(0.075)		0.060		0.060		0.060		0.060		0.060		0.060	
15	(0.075)		0.060		0.060		0.060		0.060		0.060		0.060	
18	(0.075)		0.060		0.060		0.060		0.060		0.060		0.060	
21	H 0.060E		0.060		0.060		0.060		(0.075)		H 0.060		H 0.060E	
24	(0.105E)		0.060		0.060		(0.075)		(0.105)		(0.105)		(0.105E)	
30	H 0.075E	H 0.060	0.075	H 0.060	0.075	H 0.060	(0.105)	H 0.060	(0.105)	H 0.060	H 0.075E	H 0.060	H 0.075E	H 0.060
36	(0.135E)	H 0.060E	0.075	H 0.060	(0.105)	H 0.060	(0.105)	H 0.060	(0.135)	H 0.060	H 0.075E	H 0.060	H 0.075E	H 0.060E
42	0.105E	(0.075)	0.105	0.060	0.105	0.060	0.105	0.060	0.105	(0.075)	0.105E	0.105	0.105E	(0.105E)
48	0.105E	(0.075)	0.105	0.060	0.105	0.060	0.105	(0.075)	0.105	(0.105)	0.105E	(0.105E)	0.105E	(0.135E)
54	0.105E	(0.105)	0.105	0.060	0.105	0.060	0.105	(0.075)	0.105	(0.105)	0.105E	(0.105E)	(0.135E)	(0.135E)
60	0.135E	(0.105)	0.135	0.060	0.135	(0.075)	0.135	(0.105)	0.135	(0.105)	0.135E	(0.135E)	(0.164E)	(0.135E)
66	0.164E	(0.105)	0.164	0.060	0.164	(0.075)	0.164	(0.105)	0.164	(0.135)	0.164E	(0.135E)	H 0.164E	(0.135E)
72	0.164E	(0.105)	0.164	0.060	0.164	(0.075)	0.164	(0.105)	0.164	(0.135)	H 0.164E	(0.135E)	H 0.164E	(0.164E)
78		(0.135)		0.075		(0.105)		(0.105)		(0.135)		(0.135E)		(0.164E)
84		(0.135)		0.105		0.105		(0.135)		(0.135)		(0.164E)		(0.164E)
90		(0.135)		0.105		0.105		(0.135)		(0.135)		(0.164E)		(0.164E)
96		(0.135)		0.105		0.105		(0.135)		(0.135)		(0.164E)		H 0.135E
102		0.135Z		0.135		0.135		0.135		(0.164)		(0.164E)		H 0.135E
108		0.135Z		0.135		0.135		0.135		(0.164)		(0.164E)		H 0.164E
114		0.164Z		0.164		0.164		0.164		0.164		H 0.164E		H 0.164E
120		0.164Z		0.164		0.164		0.164		0.164		H 0.164E		H 0.164E

Notes:

Thicknesses are based on longitudinal riveted seam fabrication, values in "()" can be reduced by one gage thickness if helical seam fabrication is utilized.

A thickness preceded by an "H" indicates only helical seam fabrication is allowed.

E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 1'-6"

Z 1"-6" Minimum fill

TABLE IC: THICKNESS OF CORRUGATED ALUMINUM ALLOY PIPE FOR THE RESPECTIVE DIAMETER OF PIPE AND FILL HEIGHTS OVER THE TOP OF THE PIPE FOR 68 mm x 13 mm AND 75 mm x 25 mm CORRUGATIONS (Metric)														
Nominal Diameter mm	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7	
	Fill Height: 1 m and less 0.3 m min. cover		Fill Height: Greater than 1 m not exceeding 3 m		Fill Height: Greater than 3 m not exceeding 4.5 m		Fill Height: Greater than 4.5 m not exceeding 6 m		Fill Height: Greater than 6 m not exceeding 7.5 m		Fill Height: Greater than 7.5 m not exceeding 9 m		Fill Height: Greater than 9 m not exceeding 10.5 m	
	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm
300	(1.91)		1.52		1.52		1.52		1.52		1.52		1.52	
375	(1.91)		1.52		1.52		1.52		1.52		1.52		(1.91)	
450	(1.91)		1.52		1.52		1.52		1.52		(1.91)		H 1.52	
525	H 1.52E		1.52		1.52		1.52		(1.91)		H 1.52		H 1.52E	
600	(2.67E)		1.52		1.52		(1.91)		(2.67)		(2.67)		(2.67E)	
750	H 1.91E	H 1.52	1.91	H 1.52	1.91	H 1.52	(2.67)	H 1.52	(2.67)	H 1.52	H 1.91E	H 1.52	H 1.91E	H 1.52
900	(3.43E)	H 1.52E	1.91	H 1.52	(2.67)	H 1.52	(2.67)	H 1.52	(3.43)	H 1.52	H 1.91E	H 1.52	H 1.91E	H 1.52E
1050	2.67E	(1.91)	2.67	1.52	2.67	1.52	2.67	1.52	2.67	(1.91)	2.67E	2.67	2.67E	(2.67E)
1200	2.67E	(1.91)	2.67	1.52	2.67	1.52	2.67	(1.91)	2.67	(2.67)	2.67E	(2.67E)	2.67E	(3.43E)
1350	2.67E	(2.67)	2.67	1.52	2.67	1.52	2.67	(1.91)	2.67	(2.67)	2.67E	(2.67E)	(3.43E)	(3.43E)
1500	3.43E	(2.67)	3.43	1.52	3.43	(1.91)	3.43	(2.67)	3.43	(2.67)	3.43E	(3.43E)	(4.17E)	(3.43E)
1650	4.17E	(2.67)	4.17	1.52	4.17	(1.91)	4.17	(2.67)	4.17	(3.43)	4.17E	(3.43E)	H 4.17E	(3.43E)
1800	4.17E	(2.67)	4.17	1.52	4.17	(1.91)	4.17	(2.67)	4.17	(3.43)	H 4.17E	(3.43E)	H 4.17E	(4.17E)
1950		(3.43)		1.91		(2.67)		(2.67)		(3.43)		(3.43E)		(4.17E)
2100		(3.43)		2.67		2.67		(3.43)		(3.43)		(4.17E)		(4.17E)
2250		(3.43)		2.67		2.67		(3.43)		(3.43)		(4.17E)		(4.17E)
2400		(3.43)		2.67		2.67		(3.43)		(3.43)		(4.17E)		H 3.43E
2550		3.43Z		3.43		3.43		3.43		(4.17)		(4.17E)		H 3.43E
2700		3.43Z		3.43		3.43		3.43		(4.17)		(4.17E)		H 4.17E
2850		4.17Z		4.17		4.17		4.17		4.17		H 4.17E		H 4.17E
3000		4.17Z		4.17		4.17		4.17		4.17		H 4.17E		H 4.17E

Notes:

Thicknesses are based on longitudinal riveted seam fabrication, values in "()" can be reduced by one gage thickness if helical seam fabrication is utilized.

A thickness preceded by an "H" indicates only helical seam fabrication is allowed.

E Elongation according to Article 542.04(e), the elongation requirement for Type 1 fill heights may be eliminated for fills above 450 mm.

Z 450 mm Minimum fill

Table IIA: THICKNESS FOR CORRUGATED STEEL PIPE ARCHES AND CORRUGATED ALUMINUM ALLOY PIPE ARCHES FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE																									
Equivalent Round Size in.	Corrugated Steel & Aluminum Pipe Arch 2 2/3" x 1/2"		Corrugated Steel & Aluminum Pipe Arch 3" x 1"		Corrugated Steel Pipe Arch 5" x 1"		Min. Cover	Type 1						Type 2				Type 3							
	Span Rise (in.)*		Span Rise (in.)		Span Rise (in.)			Steel & Aluminum	Fill Height: 3' and less			Fill Height: Greater than 3' not exceeding 10'			Fill Height: Greater than 10' not exceeding 15'										
	Span (in.)	Rise (in.)	Span (in.)	Rise (in.)	Span (in.)	Rise (in.)	Steel			Aluminum		Steel			Aluminum		Steel			Aluminum					
							2 2/3" x 1/2"	3"x1"	5" x 1"	2 2/3" x 1/2"	3"x1"	2 2/3" x 1/2"	3"x1"	5" x 1"	2 2/3" x 1/2"	3"x1"	2 2/3" x 1/2"	3"x1"	5" x 1"	2 2/3" x 1/2"	3"x1"	5" x 1"	2 2/3" x 1/2"	3"x1"	
15	17	13					1'-6"	0.064			0.060			0.064			0.060			0.064			0.060		
18	21	15					1'-6"	0.064			0.060			0.064			0.060			0.064			0.060		
21	24	18					1'-6"	0.064			(0.075)			0.064			0.060			0.064			0.060		
24	28	20					1'-6"	(0.079)			(0.105)			0.064			0.075			0.064			0.075		
30	35	24					1'-6"	(0.079)			(0.105)			0.064			0.075			(0.079)			(0.105)		
36	42	29					1'-6"	(0.079)			0.105			0.064			0.105			0.064			0.105		
42	49	33					1'-6"	0.109			0.105			(0.109)			0.105			(0.109)			0.105		
48	57	38	53	41	53	41	1'-6"	0.109	(0.109)	(0.109)	0.135	0.060	0.109	0.079	0.079	0.135	0.060	0.109	0.079	(0.109)	0.135	0.060	0.109	0.079	(0.109)
54	64	43	60	46	60	46	1'-6"	0.109	(0.109)	0.109	0.164	(0.075)	0.109	0.079	0.079	0.164	0.060	0.109	(0.109)	0.109	0.164	(0.075)	0.109	0.079	(0.109)
60	71	47	66	51	66	51	1'-6"	0.138	(0.109)	0.109	0.164	(0.075)	0.138	0.079	(0.109)	0.164	0.060	0.138	(0.109)	0.109	0.164	(0.075)	0.138	0.079	(0.109)
66	77	52	73	55	73	55	1'-6"	0.168	(0.109)	0.109		0.075	0.168	0.079	(0.109)		0.075	0.168	(0.109)	0.109		0.075	0.168	0.079	(0.109)
72	83	57	81	59	81	59	1'-6"	0.168	(0.109)	0.109		0.105	0.168	0.079	(0.109)		0.105	0.168	(0.109)	0.109		0.105	0.168	0.079	(0.109)
78			87	63	87	63	1'-6"		0.109	0.109		0.105		(0.109)	0.109		0.105		0.109	0.109		0.105		0.109	0.109
84			95	67	95	67	1'-6"		0.109	0.109		0.105		(0.109)	0.109		0.105		0.109	0.109		0.105		0.109	0.109
90			103	71	103	71	1'-6"		0.109	0.109		0.135		(0.109)	0.109		0.135		0.109	0.109		0.135		0.109	0.109
96			112	75	112	75	1'-6"		0.109	(0.138)		0.164		0.109	0.109		0.164		0.109	(0.138)		0.164		0.109	(0.138)
102			117	79	117	79	1'-6"		0.109	(0.138)		0.164		0.109	0.109		0.164		0.109	(0.138)		0.164		0.109	(0.138)
108			128	83	128	83	1'-6"		0.138	0.138				0.138	0.138				0.138	0.138				0.138	0.138
114			137	87	137	87	1'-6"		0.138	0.138				0.138	0.138				0.138	0.138				0.138	0.138
120			142	91	142	91	1'-6"		0.168	0.168				0.168	0.168				0.168	0.168				0.168	0.168

Notes:

* Aluminized Type 2 Steel or Precoated Galvanized Steel shall be required for steel spans up to 42" according to Article 1006.01.
Thicknesses are based on longitudinal riveted seam fabrication, values in "(" can be reduced by one gage thickness if helical seam fabrication is utilized.
The Type 1 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 3 tons per square foot.
The Type 2 and 3 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 2 tons per square foot.
This minimum bearing capacity will be determined by the Engineer in the field.

Table IIA: THICKNESS FOR CORRUGATED STEEL PIPE ARCHES AND CORRUGATED ALUMINUM ALLOY PIPE ARCHES FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE (Metric)

Equivalent Round Size (mm)	Corrugated Steel & Aluminum Pipe Arch 68 x 13 mm		Corrugated Steel & Aluminum Pipe Arch 75 x 25 mm		Corrugated Steel Pipe Arch 125 x 25 mm		Min. Cover	Type 1						Type 2						Type 3					
								Fill Height:						Fill Height:						Fill Height:					
								1 m and less						Greater than 1 m not exceeding 3 m						Greater than 3 m not exceeding 4.5 m					
	Span (mm)*	Rise (mm)	Span (mm)	Rise (mm)	Span (mm)	Rise (mm)		Steel			Aluminum			Steel			Aluminum			Steel			Aluminum		
68 x 13 mm							75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm	125 x 25 mm	68 x 13 mm	75 x 25 mm		
375	430	330				0.5 m	1.63			1.52			1.63			1.52			1.63			1.52			
450	530	380				0.5 m	1.63			1.52			1.63			1.52			1.63			1.52			
525	610	460				0.5 m	1.63			(1.91)			1.63			1.52			1.63			1.52			
600	710	510				0.5 m	(2.01)			(2.67)			1.63			1.91			1.63			1.91			
750	870	630				0.5 m	(2.01)			(2.67)			1.63			1.91			(2.01)			(2.67)			
900	1060	740				0.5 m	(2.01)			2.67			1.63			2.67			1.63			2.67			
1050	1240	840				0.5 m	2.77			2.67		(2.77)			2.67			(2.77)			2.67				
1200	1440	970	1340	1050	1340	1050	0.5 m	2.77	(2.77)	(2.77)	3.43	1.52	2.77	2.01	2.01	3.43	1.52	2.77	2.01	(2.77)	3.43	1.52			
1350	1620	1100	1520	1170	1520	1170	0.5 m	2.77	(2.77)	2.77	4.17	(1.91)	2.77	2.01	2.01	4.17	1.52	2.77	(2.77)	2.77	4.17	(1.91)			
1500	1800	1200	1670	1300	1670	1300	0.5 m	3.51	(2.77)	2.77	4.17	(1.91)	3.51	2.01	(2.77)	4.17	1.52	3.51	(2.77)	2.77	4.17	(1.91)			
1650	1950	1320	1850	1400	1850	1400	0.5 m	4.27	(2.77)	2.77		1.91	4.27	2.01	(2.77)		1.91	4.27	(2.77)	2.77		1.91			
1800	2100	1450	2050	1500	2050	1500	0.5 m	4.27	(2.77)	2.77		2.67	4.27	2.01	(2.77)		2.67	4.27	(2.77)	2.77		2.67			
1950			2200	1620	2200	1620	0.5 m		2.77	2.77		2.67		(2.77)	2.77		2.67		2.77	2.77		2.67			
2100			2400	1720	2400	1720	0.5 m		2.77	2.77		2.67		(2.77)	2.77		2.67		2.77	2.77		2.67			
2250			2600	1820	2600	1820	0.5 m		2.77	2.77		3.43		(2.77)	2.77		3.43		2.77	2.77		3.43			
2400			2840	1920	2840	1920	0.5 m		2.77	(3.51)		4.17		2.77	2.77		4.17		2.77	(3.51)		4.17			
2550			2970	2020	2970	2020	0.5 m		2.77	(3.51)		4.17		2.77	2.77		4.17		2.77	(3.51)		4.17			
2700			3240	2120	3240	2120	0.5 m		3.51	3.51				3.51	3.51				3.51	3.51					
2850			3470	2220	3470	2220	0.5 m		3.51	3.51				3.51	3.51				3.51	3.51					
3000			3600	2320	3600	2320	0.5 m		4.27	4.27				4.27	4.27				4.27	4.27					

Notes:

- * Aluminized Type 2 Steel or Precoated Galvanized Steel shall be required for steel spans up to 1060 mm according to Article 1006.01.
- Thicknesses are based on longitudinal riveted seam fabrication, values in "()" can be reduced by one gage thickness if helical seam fabrication is utilized.
- The Type 1 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 290 kN per square meter.
- The Type 2 and 3 corrugated steel or aluminum pipe arches shall be placed on soil having a minimum bearing capacity of 192 kN per square meter.
- This minimum bearing capacity will be determined by the Engineer in the field.

Table IIB: CLASSES OF REINFORCED CONCRETE ELLIPTICAL AND REINFORCED CONCRETE ARCH PIPE FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE											
Equivalent Round Size (in.)	Reinforced Concrete Elliptical pipe (in.)		Reinforced Concrete Arch pipe (in.)		Minimum Cover RCCP HE & A	Type 1		Type 2		Type 3	
	Span	Rise	Span	Rise		Fill Height: 3' and less		Fill Height: Greater than 3' not exceeding 10'		Fill Height: Greater than 10' not exceeding 15'	
					HE	Arch	HE	Arch	HE	Arch	
15	23	14	18	11	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
18	23	14	22	13 1/2	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
21	30	19	26	15 1/2	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
24	30	19	28 1/2	18	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
27	34	22	36 1/4	22 1/2	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
30	38	24	36 1/4	22 1/2	1' -0"	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
36	45	29	43 3/4	26 5/8	1' -0"	HE-II	A-II	HE-III	A-III	HE-IV	A-IV
42	53	34	51 1/8	31 5/16	1' -0"	HE-I	A-II	HE-III	A-III	HE-IV	A-IV
48	60	38	58 1/2	36	1' -0"	HE-I	A-II	HE-III	A-III	1460	1450
54	68	43	65	40	1' -0"	HE-I	A-II	HE-III	A-III	1460	1460
60	76	48	73	45	1' -0"	HE-I	A-II	HE-III	A-III	1460	1470
66	83	53	88	54	1' -0"	HE-I	A-II	HE-III	A-III	1470	1480
72	91	58	88	54	1' -0"	HE-I	A-II	HE-III	A-III	1470	1480

Notes:

A number indicates the D-Load for the diameter and depth of fill and that a special design is required.

Design assumptions; Water filled pipe, AASHTO Type 2 installation per AASHTO LRFD Table 12.10.2.1-1

Table IIB: CLASSES OF REINFORCED CONCRETE ELLIPTICAL AND REINFORCED CONCRETE ARCH PIPE FOR THE RESPECTIVE EQUIVALENT ROUND SIZE OF PIPE AND FILL HEIGHTS OVER THE TOP OF PIPE (Metric)

Equivalent Round Size (mm)	Reinforced Concrete Elliptical pipe (mm)		Reinforced Concrete Arch pipe (mm)		Minimum Cover RCCP HE & A	Type 1 Fill Height: 1 m and less		Type 2 Fill Height: Greater than 1 m not exceeding 3 m		Type 3 Fill Height: Greater than 3 m not exceeding 4.5 m	
	Span	Rise	Span	Rise		HE	Arch	HE	Arch	HE	Arch
	375	584	356	457	279	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV
450	584	356	559	343	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
525	762	483	660	394	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
600	762	483	724	457	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
686	864	559	921	572	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
750	965	610	921	572	0.3 m	HE-III	A-III	HE-III	A-III	HE-IV	A-IV
900	1143	737	1111	676	0.3 m	HE-II	A-II	HE-III	A-III	HE-IV	A-IV
1050	1346	864	1299	795	0.3 m	HE-I	A-II	HE-III	A-III	HE-IV	A-IV
1200	1524	965	1486	914	0.3 m	HE-I	A-II	HE-III	A-III	70	70
1350	1727	1092	1651	1016	0.3 m	HE-I	A-II	HE-III	A-III	70	70
1500	1930	1219	1854	1143	0.3 m	HE-I	A-II	HE-III	A-III	70	70
1676	2108	1346	2235	1372	0.3 m	HE-I	A-II	HE-III	A-III	70	70
1800	2311	1473	2235	1372	0.3 m	HE-I	A-II	HE-III	A-III	70	70

Notes:

A number indicates the D-Load for the diameter and depth of fill and that a special design is required.

Design assumptions; Water filled pipe, AASHTO Type 2 installation per AASHTO LRFD Table 12.10.2.1-1

TABLE IIIA: PLASTIC PIPE PERMITTED
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE

Nominal Diameter (in.)	Type 1 Fill Height: 3' and less, with 1' min					Type 2 Fill Height: Greater than 3', not exceeding 10'					Type 3 Fill Height: Greater than 10', not exceeding 15'					Type 4 Fill Height: Greater than 15', not exceeding 20'			
	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPP
	10	X	X	X	X	NA	X	X	X	X	NA	X	X	X	X	NA	X	X	X
12	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
15	X	X	NA	X	X	X	X	NA	X	X	X	X	NA	NA	X	X	X	NA	X
18	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
21	X	X	NA	NA	NA	X	X	NA	NA	NA	X	X	NA	NA	NA	X	X	NA	NA
24	X	X	X	X	X	X	X	X	X	X	X	X	NA	NA	NA	X	X	X	NA
30	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
36	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	NA	X	X	X	NA
42	X	NA	X	X	NA	X	NA	X	NA	NA	X	NA	X	NA	NA	X	NA	X	NA
48	X	NA	X	X	X	X	NA	X	NA	NA	X	NA	X	NA	NA	X	NA	X	NA

Notes:

- PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
- CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
- PE Polyethylene (PE) pipe with a smooth interior
- CPE Corrugated Polyethylene (PE) pipe with a smooth interior
- CPP Corrugated Polypropylene (CPP) pipe with a smooth interior
- X This material may be used for the given pipe diameter and fill height
- NA Not Available

TABLE IIIA: PLASTIC PIPE PERMITTED
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE
(Metric)

Nominal Diameter (mm)	Type 1					Type 2					Type 3					Type 4			
	Fill Height: 1 m and less, with 0.3 m min. cover					Fill Height: Greater than 1 m, not exceeding 3 m					Fill Height: Greater than 3 m, not exceeding 4.5 m					Fill Height: Greater than 4.5 m, not exceeding 6 m			
	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPE	CPP	PVC	CPVC	PE	CPP
250	X	X	X	X	NA	X	X	X	X	NA	X	X	X	X	NA	X	X	X	NA
300	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
375	X	X	NA	X	X	X	X	NA	X	X	X	X	NA	NA	X	X	X	NA	X
450	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
525	X	X	NA	NA	NA	X	X	NA	NA	NA	X	X	NA	NA	NA	X	X	NA	NA
600	X	X	X	X	X	X	X	X	X	X	X	X	NA	NA	NA	X	X	X	NA
750	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	X	X	X	X	NA
900	X	X	X	X	X	X	X	X	X	X	X	X	X	NA	NA	X	X	X	NA
1000	X	NA	X	X	NA	X	NA	X	NA	NA	X	NA	X	NA	NA	X	NA	X	NA
1200	X	NA	X	X	X	X	NA	X	NA	NA	X	NA	X	NA	NA	X	NA	X	NA

Notes:

- PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
- CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
- PE Polyethylene (PE) pipe with a smooth interior
- CPE Corrugated Polyethylene (PE) pipe with a smooth interior
- CPP Corrugated Polypropylene (CPP) pipe with a smooth interior
- X This material may be used for the given pipe diameter and fill height
- NA Not Available

TABLE IIIB: PLASTIC PIPE PERMITTED								
FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE								
Nominal Diameter (in.)	Type 5			Type 6			Type 7	
	Fill Height: Greater than 20', not exceeding 25'			Fill Height: Greater than 25', not exceeding 30'			Fill Height: Greater than 30', not exceeding 35'	
	PVC	CPVC		PVC	CPVC		CPVC	
10	X	X		X	X		X	
12	X	X		X	X		X	
15	X	X		X	X		X	
18	X	X		X	X		X	
21	X	X		X	X		X	
24	X	X		X	X		X	
30	X	X		X	X		X	
36	X	X		X	X		X	
42	X	NA		X	NA		NA	
48	X	NA		X	NA		NA	

Notes:

- PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
- CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
- X This material may be used for the given pipe diameter and fill height
- NA Not Available

TABLE IIIB: PLASTIC PIPE PERMITTED FOR A GIVEN PIPE DIAMETER AND FILL HEIGHT OVER THE TOP OF THE PIPE (metric)								
Nominal Diameter (mm)	Type 5			Type 6			Type 7	
	Fill Height: Greater than 6 m, not exceeding 7.5 m			Fill Height: Greater than 7.5 m, not exceeding 9 m			Fill Height: Greater than 9 m, not exceeding 10.5 m	
	PVC	CPVC		PVC	CPVC		CPVC	
250	X	X		X	X		X	
300	X	X		X	X		X	
375	X	X		X	X		X	
450	X	X		X	X		X	
525	X	X		X	X		X	
600	X	X		X	X		X	
750	X	X		X	X		X	
900	X	X		X	X		X	
1000	X	NA		X	NA		NA	
1200	X	NA		X	NA		NA	

Notes:

- PVC Polyvinyl Chloride (PVC) pipe with a smooth interior
- CPVC Corrugated Polyvinyl Chloride (CPVC) pipe with a smooth interior
- PE Polyethylene (PE) pipe with a smooth interior
- X This material may be used for the given pipe diameter and fill height
- NA Not Available"

Revise the first sentence of the first paragraph of Article 542.04(c) of the Standard Specifications to read:

“Compacted aggregate, at least 4 in. (100 mm) in depth below the pipe culvert, shall be placed the entire width of the trench and for the length of the pipe culvert, except compacted impervious material shall be used for the outer 3 ft (1 m) at each end of the pipe culvert.”

Revise the seventh paragraph of Article 542.04(d) of the Standard Specifications to read:

“PVC, PE and CPP pipes shall be joined according to the manufacturer’s specifications.”

Replace the third sentence of the first paragraph of Article 542.04(h) of the Standard Specifications with the following:

“The total cover required for various construction loadings shall be the responsibility of the Contractor.”

Delete “Table IV : Wheel Loads and Total Cover” in Article 542.04(h) of the Standard Specifications.

Revise the first and second paragraphs of Article 542.04(i) of the Standard Specifications to read:

“(i) Deflection Testing for Pipe Culverts. All PE, PVC and CPP pipe culverts shall be tested for deflection not less than 30 days after the pipe is installed and the backfill compacted. The testing shall be performed in the presence of the Engineer.

For PVC, PE, and CPP pipe culverts with diameters 24 in. (600 mm) or smaller, a mandrel drag shall be used for deflection testing. For PVC, PE, and CPP pipe culverts with diameters over 24 in. (600 mm), deflection measurements other than by a mandrel shall be used.”

Revise Articles 542.04(i)(1) and (2) of the Standard Specifications to read:

“(1) For all PVC pipe: as defined using ASTM D 3034 methodology.

(2) For all PE and CPP pipe: the average inside diameter based on the minimum and maximum tolerances specified in the corresponding ASTM or AASHTO material specifications.”

Revise the second sentence of the second paragraph of Article 542.07 of the Standard Specifications to read:

“When a prefabricated end section is used, it shall be of the same material as the pipe culvert, except for polyethylene (PE), polyvinylchloride (PVC), and polypropylene (PP) pipes which shall have metal end sections.”

Revise the first paragraph of Article 1040.03 of the Standard Specifications to read:

“1040.03 Polyvinyl Chloride (PVC) Pipe. Acceptance testing of PVC pipe and fittings shall be accomplished during the same construction season in which they are installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.”

Delete Articles 1040.03(e) and (f) of the Standard Specifications.

Revise Articles 1040.04(c) and (d) of the Standard Specifications to read:

“(c) PE Profile Wall Pipe for Insertion Lining. The pipe shall be according to ASTM F 894. When used for insertion lining of pipe culverts, the pipe liner shall have a minimum pipe stiffness of 46 psi (317 kPa) at five percent deflection for nominal inside diameters of 42 in. (1050 mm) or less. For nominal inside diameters of greater than 42 in. (1050 mm), the pipe liner shall have a minimum pipe stiffness of 32.5 psi (225 kPa) at five percent deflection. All sizes shall have wall construction that presents essentially smooth internal and external surfaces.

(d) PE Pipe with a Smooth Interior. The pipe shall be according to ASTM F 714 (DR 32.5) with a minimum cell classification of PE 335434 as defined in ASTM D 3350. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties and the resin used to manufacture the pipe meets or exceeds the minimum cell classification requirements.”

Add the following to Section 1040 of the Standard Specifications:

“1040.08 Polypropylene (PP) Pipe. Storage and handling shall be according to the manufacturer's recommendations, except in no case shall the pipe be exposed to direct sunlight for more than six months. Acceptance testing of the pipe shall be accomplished during the same construction season in which it is installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.

(a) Corrugated PP Pipe with a Smooth Interior. The pipe shall be according to AAHSTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type S or D.

(b) Perforated Corrugated PP Pipe with A Smooth Interior. The pipe shall be according to AASHTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type SP. In addition, the top centerline of the pipe shall be marked so that it is readily visible from the top of the trench before backfilling, and the upper ends of the slot perforations shall be a minimum of ten degrees below the horizontal.”

LRFD STORM SEWER BURIAL TABLES (BDE)

Effective: November 1, 2013

Revised: November 1, 2014

Revise Article 550.02 of the Standard Specifications to read as follows:

“Item	Article Section
(a) Clay Sewer Pipe	1040.02
(b) Extra Strength Clay Pipe	1040.02
(c) Concrete Sewer, Storm Drain, and Culvert Pipe	1042
(d) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe	1042
(e) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Note 1)	1042
(f) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Note 1)	1042
(g) Polyvinyl Chloride (PVC) Pipe	1040.03
(h) Corrugated Polyvinyl Chloride (PVC) Pipe with a Smooth Interior	1040.03
(i) Corrugated Polypropylene (CPP) Pipe with Smooth Interior	1040.07
(j) Rubber Gaskets and Preformed Flexible Joint Sealants for Concrete Pipe	1056
(k) Mastic Joint Sealer for Pipe	1055
(l) External Sealing Band	1057
(m) Fine Aggregate (Note 2)	1003.04
(n) Coarse Aggregate (Note 3)	1004.05
(o) Reinforcement Bars and Welded Wire Fabric	1006.10
(p) Handling Hole Plugs	1042.16
(q) Polyethylene (PE) Pipe with a Smooth Interior	1040.04
(r) Corrugated Polyethylene (PE) Pipe with a Smooth Interior	1040.04

Note 1. The class of elliptical and arch pipe used for various storm sewer sizes and heights of fill shall conform to the requirements for circular pipe.

Note 2. The fine aggregate shall be moist.

Note 3. The coarse aggregate shall be wet.”

Revise the table for permitted materials in Article 550.03 of the Standard Specifications as follows:

"Class	Materials
A	Rigid Pipes: Clay Sewer Pipe Extra Strength Clay Pipe Concrete Sewer, Storm Drain, and Culvert Pipe Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
B	Rigid Pipes: Clay Sewer Pipe Extra Strength Clay Pipe Concrete Sewer, Storm Drain, and Culvert Pipe Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe Flexible Pipes: Polyvinyl Chloride (PVC) Pipe Corrugated Polyvinyl Chloride Pipe (PVC) with a Smooth Interior Polyethylene (PE) Pipe with a Smooth Interior Corrugated Polyethylene (PE) Pipe with a Smooth Interior Corrugated Polypropylene (CPP) Pipe with a Smooth Interior"

Replace the storm sewers tables in Article 550.03 of the Standard Specifications with the following:

STORM SEWERS KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE																
Nominal Diameter in.	Type 1								Type 2							
	Fill Height: 3' and less With 1' minimum cover								Fill Height: Greater than 3' not exceeding 10'							
	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP
10	NA	3	X	X	X	X	X	NA	NA	1	*X	X	X	X	X	NA
12	IV	NA	X	X	X	X	X	X	II	1	*X	X	X	X	X	X
15	IV	NA	NA	X	X	NA	X	X	II	1	*X	X	X	NA	X	X
18	IV	NA	NA	X	X	X	X	X	II	2	X	X	X	X	X	X
21	III	NA	NA	X	X	NA	NA	NA	II	2	X	X	X	NA	NA	NA
24	III	NA	NA	X	X	X	X	X	II	2	X	X	X	X	X	X
27	III	NA	NA	NA	NA	NA	NA	NA	II	3	X	NA	NA	NA	NA	NA
30	IV	NA	NA	X	X	X	X	X	II	3	X	X	X	X	X	X
33	III	NA	NA	NA	NA	NA	NA	NA	II	NA	X	NA	NA	NA	NA	NA
36	III	NA	NA	X	X	X	X	X	II	NA	X	X	X	X	X	X
42	II	NA	X	X	NA	X	X	NA	II	NA	X	X	NA	X	NA	NA
48	II	NA	X	X	NA	X	X	X	II	NA	X	X	NA	X	NA	NA
54	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
60	II	NA	NA	NA	NA	NA	NA	X	II	NA	NA	NA	NA	NA	NA	X
66	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
72	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
78	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
84	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
90	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
96	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA
102	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA
108	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA

- RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- CSP Concrete Sewer, Storm drain, and Culvert Pipe
- PVC Polyvinyl Chloride Pipe
- CPVC Corrugated Polyvinyl Chloride Pipe
- ESCP Extra Strength Clay Pipe
- PE Polyethylene Pipe with a Smooth Interior
- CPE Corrugated Polyethylene Pipe with a Smooth Interior
- CPP Corrugated Polypropylene pipe with a Smooth Interior
- X This material may be used for the given pipe diameter and fill height.
- NA This material is Not Acceptable for the given pipe diameter and fill height.
- * May also use Standard Strength Clay Pipe

STORM SEWERS (Metric) KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE																
Nominal Diameter in.	Type 1								Type 2							
	Fill Height: 1 m and less With 300 mm minimum cover								Fill Height: Greater than 1 m not exceeding 3 m							
	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP
250	NA	3	X	X	X	X	X	NA	NA	1	*X	X	X	X	X	NA
300	IV	NA	X	X	X	X	X	X	II	1	*X	X	X	X	X	X
375	IV	NA	NA	X	X	NA	X	X	II	1	*X	X	X	NA	X	X
450	IV	NA	NA	X	X	X	X	X	II	2	X	X	X	X	X	X
525	III	NA	NA	X	X	NA	NA	NA	II	2	X	X	X	NA	NA	NA
600	III	NA	NA	X	X	X	X	X	II	2	X	X	X	X	X	X
675	III	NA	NA	NA	NA	NA	NA	NA	II	3	X	NA	NA	NA	NA	NA
750	IV	NA	NA	X	X	X	X	X	II	3	X	X	X	X	X	X
825	III	NA	NA	NA	NA	NA	NA	NA	II	NA	X	NA	NA	NA	NA	NA
900	III	NA	NA	X	X	X	X	X	II	NA	X	X	X	X	X	X
1050	II	NA	X	X	NA	X	X	NA	II	NA	X	X	NA	X	NA	NA
1200	II	NA	X	X	NA	X	X	X	II	NA	X	X	NA	X	NA	NA
1350	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
1500	II	NA	NA	NA	NA	NA	NA	X	II	NA	NA	NA	NA	NA	NA	X
1650	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
1800	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
1950	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
2100	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
2250	II	NA	NA	NA	NA	NA	NA	NA	II	NA	NA	NA	NA	NA	NA	NA
2400	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA
2550	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA
2700	II	NA	NA	NA	NA	NA	NA	NA	III	NA	NA	NA	NA	NA	NA	NA

- RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- CSP Concrete Sewer, Storm drain, and Culvert Pipe
- PVC Polyvinyl Chloride Pipe
- CPVC Corrugated Polyvinyl Chloride Pipe
- ESCP Extra Strength Clay Pipe
- PE Polyethylene Pipe with a Smooth Interior
- CPE Corrugated Polyethylene Pipe with a Smooth Interior
- CPP Corrugated Polypropylene pipe with a Smooth Interior
- X This material may be used for the given pipe diameter and fill height.
- NA This material is Not Acceptable for the given pipe diameter and fill height.
- * May also use Standard Strength Clay Pipe

STORM SEWERS KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE															
Nominal Diameter in.	Type 3								Type 4						
	Fill Height: Greater than 10' not exceeding 15'								Fill Height: Greater than 15' not exceeding 20'						
	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP	RCCP	CSP	ESCP	PVC	CPVC	PE	CPP
10	NA	2	X	X	X	X	X	NA	NA	3	X	X	X	X	NA
12	III	2	X	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
15	III	3	X	X	X	NA	NA	X	IV	NA	NA	X	X	NA	X
18	III	NA	X	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
21	III	NA	NA	X	X	NA	NA	NA	IV	NA	NA	X	X	NA	NA
24	III	NA	NA	X	X	X	NA	NA	IV	NA	NA	X	X	X	NA
27	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
30	III	NA	NA	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
33	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
36	III	NA	NA	X	X	X	NA	NA	IV	NA	NA	X	X	X	NA
42	III	NA	NA	X	NA	X	NA	NA	IV	NA	NA	X	NA	X	NA
48	III	NA	NA	X	NA	X	NA	NA	IV	NA	NA	X	NA	X	NA
54	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
60	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
66	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
72	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
78	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
84	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
90	III	NA	NA	NA	NA	NA	NA	NA	1680	NA	NA	NA	NA	NA	NA
96	III	NA	NA	NA	NA	NA	NA	NA	1690	NA	NA	NA	NA	NA	NA
102	III	NA	NA	NA	NA	NA	NA	NA	1700	NA	NA	NA	NA	NA	NA
108	1360	NA	NA	NA	NA	NA	NA	NA	1710	NA	NA	NA	NA	NA	NA

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

CSP Concrete Sewer, Storm drain, and Culvert Pipe

PVC Polyvinyl Chloride Pipe

CPVC Corrugated Polyvinyl Chloride Pipe

ESCP Extra Strength Clay Pipe

PE Polyethylene Pipe with a Smooth Interior

CPE Corrugated Polyethylene Pipe with a Smooth Interior

CPP Corrugated Polypropylene pipe with a Smooth Interior

X This material may be used for the given pipe diameter and fill height.

NA This material is Not Acceptable for the given pipe diameter and fill height.

* May also use Standard Strength Clay Pipe

Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the D-load to produce a 0.01 in crack.

STORM SEWERS (metric) KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE															
Nominal Diameter in.	Type 3								Type 4						
	Fill Height: Greater than 3 m not exceeding 4.5 m								Fill Height: Greater than 4.5 m not exceeding 6 m						
	RCCP	CSP	ESCP	PVC	CPVC	PE	CPE	CPP	RCCP	CSP	ESCP	PVC	CPVC	PE	CPP
250	NA	2	X	X	X	X	X	NA	NA	3	X	X	X	X	NA
300	III	2	X	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
375	III	3	X	X	X	NA	NA	X	IV	NA	NA	X	X	NA	X
450	III	NA	X	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
525	III	NA	NA	X	X	NA	NA	NA	IV	NA	NA	X	X	NA	NA
600	III	NA	NA	X	X	X	NA	NA	IV	NA	NA	X	X	X	NA
675	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
750	III	NA	NA	X	X	X	NA	X	IV	NA	NA	X	X	X	NA
825	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
900	III	NA	NA	X	X	X	NA	NA	IV	NA	NA	X	X	X	NA
1050	III	NA	NA	X	NA	X	NA	NA	IV	NA	NA	X	NA	X	NA
1200	III	NA	NA	X	NA	X	NA	NA	IV	NA	NA	X	NA	X	NA
1350	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
1500	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
1650	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
1800	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
1950	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
2100	III	NA	NA	NA	NA	NA	NA	NA	IV	NA	NA	NA	NA	NA	NA
2250	III	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	NA	NA	NA	NA
2400	III	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	NA	NA	NA	NA
2550	III	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	NA	NA	NA	NA
2700	70	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	NA	NA	NA	NA

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

CSP Concrete Sewer, Storm drain, and Culvert Pipe

PVC Polyvinyl Chloride Pipe

CPVC Corrugated Polyvinyl Chloride Pipe

ESCP Extra Strength Clay Pipe

PE Polyethylene Pipe with a Smooth Interior

CPE Corrugated Polyethylene Pipe with a Smooth Interior

CPP Corrugated Polypropylene pipe with a Smooth Interior

X This material may be used for the given pipe diameter and fill height.

NA This material is Not Acceptable for the given pipe diameter and fill height.

* May also use Standard Strength Clay Pipe

Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the metric D-load to produce a 25.4 micro-meter crack.

STORM SEWERS KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE								
Nominal Diameter in.	Type 5			Type 6			Type 7	
	Fill Height: Greater than 20' not exceeding 25'			Fill Height: Greater than 25' not exceeding 30'			Fill Height: Greater than 30' not exceeding 35'	
	RCCP	PVC	CPVC	RCCP	PVC	CPVC	RCCP	CPVC
10	NA	X	X	NA	X	X	NA	X
12	IV	X	X	V	X	X	V	X
15	IV	X	X	V	X	X	V	X
18	IV	X	X	V	X	X	V	X
21	IV	X	X	V	X	X	V	X
24	IV	X	X	V	X	X	V	X
27	IV	NA	NA	V	NA	NA	V	NA
30	IV	X	X	V	X	X	V	X
33	IV	NA	NA	V	NA	NA	V	NA
36	IV	X	X	V	X	X	V	X
42	IV	X	NA	V	X	NA	V	NA
48	IV	X	NA	V	X	NA	V	NA
54	IV	NA	NA	V	NA	NA	V	NA
60	IV	NA	NA	V	NA	NA	V	NA
66	IV	NA	NA	V	NA	NA	V	NA
72	V	NA	NA	V	NA	NA	V	NA
78	2020	NA	NA	2370	NA	NA	2730	NA
84	2020	NA	NA	2380	NA	NA	2740	NA
90	2030	NA	NA	2390	NA	NA	2750	NA
96	2040	NA	NA	2400	NA	NA	2750	NA
102	2050	NA	NA	2410	NA	NA	2760	NA
108	2060	NA	NA	2410	NA	NA	2770	NA

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

PVC Polyvinyl Chloride Pipe

CPVC Corrugated Polyvinyl Chloride Pipe

ESCP Extra Strength Clay Pipe

X This material may be used for the given pipe diameter and fill height.

NA This material is Not Acceptable for the given pipe diameter and fill height.

Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the D-load to produce a 0.01 in crack.

STORM SEWERS (metric) KIND OF MATERIAL PERMITTED AND STRENGTH REQUIRED FOR A GIVEN PIPE DIAMETERS AND FILL HEIGHTS OVER THE TOP OF THE PIPE								
Nominal Diameter in.	Type 5			Type 6			Type 7	
	Fill Height: Greater than 20' not exceeding 25'			Fill Height: Greater than 25' not exceeding 30'			Fill Height: Greater than 30' not exceeding 35'	
	RCCP	PVC	CPVC	RCCP	PVC	CPVC	RCCP	CPVC
250	NA	X	X	NA	X	X	NA	X
300	IV	X	X	V	X	X	V	X
375	IV	X	X	V	X	X	V	X
450	IV	X	X	V	X	X	V	X
525	IV	X	X	V	X	X	V	X
600	IV	X	X	V	X	X	V	X
675	IV	NA	NA	V	NA	NA	V	NA
750	IV	X	X	V	X	X	V	X
825	IV	NA	NA	V	NA	NA	V	NA
900	IV	X	X	V	X	X	V	X
1050	IV	X	NA	V	X	NA	V	NA
1200	IV	X	NA	V	X	NA	V	NA
1350	IV	NA	NA	V	NA	NA	V	NA
1500	IV	NA	NA	V	NA	NA	V	NA
1650	IV	NA	NA	V	NA	NA	V	NA
1800	V	NA	NA	V	NA	NA	V	NA
1950	100	NA	NA	110	NA	NA	130	NA
2100	100	NA	NA	110	NA	NA	130	NA
2250	100	NA	NA	110	NA	NA	130	NA
2400	100	NA	NA	120	NA	NA	130	NA
2550	100	NA	NA	120	NA	NA	130	NA
2700	100	NA	NA	120	NA	NA	130	NA

RCCP Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

PVC Polyvinyl Chloride Pipe

CPVC Corrugated Polyvinyl Chloride Pipe

ESCP Extra Strength Clay Pipe

X This material may be used for the given pipe diameter and fill height.

NA This material is Not Acceptable for the given pipe diameter and fill height.

Note RCCP with a number instead of a Roman numeral shall be furnished according to AASHTO M170 Section 6. This number represents the metric D-load to produce a 25.4 micro-meter crack.

Revise the sixth paragraph of Article 550.06 of the Standard Specifications to read:

“PVC, PE and CPP pipes shall be joined according to the manufacturer’s specifications.”

Revise the first and second paragraphs of Article 550.08 of the Standard Specifications to read:

“**550.08 Deflection Testing for Storm Sewers.** All PVC, PE, and CPP storm sewers shall be tested for deflection not less than 30 days after the pipe is installed and the backfill compacted. The testing shall be performed in the presence of the Engineer.

For PVC, PE, and CPP storm sewers with diameters 24 in. (600 mm) or smaller, a mandrel drag shall be used for deflection testing. For PVC, PE, and CPP storm sewers with diameters over 24 in. (600 mm), deflection measurements other than by a mandrel shall be used.”

Revise the fifth paragraph of Article 550.08 to read as follows.

“The outside diameter of the mandrel shall be 95 percent of the base inside diameter. For all PVC pipe the base inside diameter shall be defined using ASTM D 3034 methodology. For all PE and CPP pipe, the base inside diameter shall be defined as the average inside diameter based on the minimum and maximum tolerances specified in the corresponding ASTM or AASHTO material specifications.”

Revise the first paragraph of Article 1040.03 of the Standard Specifications to read:

“**1040.03 Polyvinyl Chloride (PVC) Pipe.** Acceptance testing of PVC pipe and fittings shall be accomplished during the same construction season in which they are installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.”

Delete Articles 1040.03(e) and (f) of the Standard Specifications.

Revise Articles 1040.04(c) and (d) of the Standard Specifications to read:

“(c) PE Profile Wall Pipe for Insertion Lining. The pipe shall be according to ASTM F 894. When used for insertion lining of pipe culverts, the pipe liner shall have a minimum pipe stiffness of 46 psi (317 kPa) at five percent deflection for nominal inside diameters of 42 in. (1050 mm) or less. For nominal inside diameters of greater than 42 in. (1050 mm), the pipe liner shall have a minimum pipe stiffness of 32.5 psi (225 kPa) at five percent deflection. All sizes shall have wall construction that presents essentially smooth internal and external surfaces.

(d) PE Pipe with a Smooth Interior. The pipe shall be according to ASTM F 714 (DR 32.5) with a minimum cell classification of PE 335434 as defined in ASTM D 3350. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties and the resin used to manufacture the pipe meets or exceeds the minimum cell classification requirements.”

Add the following to Section 1040 of the Standard Specifications:

“1040.08 Polypropylene (PP) Pipe. Storage and handling shall be according to the manufacturer's recommendations, except in no case shall the pipe be exposed to direct sunlight for more than six months. Acceptance testing of the pipe shall be accomplished during the same construction season in which it is installed. The section properties shall be according to the manufacturer pre-submitted geometric properties on file with the Department. The manufacturer shall submit written certification that the material meets those properties. The pipe shall meet the following additional requirements.

- (a) Corrugated PP Pipe with a Smooth Interior. The pipe shall be according to AAHSTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type S or D.
- (b) Perforated Corrugated PP Pipe with A Smooth Interior. The pipe shall be according to AASHTO M 330 (nominal size – 12 to 60 in. (300 to 1500 mm)). The pipe shall be Type SP. In addition, the top centerline of the pipe shall be marked so that it is readily visible from the top of the trench before backfilling, and the upper ends of the slot perforations shall be a minimum of ten degrees below the horizontal.”

PAVEMENT PATCHING (BDE)

Effective: January 1, 2010

Revise the first sentence of the second paragraph of Article 701.17(e)(1) of the Standard Specifications to read:

“In addition to the traffic control and protection shown elsewhere in the contract for pavement, two devices shall be placed immediately in front of each open patch, open hole, and broken pavement where temporary concrete barriers are not used to separate traffic from the work area.”

PAYROLLS AND PAYROLL RECORDS (BDE)

Effective: January 1, 2014

FEDERAL AID CONTRACTS. Revise the following section of Check Sheet #1 of the Recurring Special Provisions to read:

“STATEMENTS AND PAYROLLS

The payroll records shall include the worker’s name, the worker’s address, the worker’s telephone number when available, the worker’s social security number, the worker’s classification or classifications, the worker’s gross and net wages paid in each pay period, the worker’s number of hours worked each day, the worker’s starting and ending times of work each day. However, any Contractor or subcontractor who remits contributions to a fringe benefit fund that is not jointly maintained and jointly governed by one or more employers and one or more labor organization must additionally submit the worker’s hourly wage rate, the worker’s hourly overtime wage rate, the worker’s hourly fringe benefit rates, the name and address of each fringe benefit fund, the plan sponsor of each fringe benefit, if applicable, and the plan administrator of each fringe benefit, if applicable.

The Contractor and each subcontractor shall submit payroll records to the Engineer each week from the start to the completion of their respective work, except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead, the payrolls shall include an identification number for each employee (e.g., the last four digits of the employee’s social security number). In addition, starting and ending times of work each day may be omitted from the payroll records submitted to the Engineer. The submittals shall be on the Department’s form SBE 48, or an approved facsimile. When there has been no activity during a work week, a payroll record shall still be submitted with the appropriate box (“No Work”, “Suspended”, or “Complete”) checked on the form.”

STATE CONTRACTS. Revise Section IV of Check Sheet #5 of the Recurring Special Provisions to read:

“IV. COMPLIANCE WITH THE PREVAILING WAGE ACT

1. Prevailing Wages. All wages paid by the Contractor and each subcontractor shall be in compliance with The Prevailing Wage Act (820 ILCS 130), as amended, except where a prevailing wage violates a federal law, order, or ruling, the rate conforming to the federal law, order, or ruling shall govern. The Contractor shall be responsible to notify each subcontractor of the wage rates set forth in this contract and any revisions thereto. If the Department of Labor revises the wage rates, the Contractor will not be allowed additional compensation on account of said revisions.

2. Payroll Records. The Contractor and each subcontractor shall make and keep, for a period of five years from the later of the date of final payment under the contract or completion of the contract, records of the wages paid to his/her workers. The payroll records shall include the worker's name, the worker's address, the worker's telephone number when available, the worker's social security number, the worker's classification or classifications, the worker's gross and net wages paid in each pay period, the worker's number of hours worked each day, the worker's starting and ending times of work each day. However, any contractor or subcontractor who remits contributions to a fringe benefit fund that is not jointly maintained and jointly governed by one or more employers and one or more labor organization must additionally submit the worker's hourly wage rate, the worker's hourly overtime wage rate, the worker's hourly fringe benefit rates, the name and address of each fringe benefit fund, the plan sponsor of each fringe benefit, if applicable, and the plan administrator of each fringe benefit, if applicable. Upon seven business days' notice, these records shall be available at a location within the State, during reasonable hours, for inspection by the Department or the Department of Labor; and Federal, State, or local law enforcement agencies and prosecutors.
3. Submission of Payroll Records. The Contractor and each subcontractor shall submit payroll records to the Engineer each week from the start to the completion of their respective work, except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall include an identification number for each employee (e.g., the last four digits of the employee's social security number). In addition, starting and ending times of work each day may be omitted from the payroll records submitted to the Engineer. The submittals shall be on the Department's form SBE 48, or an approved facsimile. When there has been no activity during a work week, a payroll record shall still be submitted with the appropriate box ("No Work", "Suspended", or "Complete") checked on the form.

Each submittal shall be accompanied by a statement signed by the Contractor or subcontractor, or an officer, employee, or officer thereof, which avers that: (i) he or she has examined the records and such records are true and accurate; (ii) the hourly rate paid to each worker is not less than the general prevailing rate of hourly wages required by the Act; and (iii) the Contractor or subcontractor is aware that filing a payroll record that he/she knows to be false is a Class A misdemeanor.

4. Employee Interviews. The Contractor and each subcontractor shall permit his/her employees to be interviewed on the job, during working hours, by compliance investigators of the Department or the Department of Labor."

PORTLAND CEMENT CONCRETE EQUIPMENT (BDE)

Effective: November 1, 2013

Add the following to the first paragraph of Article 1103.03(a)(5) of the Standard Specifications to read:

“As an alternative to a locking key, the start and finish time for mixing may be automatically printed on the batch ticket. The start and finish time shall be reported to the nearest second.”

PROGRESS PAYMENTS (BDE)

Effective: November 2, 2013

Revise Article 109.07(a) of the Standard Specifications to read:

“(a) Progress Payments. At least once each month, the Engineer will make a written estimate of the quantity of work performed in accordance with the contract, and the value thereof at the contract unit prices. The amount of the estimate approved as due for payment will be vouchered by the Department and presented to the State Comptroller for payment. No amount less than \$1000.00 will be approved for payment other than the final payment.

Progress payments may be reduced by liens filed pursuant to Section 23(c) of the Mechanics' Lien Act, 770 ILCS 60/23(c).

If a Contractor or subcontractor has defaulted on a loan issued under the Department's Disadvantaged Business Revolving Loan Program (20 ILCS 2705/2705-610), progress payments may be reduced pursuant to the terms of that loan agreement. In such cases, the amount of the estimate related to the work performed by the Contractor or subcontractor, in default of the loan agreement, will be offset, in whole or in part, and vouchered by the Department to the Working Capital Revolving Fund or designated escrow account. Payment for the work shall be considered as issued and received by the Contractor or subcontractor on the date of the offset voucher. Further, the amount of the offset voucher shall be a credit against the Department's obligation to pay the Contractor, the Contractor's obligation to pay the subcontractor, and the Contractor's or subcontractor's total loan indebtedness to the Department. The offset shall continue until such time as the entire loan indebtedness is satisfied. The Department will notify the Contractor and Fund Control Agent in a timely manner of such offset. The Contractor or subcontractor shall not be entitled to additional payment in consideration of the offset.

The failure to perform any requirement, obligation, or term of the contract by the Contractor shall be reason for withholding any progress payments until the Department determines that compliance has been achieved.”

REINFORCEMENT BARS (BDE)

Effective: November 1, 2013

Revise the first and second paragraphs of Article 508.05 of the Standard Specifications to read:

“508.05 Placing and Securing. All reinforcement bars shall be placed and tied securely at the locations and in the configuration shown on the plans prior to the placement of concrete. Manual welding of reinforcement may only be permitted on precast concrete products as indicated in the current Bureau of Materials and Physical Research Policy Memorandum “Quality Control / Quality Assurance Program for Precast Concrete Products”, and for precast prestressed concrete products as indicated in the Department’s current “Manual for Fabrication of Precast Prestressed Concrete Products”. Reinforcement bars shall not be placed by sticking or floating into place or immediately after placement of the concrete.

Bars shall be tied at all intersections, except where the center to center dimension is less than 1 ft (300 mm) in each direction, in which case alternate intersections shall be tied. Molded plastic clips may be used in lieu of wire to secure bar intersections, but shall not be permitted in horizontal bar mats subject to construction foot traffic or to secure longitudinal bar laps. Plastic clips shall adequately secure the reinforcement bars, and shall permit the concrete to flow through and fully encase the reinforcement. Plastic clips may be recycled plastic, and shall meet the approval of the Engineer. The number of ties as specified shall be doubled for lap splices at the stage construction line of concrete bridge decks when traffic is allowed on the first completed stage during the pouring of the second stage.”

Revise the fifth paragraph of Article 508.05 of the Standard Specifications to read:

“Supports for reinforcement in bridge decks shall be metal. For all other concrete construction the supports shall be metal or plastic. Metal bar supports shall be made of cold-drawn wire, or other approved material and shall be either epoxy coated, galvanized or plastic tipped. When the reinforcement bars are epoxy coated, the metal supports shall be epoxy coated. Plastic supports may be recycled plastic. Supports shall be provided in sufficient number and spaced to provide the required clearances. Supports shall adequately support the reinforcement bars, and shall permit the concrete to flow through and fully encase the reinforcement. The legs of supports shall be spaced to allow an opening that is a minimum 1.33 times the nominal maximum aggregate size used in the concrete. Nominal maximum aggregate size is defined as the largest sieve which retains any of the aggregate sample particles. All supports shall meet the approval of the Engineer.”

Revise the first sentence of the eighth paragraph of Article 508.05 of the Standard Specifications to read:

“Epoxy coated reinforcement bars shall be tied with plastic coated wire, epoxy coated wire, or molded plastic clips where allowed.”

Add the following sentence to the end of the first paragraph of Article 508.06(c) of the Standard Specifications:

“In addition, the total slip of the bars within the splice sleeve of the connector after loading in tension to 30 ksi (207 MPa) and relaxing to 3 ksi (20.7 MPa) shall not exceed 0.01 in. (254 microns).”

Revise Article 1042.03(d) of the Standard Specifications to read:

“(d) Reinforcement and Accessories: The concrete cover over all reinforcement shall be within $\pm 1/4$ in. (± 6 mm) of the specified cover.

Welded wire fabric shall be accurately bent and tied in place.

Miscellaneous accessories to be cast into the concrete or for forming holes and recesses shall be carefully located and rigidly held in place by bolts, clamps, or other effective means. If paper tubes are used for vertical dowel holes, or other vertical holes which require grouting, they shall be removed before transportation to the construction site.”

REMOVAL AND DISPOSAL OF SURPLUS MATERIALS (BDE)

Effective: November 2, 2012

Revise the first four paragraphs of Article 202.03 of the Standard Specifications to read:

“**202.03 Removal and Disposal of Surplus, Unstable, Unsuitable, and Organic Materials.** Suitable excavated materials shall not be wasted without permission of the Engineer. The Contractor shall dispose of all surplus, unstable, unsuitable, and organic materials, in such a manner that public or private property will not be damaged or endangered.

Suitable earth, stones and boulders naturally occurring within the right-of-way may be placed in fills or embankments in lifts and compacted according to Section 205. Broken concrete without protruding metal bars, bricks, rock, stone, reclaimed asphalt pavement with no expansive aggregate, or uncontaminated dirt and sand generated from construction or demolition activities may be used in embankment or in fill. If used in fills or embankments, these materials shall be placed and compacted to the satisfaction of the Engineer; shall be buried under a minimum of 2 ft (600 mm) of earth cover (except when the materials include only uncontaminated dirt); and shall not create an unsightly appearance or detract from the natural topographic features of an area. Broken concrete without protruding metal bars, bricks, rock, or stone may be used as riprap as approved by the Engineer. If the materials are used for fill in locations within the right-of-way but outside project construction limits, the Contractor must specify to the Engineer, in writing, how the landscape restoration of the fill areas will be accomplished. Placement of fill in such areas shall not commence until the Contractor's landscape restoration plan is approved by the Engineer.

Aside from the materials listed above, all other construction and demolition debris or waste shall be disposed of in a licensed landfill, recycled, reused, or otherwise disposed of as allowed by State or Federal laws and regulations. When the Contractor chooses to dispose of uncontaminated soil at a clean construction and demolition debris (CCDD) facility or at an uncontaminated soil fill operation, it shall be the Contractor's responsibility to have the pH of the material tested to ensure the value is between 6.25 and 9.0, inclusive. A copy of the pH test results shall be provided to the Engineer.

A permit shall be obtained from IEPA and made available to the Engineer prior to open burning of organic materials (i.e., plant refuse resulting from pruning or removal of trees or shrubs) or other construction or demolition debris. Organic materials originating within the right-of-way limits may be chipped or shredded and placed as mulch around landscape plantings within the right-of-way when approved by the Engineer. Chipped or shredded material to be placed as mulch shall not exceed a depth of 6 in. (150 mm)."

RIGID METAL CONDUIT (BDE)

Effective: August 1, 2014

Add the following to Article 1088.01(a) of the Standard Specifications:

"(6) Stainless Steel Conduit. The conduit shall be Type 304 or Type 316 stainless steel, shall be manufactured according to UL Standard 6A, and shall meet ANSI Standard C80.1. Conduit fittings shall be Type 304 or Type 316 stainless steel and shall be manufactured according to UL Standard 514B.

All conduit supports, straps, clamps. And other attachments shall be Type 304 or Type 316 stainless steel. Attachment hardware shall be stainless steel according to Article 1006.31."

SPEED DISPLAY TRAILER (BDE)

Effective: April 2, 2014

Add the following to Article 701.15(l) of the Standard Specifications:

"(l) Speed Display Trailer. A speed display trailer shall be utilized on freeways and expressways as part of Highway Standard 701400. The trailer shall be placed on the right hand side of the roadway adjacent to, or within 100 ft (30 m) beyond, the first work zone speed limit sign.

Whenever the speed display trailer is not in use, it shall be considered non-operating equipment and shall be stored according to Article 701.11."

Add the following to Article 701.20 of the Standard Specifications:

"(k) Speed Display Trailer will be paid for at the contract unit price per calendar month or fraction thereof for each trailer as SPEED DISPLAY TRAILER."

Add the following to Article 1106.02 of the Standard Specifications:

“(o) Speed Display Trailer. The speed display trailer shall consist of a LED speed indicator display with self-contained, one-direction radar mounted on an orange see-through trailer. The height of the display and radar shall be such that it will function and be visible when located behind concrete barrier.

The speed measurement shall be by radar and provide a minimum detection distance of 1000 ft (300 m). The radar shall have an accuracy of ± 1 mile per hour.

The speed indicator display shall face approaching traffic and shall have a sign legend of “YOUR SPEED” immediately above or below the speed display. The digital speed display shall show two digits (00 to 99) in mph. The color of the changeable message legend shall be a yellow legend on a black background. The minimum height of the numerals shall be 18 in. (450 mm), and the nominal legibility distance shall be at least 750 ft (250 m).

The speed indicator display shall be equipped with a violation alert that flashes the displayed detected speed when the posted limit is exceeded. The speed indicator shall have a maximum speed cutoff. The display shall include automatic dimming for nighttime operation.

The speed indicator measurement and display functions shall be equipped with the power supply capable of providing 24 hours of uninterrupted service.”

TRACKING THE USE OF PESTICIDES (BDE)

Effective: August 1, 2012

Add the following paragraph after the first paragraph of Article 107.23 of the Standard Specifications:

“Within 48 hours of the application of pesticides, including but not limited to herbicides, insecticides, algacides, and fungicides, the Contractor shall complete and return to the Engineer, Operations form “OPER 2720”.”

TRAFFIC CONTROL SETUP AND REMOVAL FREEWAY/EXPRESSWAY (BDE)

Effective: January 1, 2014

Add the following to the Article 701.18 of the Standard Specifications:

“(l) Standard 701428. When the shoulder width will not allow placement of the shoulder truck and provide 9 ft (3.0 m) of unobstructed lane width in the lane being closed, the shoulder truck shall not be used.”

Revise Article 701.19(a) of the Standard Specifications to read:

“(a) Not Measured. Traffic control and protection required under Standards 701001, 701006, 701011, 701101, 701106, 701301, 701311, 701400, 701426, 701427, and 701428 will not be measured for payment.”

TRAVERSABLE PIPE GRATE (BDE)

Effective: January 1, 2013

Revised: April 1, 2014

Description. This work shall consist of constructing a traversable pipe grate on a concrete end section.

Materials. Materials shall be according to the following Articles of Division 1000 – Materials of the Standard Specifications.

Item	Article/Section
(a) Traversable Pipe Grate Components (Note 1)	
(b) Chemical Adhesive Resin System	1027
(c) High Strength Steel Bolts, Nuts, and Washers (Note 2)	1006.08

Note 1. All steel pipe shall be according to ASTM A 53 (Type E or S), Grade B, or ASTM A 500 Grade B, standard weight (SCH. 40). Structural steel shapes and plates shall be according to AASHTO M270 Grade 50 (M 270M Grade 345) and the requirements of Article 1006.04 of the Standard Specifications. All steel components of the grating system shall be galvanized according to AASHTO M 111 or M 232 as applicable.

Anchor rods shall be according to ASTM F 1554, Grade 36 (Grade 250).

Note 2. Threaded rods conforming to the requirements of ASTM F 1554, Grade 105 (Grade 725) may be used for the thru bolts.

CONSTRUCTION REQUIREMENTS

Fabrication of the traversable pipe grate shall be according to the requirements of Section 505 of the Standard Specifications and as shown on the plans.

Anchor rods shall be set according to Article 509.06 of the Standard Specifications. Bolts and anchor rods shall be snug tightened by a few impacts of an impact wrench or the full force of a worker using an ordinary spud wrench. Thru bolts shall be snug tightened and shall be brought to a snug tight condition followed by an additional 2/3 turn on one of the nuts. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut.

Splicing of pipes shall be made by utilizing full penetration butt welds according to Article 505.04(q) of the Standard Specifications. In lieu of welding, bolted or sleeve type splices may be utilized, provided the splices are located over intermediate supports with no more than one splice per pipe run with the exception that no splice may occur in pipe runs under 30 ft (9 m) in length.

Method of Measurement. This work will be measured for payment in place in feet (meters). The length measured shall be along the pipe grate elements from end to end for both longitudinal and intermediate support pipes.

Basis of Payment. This work will be paid for at the contract unit price per foot (meter) for TRAVERSABLE PIPE GRATE.

WEEKLY DBE TRUCKING REPORTS (BDE)

Effective: June 2, 2012

The Contractor shall provide a weekly report of Disadvantaged Business Enterprise (DBE) trucks hired by the Contractor or subcontractors (i.e. not owned by the Contractor or subcontractors) that are used on the jobsite; or used for the delivery and/or removal of equipment/material to and from the jobsite. The jobsite shall also include offsite locations, such as plant sites or storage sites, when those locations are used solely for this contract.

The report shall be submitted on the form provided by the Department within ten business days following the reporting period. The reporting period shall be Monday through Sunday for each week reportable trucking activities occur. The report shall be submitted to the Engineer and a copy shall be provided to the district EEO Officer.

Any costs associated with providing weekly DBE trucking reports shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

WORKING DAYS (BDE)

Effective: January 1, 2002

The Contractor shall complete the work within **260** working days.

STEEL COST ADJUSTMENT (BDE) (RETURN FORM WITH BID)

Effective: April 2, 2004

Revised: April 1, 2009

Description. Steel cost adjustments will be made to provide additional compensation to the Contractor, or a credit to the Department, for fluctuations in steel prices when optioned by the Contractor. The bidder shall indicate on the attached form whether or not this special provision will be part of the contract and submit the completed form with his/her bid. Failure to submit the form or failure to indicate contract number, company name, and sign and date the form shall make this contract exempt of steel cost adjustments for all items of steel. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment.

Types of Steel Products. An adjustment will be made for fluctuations in the cost of steel used in the manufacture of the following items:

Metal Piling (excluding temporary sheet piling)
Structural Steel
Reinforcing Steel

Other steel materials such as dowel bars, tie bars, mesh reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates will be subject to a steel cost adjustment when the pay items they are used in has a contract value of \$10,000 or greater.

Documentation. Sufficient documentation shall be furnished to the Engineer to verify the following:

- (a) The dates and quantity of steel, in lb (kg), shipped from the mill to the fabricator.
- (b) The quantity of steel, in lb (kg), incorporated into the various items of work covered by this special provision. The Department reserves the right to verify submitted quantities.

Method of Adjustment. Steel cost adjustments will be computed as follows:

$$SCA = Q \times D$$

Where: SCA = steel cost adjustment, in dollars
Q = quantity of steel incorporated into the work, in lb (kg)
D = price factor, in dollars per lb (kg)

$$D = MPI_M - MPI_L$$

Where: MPI_M = The Materials Cost Index for steel as published by the Engineering News-Record for the month the steel is shipped from the mill. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

MPI_L = The Materials Cost Index for steel as published by the Engineering News-Record for the month prior to the letting. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

The unit weights (masses) of steel that will be used to calculate the steel cost adjustment for the various items are shown in the attached table.

No steel cost adjustment will be made for any products manufactured from steel having a mill shipping date prior to the letting date.

If the Contractor fails to provide the required documentation, the method of adjustment will be calculated as described above; however, the MPI_M will be based on the date the steel arrives at the job site. In this case, an adjustment will only be made when there is a decrease in steel costs.

Basis of Payment. Steel cost adjustments may be positive or negative but will only be made when there is a difference between the MPI_L and MPI_M in excess of five percent, as calculated by:

$$\text{Percent Difference} = \{(MPI_L - MPI_M) \div MPI_L\} \times 100$$

Steel cost adjustments will be calculated by the Engineer and will be paid or deducted when all other contract requirements for the items of work are satisfied. Adjustments will only be made for fluctuations in the cost of the steel as described herein. No adjustment will be made for changes in the cost of manufacturing, fabrication, shipping, storage, etc.

The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

Attachment

Item	Unit Mass (Weight)
Metal Piling (excluding temporary sheet piling)	
Furnishing Metal Pile Shells 12 in. (305 mm), 0.179 in. (3.80 mm) wall thickness)	23 lb/ft (34 kg/m)
Furnishing Metal Pile Shells 12 in. (305 mm), 0.250 in. (6.35 mm) wall thickness)	32 lb/ft (48 kg/m)
Furnishing Metal Pile Shells 14 in. (356 mm), 0.250 in. (6.35 mm) wall thickness)	37 lb/ft (55 kg/m)
Other piling	See plans
Structural Steel	See plans for weights (masses)
Reinforcing Steel	See plans for weights (masses)
Dowel Bars and Tie Bars	6 lb (3 kg) each
Mesh Reinforcement	63 lb/100 sq ft (310 kg/sq m)
Guardrail	
Steel Plate Beam Guardrail, Type A w/steel posts	20 lb/ft (30 kg/m)
Steel Plate Beam Guardrail, Type B w/steel posts	30 lb/ft (45 kg/m)
Steel Plate Beam Guardrail, Types A and B w/wood posts	8 lb/ft (12 kg/m)
Steel Plate Beam Guardrail, Type 2	305 lb (140 kg) each
Steel Plate Beam Guardrail, Type 6	1260 lb (570 kg) each
Traffic Barrier Terminal, Type 1 Special (Tangent)	730 lb (330 kg) each
Traffic Barrier Terminal, Type 1 Special (Flared)	410 lb (185 kg) each
Steel Traffic Signal and Light Poles, Towers and Mast Arms	
Traffic Signal Post	11 lb/ft (16 kg/m)
Light Pole, Tenon Mount and Twin Mount, 30 - 40 ft (9 - 12 m)	14 lb/ft (21 kg/m)
Light Pole, Tenon Mount and Twin Mount, 45 - 55 ft (13.5 - 16.5 m)	21 lb/ft (31 kg/m)
Light Pole w/Mast Arm, 30 - 50 ft (9 - 15.2 m)	13 lb/ft (19 kg/m)
Light Pole w/Mast Arm, 55 - 60 ft (16.5 - 18 m)	19 lb/ft (28 kg/m)
Light Tower w/Luminaire Mount, 80 - 110 ft (24 - 33.5 m)	31 lb/ft (46 kg/m)
Light Tower w/Luminaire Mount, 120 - 140 ft (36.5 - 42.5 m)	65 lb/ft (97 kg/m)
Light Tower w/Luminaire Mount, 150 - 160 ft (45.5 - 48.5 m)	80 lb/ft (119 kg/m)
Metal Railings (excluding wire fence)	
Steel Railing, Type SM	64 lb/ft (95 kg/m)
Steel Railing, Type S-1	39 lb/ft (58 kg/m)
Steel Railing, Type T-1	53 lb/ft (79 kg/m)
Steel Bridge Rail	52 lb/ft (77 kg/m)
Frames and Grates	
Frame	250 lb (115 kg)
Lids and Grates	150 lb (70 kg)

Return With Bid

**ILLINOIS DEPARTMENT
OF TRANSPORTATION**

**OPTION FOR
STEEL COST ADJUSTMENT**

The bidder shall submit this completed form with his/her bid. Failure to submit the form or properly complete contract number, company name, and sign and date the form shall make this contract exempt of steel cost adjustments for all items of steel. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment. After award, this form, when submitted shall become part of the contract.

Contract No.: _____

Company Name: _____

Contractor's Option:

Is your company opting to include this special provision as part of the contract plans for the following items of work?

- | | | |
|--|-----|--------------------------|
| Metal Piling | Yes | <input type="checkbox"/> |
| Structural Steel | Yes | <input type="checkbox"/> |
| Reinforcing Steel | Yes | <input type="checkbox"/> |
| Dowel Bars, Tie Bars and Mesh Reinforcement | Yes | <input type="checkbox"/> |
| Guardrail | Yes | <input type="checkbox"/> |
| Steel Traffic Signal and Light Poles, Towers and Mast Arms | Yes | <input type="checkbox"/> |
| Metal Railings (excluding wire fence) | Yes | <input type="checkbox"/> |
| Frames and Grates | Yes | <input type="checkbox"/> |

Signature: _____ **Date:** _____

SWPPP



Storm Water Pollution Prevention Plan

Route FAI 55/70/64 Marked Rte. I-055/070/064
 Section 84-4T-1 Project No. _____
 County St. Clair Contract No. 76G99

This plan has been prepared to comply with the provisions of the National Pollutant Discharge Elimination System (NPDES) Permit No. ILR10 (Permit ILR10), issued by the Illinois Environmental Protection Agency (IEPA) for storm water discharges from construction site activities.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Jeffrey Keirn Print Name	 Signature
Deputy Director of Highways Region 5 Engineer Title	8/26/14 Date
Illinois Department of Transportation Agency	

I. Site Description:

- A. Provide a description of the project location (include latitude and longitude):
 This project is located in the City of East St. Louis approximately 1/2 mile east of the Mississippi River at the intersection of Missouri Avenue and 2nd Street. The project extends to the east up to St. Clair Avenue underpass for the construction of a underground force main.
- B. Provide a description of the construction activity which is the subject of this plan:
 The project will consist of clearing and grading, earth excavation for construction of a groundwater collector well and detention basin, and other construction activities at the northwest quadrant of the Missouri Avenue and 2nd Street intersection. A underground force main will be constructed for the well site to the east along the north side of I-55/64 to just east of the St. Clair Drive underpass.
- C. Provide the estimated duration of this project:
 12 months
- D. The total area of the construction site is estimated to be 11.6 acres.
 The total area of the site estimated to be disturbed by excavation, grading or other activities is 4.0 acres.
- E. The following is a weighted average of the runoff coefficient for this project after construction activities are completed:
 Some of the pervious areas will be replaced with pavement and concrete slopewall (impervious) the completed area will have an approximate runoff coefficient of 0.80.
- F. List all soils found within project boundaries. Include map unit name, slope information, and erosivity:
 Soil survey indicates this area is defined as Urban Land (533).
- G. Provide an aerial extent of wetland acreage at the site:
 No wetlands are located within the project site.
- H. Provide a description of potentially erosive areas associated with this project:

- b. Provide a description of how erosion and sediment control practices will prevent a discharge of sediment resulting from a storm event equal to or greater than a twenty-five (25) year, twenty-four (24) hour rainfall event:
- c. Provide a description of the location(s) of direct discharge from the project site to the 303(d) water body:
- d. Provide a description of the location(s) of any dewatering discharges to the MS4 and/or water body:

2. TMDL (fill out this section if checked above)

- a. The name(s) of the listed water body:
- b. Provide a description of the erosion and sediment control strategy that will be incorporated into the site design that is consistent with the assumptions and requirements of the TMDL:
- c. If a specific numeric waste load allocation has been established that would apply to the project's discharges, provide a description of the necessary steps to meet that allocation:

P. The following pollutants of concern will be associated with this construction project:

- | | |
|--|--|
| <input checked="" type="checkbox"/> Soil Sediment | <input checked="" type="checkbox"/> Petroleum (gas, diesel, oil, kerosene, hydraulic oil / fluids) |
| <input type="checkbox"/> Concrete | <input type="checkbox"/> Antifreeze / Coolants |
| <input checked="" type="checkbox"/> Concrete Truck Waste | <input checked="" type="checkbox"/> Waste water from cleaning construction equipment |
| <input type="checkbox"/> Concrete Curing Compounds | <input type="checkbox"/> Other (specify) |
| <input checked="" type="checkbox"/> Solid Waste Debris | <input type="checkbox"/> Other (specify) |
| <input checked="" type="checkbox"/> Paints | <input type="checkbox"/> Other (specify) |
| <input checked="" type="checkbox"/> Solvents | <input type="checkbox"/> Other (specify) |
| <input type="checkbox"/> Fertilizers / Pesticides | <input type="checkbox"/> Other (specify) |

II. Controls:

This section of the plan addresses the controls that will be implemented for each of the major construction activities described in I.C. above and for all use areas, borrow sites, and waste sites. For each measure discussed, the Contractor will be responsible for its implementation as indicated. The Contractor shall provide to the Resident Engineer a plan for the implementation of the measures indicated. The Contractor, and subcontractors, will notify the Resident Engineer of any proposed changes, maintenance, or modifications to keep construction activities compliant with the Permit ILR10. Each such Contractor has signed the required certification on forms which are attached to, and are a part of, this plan:

A. **Erosion and Sediment Controls:** At a minimum, controls must be coordinated, installed and maintained to:

1. Minimize the amount of soil exposed during construction activity;
2. Minimize the disturbance of steep slopes;
3. Maintain natural buffers around surface waters, direct storm water to vegetated areas to increase sediment removal and maximize storm water infiltration, unless infeasible;
4. Minimize soil compaction and, unless infeasible, preserve topsoil.

protection will be installed at the upstream end of pipe culverts and inlets to prevent sediment from entering into the drainage structures. Riprap will be placed around surface water inlets and at curb outlets to limit the amount of erosion.

Describe how the structural practices listed above will be utilized after construction activities have been completed:

The noted structural practices listed above will all be removed and permanent seeding, mulch, turf reinforcement mat, and erosion control blanket will be installed in place of the temporary practices. The riprap will remain in place.

D. Treatment Chemicals

Will polymer flocculants or treatment chemicals be utilized on this project: Yes No

If yes above, identify where and how polymer flocculants or treatment chemicals will be utilized on this project.

E. Permanent Storm Water Management Controls: Provided below is a description of measures that will be installed during the construction process to control volume and pollutants in storm water discharges that will occur after construction operations have been completed. The installation of these devices may be subject to Section 404 of the Clean Water Act.

1. Such practices may include but are not limited to: storm water detention structures (including wet ponds), storm water retention structures, flow attenuation by use of open vegetated swales and natural depressions, infiltration of runoff on site, and sequential systems (which combine several practices).

The practices selected for implementation were determined on the basis of the technical guidance in Chapter 41 (Construction Site Storm Water Pollution Control) of the IDOT Bureau of Design and Environment Manual. If practices other than those discussed in Chapter 41 are selected for implementation or if practices are applied to situations different from those covered in Chapter 41, the technical basis for such decisions will be explained below.

2. Velocity dissipation devices will be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g. maintenance of hydrologic conditions such as the hydroperiod and hydrodynamics present prior to the initiation of construction activities).

Description of permanent storm water management controls:

Rip rap will be placed at curb outlets and around area inlets to limit the amount of erosion. A detention basin will be constructed to control and contain surface water from the existing pump station. All water from this system will remain contained as it currently is.

F. Approved State or Local Laws: The management practices, controls and provisions contained in this plan will be in accordance with IDOT specifications, which are at least as protective as the requirements contained in the Illinois Environmental Protection Agency's Illinois Urban Manual. Procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by local officials shall be described or incorporated by reference in the space provided below. Requirements specified in sediment and erosion site plans, site permits, storm water management site plans or site permits approved by local officials that are applicable to protecting surface water resources are, upon submittal of an NOI, to be authorized to discharge under the Permit ILR10 incorporated by reference and are enforceable under this permit even if they are not specifically included in the plan.

Description of procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by local officials:

All management practices, controls and other provisions provided in this plan are in accordance with IDOT Standard Specifications for Road and Bridge Construction and the Illinois Urban Manual.

G. Contractor Required Submittals: Prior to conducting any professional services at the site covered by this plan, the Contractor and each subcontractor responsible for compliance with the permit shall submit to the Resident Engineer a Contractor Certification Statement, BDE 2342a.

be repaired immediately.

Storm Drain Inlet Protection - Sediment will be removed if the integrity of the protection is in jeopardy and will be cleaned on a weekly basis.

IV. Inspections:

Qualified personnel shall inspect disturbed areas of the construction site which have not yet been finally stabilized, structural control measures, and locations where vehicles and equipment enter and exit the site using IDOT Storm Water Pollution Prevention Plan Erosion Control Inspection Report (BC 2259). Such inspections shall be conducted at least once every seven (7) calendar days and within twenty-four (24) hours of the end of a storm or by the end of the following business or work day that is 0.5 inch or greater or equivalent snowfall.

Inspections may be reduced to once per month when construction activities have ceased due to frozen conditions. Weekly inspections will recommence when construction activities are conducted, or if there is 0.5" or greater rain event, or a discharge due to snowmelt occurs.

If any violation of the provisions of this plan is identified during the conduct of the construction work covered by this plan, the Resident Engineer shall notify the appropriate IEPA Field Operations Section office by email at: epa.swnoncomp@illinois.gov, telephone or fax within twenty-four (24) hours of the incident. The Resident Engineer shall then complete and submit an "Incidence of Non-Compliance" (ION) report for the identified violation within five (5) days of the incident. The Resident Engineer shall use forms provided by IEPA and shall include specific information on the cause of noncompliance, actions which were taken to prevent any further causes of noncompliance, and a statement detailing any environmental impact which may have resulted from the noncompliance. All reports of non-compliance shall be signed by a responsible authority in accordance with Part VI. G of the Permit ILR10.

The Incidence of Non-Compliance shall be mailed to the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
Attn: Compliance Assurance Section
1021 North Grand East
Post Office Box 19276
Springfield, Illinois 62794-9276

Additional Inspections Required:

None

V. Failure to Comply:

Failure to comply with any provisions of this Storm Water Pollution Prevention Plan will result in the implementation of a National Pollutant Discharge Elimination System/Erosion and Sediment Control Deficiency Deduction against the Contractor and/or penalties under the Permit ILR10 which could be passed on to the Contractor.

PROJECT LABOR AGREEMENT - QUARTERLY EMPLOYMENT REPORT

Public Act 97-0199 requires the Department to submit quarterly reports regarding the number of minorities and females employed under Project Labor Agreements. To assist in this reporting effort, the Contractor shall provide a quarterly workforce participation report for all minority and female employees working under the project labor agreement of this contract. The data shall be reported on Construction Form BC 820, Project Labor Agreement (PLA) Workforce Participation Quarterly Reporting Form available on the Department's website <http://www.dot.il.gov/const/conforms.html>.

The report shall be submitted no later than the 15th of the month following the end of each quarter (i.e. April 15 for the January – March reporting period). The form shall be emailed to DOT.PLA.Reporting@illinois.gov or faxed to (217) 524-4922.

Any costs associated with complying with this provision shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

Illinois Department of Transportation
PROJECT LABOR AGREEMENT

This Project Labor Agreement (“PLA” or “Agreement”) is entered into this _____ day of _____, 2014, by and between the Illinois Department of Transportation (“IDOT” or “Department”) in its proprietary capacity, and each relevant Illinois AFL-CIO Building Trades signatory hereto as determined by the Illinois AFL-CIO Statewide Project Labor Agreement Committee on behalf of each of its affiliated members (individually and collectively, the “Unions”). This PLA shall apply to Construction Work (as defined herein) to be performed by IDOT’s Prime Contractor and each of its subcontractors of whatever tier (“Subcontractor” or “Subcontractors”) on Contract No. **76G99** (hereinafter, the “Project”).

ARTICLE 1 - INTENT AND PURPOSES

- 1.1 This PLA is entered into in accordance with the Project Labor Agreement Act (“Act”, 30 ILCS 571). It is mutually understood and agreed that the terms and conditions of this PLA are intended to promote the public interest in obtaining timely and economical completion of the Project by encouraging productive and efficient construction operations; by establishing a spirit of harmony and cooperation among the parties; and by providing for peaceful and prompt settlement of any and all labor grievances or jurisdictional disputes of any kind without strikes, lockouts, slowdowns, delays, or other disruptions to the prosecution of the work. The parties acknowledge the obligations of the Contractors and Subcontractors to comply with the provisions of the Act. The parties will work with the Contractors and Subcontractors within the parameters of other statutory and regulatory requirements to implement the Act’s goals and objectives.
- 1.2 As a condition of the award of the contract for performance of work on the Project, IDOT’s Prime Contractor and each of its Subcontractors shall execute a “Contractor Letter of Assent”, in the form attached hereto as Exhibit A, prior to commencing Construction Work on the Project. The Contractor shall submit a Subcontractor’s Contractor Letter of Assent to the Department prior to the Subcontractor’s performance of Construction Work on the Project. Upon request copies of the applicable collective bargaining agreements will be provided by the appropriate signatory labor organization consistent with this Agreement and at the pre-job conference referenced in Article III, Section 3.1.
- 1.3 Each Union affiliate and separate local representing workers engaged in Construction Work on the Project in accordance with this PLA are bound to this agreement by the Illinois AFL-CIO Statewide Project Labor Agreement Committee which is the central committee established with full authority to negotiate and sign PLAs with the State on behalf of all respective crafts. Upon their signing the Contractor Letter of Assent, the Prime Contractor, each Subcontractor, and the individual Unions shall thereafter be deemed a party to this PLA. No party signatory to this PLA shall, contract or subcontract, nor permit any other person, firm, company, or entity to contract or subcontract for the performance of Construction Work for the Project to any person, firm, company, or entity that does not agree in writing to become bound for the term of this Project by the terms of this PLA prior to commencing such work and to the applicable area-wide collective bargaining agreement(s) with the Union(s) signatory hereto.

- 1.4 It is understood that the Prime Contractor(s) and each Subcontractor will be considered and accepted by the Unions as separate employers for the purposes of collective bargaining, and it is further agreed that the employees working under this PLA shall constitute a bargaining unit separate and distinct from all others. The parties hereto also agree that this PLA shall be applicable solely with respect to this Project, and shall have no bearing on the interpretation of any other collective bargaining agreement or as to the recognition of any bargaining unit other than for the specific purposes of this Project.
- 1.5 In the event of a variance or conflict, whether explicit or implicit, between the terms and conditions of this PLA and the provisions of any other applicable national, area, or local collective bargaining agreement, the terms and conditions of this PLA shall supersede and control. For any work performed under the NTL Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, the National Agreement of the International Union of Elevator Constructors, and for any instrument calibration work and loop checking performed under the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, the preceding sentence shall apply only with respect to Articles I, II, V, VI, and VII.
- 1.6 Subject to the provisions of paragraph 1.5 of this Article, it is the parties' intent to respect the provisions of any other collective bargaining agreements that may now or hereafter pertain, whether between the Prime Contractor and one or more of the Unions or between a Subcontractor and one or more of the Unions. Accordingly, except and to the extent of any contrary provision set forth in this PLA, the Prime Contractor and each of its Subcontractors agrees to be bound and abide by the terms of the following in order of precedence: (a) the applicable collective bargaining agreement between the Prime Contractor and one or more of the Unions made signatory hereto; (b) the applicable collective bargaining agreement between a Subcontractor and one or more of the Unions made signatory hereto; or (c) the current applicable area collective bargaining agreement for the relevant Union that is the agreement certified by the Illinois Department of Labor for purposes of establishing the Prevailing Wage applicable to the Project. The Union will provide copies of the applicable collective bargaining agreements pursuant to part (c) of the preceding sentence to the Prime Contractor. Assignments by the Contractors or Subcontractors amongst the trades shall be consistent with area practices; in the event of unresolved disagreements as to the propriety of such assignments, the provisions of Article VI shall apply.
- 1.7 Subject to the limitations of paragraphs 1.4 to 1.6 of this Article, the terms of each applicable collective bargaining agreement as determined in accordance with paragraph 1.6 are incorporated herein by reference, and the terms of this PLA shall be deemed incorporated into such other applicable collective bargaining agreements only for purposes of their application to the Project.

- 1.8 To the extent necessary to comply with the requirements of any fringe benefit fund to which the Prime Contractor or Subcontractor is required to contribute under the terms of an applicable collective bargaining agreement pursuant to the preceding paragraph, the Prime Contractor or Subcontractor shall execute all "Participation Agreements" as may be reasonably required by the Union to accomplish such purpose; provided, however, that such Participation Agreements shall, when applicable to the Prime Contractor or Subcontractor solely as a result of this PLA, be amended as reasonably necessary to reflect such fact. Upon written notice in the form of a lien of a Contractor's or Subcontractor's delinquency from any applicable fringe benefit fund, IDOT will withhold from the Contractor's periodic pay request an amount sufficient to extinguish any delinquency obligation of the Contractor or Subcontractor arising out of the Project.
- 1.9 In the event that the applicable collective bargaining agreement between a Prime Contractor and the Union or between the Subcontractor and the Union expires prior to the completion of this Project, the expired applicable contract's terms will be maintained until a new applicable collective bargaining agreement is ratified. The wages and fringe benefits included in any new applicable collective bargaining agreement will apply on and after the effective date of the newly negotiated collective bargaining agreement, except to the extent wage and fringe benefit retroactivity is specifically agreed upon by the relevant bargaining parties.

ARTICLE II – APPLICABILITY, RECOGNITION, AND COMMITMENTS

- 2.1 The term Construction Work as used herein shall include all "construction, demolition, rehabilitation, renovation, or repair" work performed by a "laborer or mechanic" at the "site of the work" for the purpose of "building" the specific structures and improvements that constitute the Project. Terms appearing within quotation marks in the preceding sentence shall have the meaning ascribed to them pursuant to 29 CFR Part 5 and Illinois labor laws.
- 2.2 By executing the Letters of Assent, Prime Contractor and each of its Subcontractors recognizes the Unions signatory to this PLA as the sole and exclusive bargaining representatives for their craft employees employed on the jobsite for this Project. Unions who are signatory to this PLA will have recognition on the Project for their craft.
- 2.3 The Prime Contractor and each of its Subcontractors retains and shall be permitted to exercise full and exclusive authority and responsibility for the management of its operations, except as expressly limited by the terms of this PLA or by the terms and conditions of the applicable collective bargaining agreement.
- 2.4 Except to the extent contrary to an express provision of the relevant collective bargaining agreement, equipment or materials used in the Project may be pre-assembled or pre-fabricated, and there shall be no refusal by the Union to handle, transport, install, or connect such equipment or materials. Equipment or materials delivered to the job-site will be unloaded and handled promptly without regard to potential jurisdictional disputes; any such disputes shall be handled in accordance with the provisions of this PLA.
- 2.5 The parties are mutually committed to promoting a safe working environment for all personnel at the job-site. It shall be the responsibility of each employer to which this PLA applies to provide and maintain safe working conditions for its employees, and to comply with all applicable federal, state, and local health and safety laws and regulations.

- 2.6 The use or furnishing of alcohol or drugs and the conduct of any other illegal activity at the job-site is strictly prohibited. The parties shall take every practical measure consistent with the terms of applicable collective bargaining agreements to ensure that the job-site is free of alcohol and drugs.
- 2.7 All parties to this PLA agree that they will not discriminate against any employee based on race, creed, religion, color, national origin, union activity, age, gender or sexual orientation and shall comply with all applicable federal, state, and local laws.
- 2.8 In accordance with the Act and to promote diversity in employment, IDOT will establish, in cooperation with the other parties, the apprenticeship hours which are to be performed by minorities and females on the Project. IDOT shall consider the total hours to be performed by these underrepresented groups, as a percentage of the workforce, and create aspirational goals for each Project, based on the level of underutilization for the service area of the Project (together "Project Employment Objectives"). IDOT shall provide a quarterly report regarding the racial and gender composition of the workforce on the Project.

Persons currently lacking qualifications to enter apprenticeship programs will have the opportunity to obtain skills through basic training programs as have been established by the Department. The parties will endeavor to support such training programs to allow participants to obtain the requisite qualifications for the Project Employment Objectives.

The parties agree that all Contractors and Subcontractors working on the Project shall be encouraged to utilize the maximum number of apprentices as permitted under the terms of the applicable collective bargaining agreements to realize the Project Employment Objectives.

The Unions shall assist the Contractor and each Subcontractor in efforts to satisfy Project Employment Objectives. A Contractor or Subcontractor may request from a Union specific categories of workers necessary to satisfy Project Employment Objectives. The application of this section shall be consistent with all local Union collective bargaining agreements, and the hiring hall rules and regulations established for the hiring of personnel, as well as the apprenticeship standards set forth by each individual Union.

- 2.9 The parties hereto agree that engineering/architectural/surveying consultants' materials testing employees are subject to the terms of this PLA for Construction Work performed for a Contractor or Subcontractor on this Project. These workers shall be fully expected to objectively and responsibly perform their duties and obligations owed to the Department without regard to the potential union affiliation of such employees or of other employees on the Project.
- 2.10 This Agreement shall not apply to IDOT employees or employees of any other governmental entity.

ARTICLE III - ADMINISTRATION OF AGREEMENT

- 3.1 In order to assure that all parties have a clear understanding of the PLA, and to promote harmony, at the request of the Unions a post-award pre-job conference will be held among the Prime Contractor, all Subcontractors and Union representatives prior to the start of any Construction Work on the Project. No later than the conclusion of such pre-job conference, the parties shall, among other matters, provide to one another contact information for their respective representatives (including name, address, phone number, facsimile number, e-mail). Nothing herein shall be construed to limit the right of the Department to discuss or explain the purpose and intent of this PLA with prospective bidders or other interested parties prior to or following its award of the job.
- 3.2 Representatives of the Prime Contractor and the Unions shall meet as often as reasonably necessary following award until completion of the Project to assure the effective implementation of this PLA.
- 3.3 Any notice contemplated under Article VI and VII of this Agreement to a signatory labor organization shall be made in writing to the Local Union with copies to the local union's International Representative.

ARTICLE IV - HOURS OF WORK AND GENERAL CONDITIONS

- 4.1 The standard work day and work week for Construction Work on the Project shall be consistent with the respective collective bargaining agreements. In the event Project site or other job conditions dictate a change in the established starting time and/or a staggered lunch period for portions of the Project or for specific crafts, the Prime Contractor, relevant Subcontractors and business managers of the specific crafts involved shall confer and mutually agree to such changes as appropriate. If proposed work schedule changes cannot be mutually agreed upon between the parties, the hours fixed at the time of the pre-job meeting shall prevail.
- 4.2 Shift work may be established and directed by the Prime Contractor or relevant Subcontractor as reasonably necessary or appropriate to fulfill the terms of its contract with the Department. If used, shift hours, rates and conditions shall be as provided in the applicable collective bargaining agreement.
- 4.3 The parties agree that chronic and/or unexcused absenteeism is undesirable and must be controlled in accordance with procedures established by the applicable collective bargaining agreement. Any employee disciplined for absenteeism in accordance with such procedures shall be suspended from all work on the Project for not less than the maximum period permitted under the applicable collective bargaining agreement.
- 4.4 Except as may be otherwise expressly provided by the applicable collective bargaining agreement, employment begins and ends at the Project site; employees shall be at their place of work at the starting time; and employees shall remain at their place of work until quitting time.

- 4.5 Except as may be otherwise expressly provided by the applicable collective bargaining agreement, there shall be no limit on production by workmen, no restrictions on the full use of tools or equipment, and no restrictions on efficient use of manpower or techniques of construction other than as may be required by safety regulations.
- 4.6 The parties recognize that specialized or unusual equipment may be installed on the Project. In such cases, the Union recognizes the right of the Prime Contractor or Subcontractor to involve the equipment supplier or vendor's personnel in supervising the setting up of the equipment, making modifications and final alignment, and performing similar activities that may be reasonably necessary prior to and during the start-up procedure in order to protect factory warranties. The Prime Contractor or Subcontractor shall notify the Union representatives in advance of any work at the job-site by such vendor personnel in order to promote a harmonious relationship between the equipment vendor's personnel and other Project employees.
- 4.7 For the purpose of promoting full and effective implementation of this PLA, authorized Union representatives shall have access to the Project job-site during scheduled work hours. Such access shall be conditioned upon adherence to all reasonable visitor and security rules of general applicability that may be established for the Project site at the pre-job conference or from time to time thereafter.

ARTICLE V – GRIEVANCE PROCEDURES FOR DISPUTES ARISING UNDER A PARTICULAR COLLECTIVE BARGAINING AGREEMENT

- 5.1 In the event a dispute arises under a particular collective bargaining agreement specifically not including jurisdictional disputes referenced in Article VI below, said dispute shall be resolved by the Grievance/Arbitration procedure of the applicable collective bargaining agreement. The resulting determination from this process shall be final and binding on all parties bound to its process.
- 5.2 Employers covered under this Agreement shall have the right to discharge or discipline any employee who violates the provisions of this Agreement. Such discharge or discipline by a contractor or subcontractor shall be subject to Grievance/Arbitration procedure of the applicable collective bargaining agreement only as to the fact of such violation of this agreement. If such fact is established, the penalty imposed shall not be disturbed. Work at the Project site shall continue without disruption or hindrance of any kind as a result of a Grievance/Arbitration procedure under this Article.
- 5.3 In the event there is a deadlock in the foregoing procedure, the parties agree that the matter shall be submitted to arbitration for the selection and decision of an Arbitrator governed under paragraph 6.8.

ARTICLE VI –DISPUTES: GENERAL PRINCIPLES

- 6.1 This Agreement is entered into to prevent strikes, lost time, lockouts and to facilitate the peaceful adjustment of jurisdictional disputes in the building and construction industry and to prevent waste and unnecessary avoidable delays and expense, and for the further purpose of at all times securing for the employer sufficient skilled workers.
- 6.2 A panel of Permanent Arbitrators are attached as addendum (A) to this agreement. By mutual agreement between IDOT and the Unions, the parties can open this section of the agreement as needed to make changes to the list of permanent arbitrators.

- 6.3 The PLA Jurisdictional Dispute Resolution Process (“Process”) sets forth the procedures below to resolve jurisdictional disputes between and among Contractors, Subcontractors, and Unions engaged in the building and construction industry. Further, the Process will be followed for any grievance or dispute arising out of the interpretation or application of this PLA by the parties except for the prohibition on attorneys contained in 6.11. All decisions made through the Process are final and binding upon all parties.

DISPUTE PROCESS

- 6.4 Administrative functions under the Process shall be performed through the offices of the President and/or Secretary-Treasurer of the Illinois State Federation of Labor, or their designated representative, called the Administrator. In no event shall any officer, employee, agent, attorney, or other representative of the Illinois Federation of Labor, AFL-CIO be subject to any subpoena to appear or testify at any jurisdictional dispute hearing.
- 6.5 There shall be no abandonment of work during any case participating in this Process or in violation of the arbitration decision. All parties to this Process release the Illinois State Federation of Labor (“Federation”) from any liability arising from its action or inaction and covenant not to sue the Federation, nor its officers, employees, agents or attorneys.
- 6.6 In the event of a dispute relating to trade or work jurisdiction, all parties, including the employers, Contractors or Subcontractors, agree that a final and binding resolution of the dispute shall be resolved as follows:
- (a) Representatives of the affected trades and the Contractor or Subcontractor shall meet on the job site within two (2) business days after receiving written notice in an effort to resolve the dispute. (In the event there is a dispute between local unions affiliated with the same International Union, the decision of the General President, or his/her designee, as the internal jurisdictional authority of that International Union, shall constitute a final and binding decision and determination as to the jurisdiction of work.)
 - (b) If no settlement is achieved subsequent to the preceding Paragraph, the matter shall be referred to the local area Building & Construction Trades Council, which shall meet with the affected trades within two (2) business days subsequent to receiving written notice. In the event the parties do not wish to avail themselves of the local Building & Construction Trades Council, the parties may elect to invoke the services of their respective International Representatives with no extension of the time limitations. An agreement reached at this Step shall be final and binding upon all parties.

(c) If no settlement agreement is reached during the proceedings contemplated by Paragraphs "a" or "b" above, the matter shall be immediately referred to the Illinois Jurisdictional Dispute Process for final and binding resolution of said dispute. Said referral submission shall be in writing and served upon the Illinois State Federation of Labor, or the Administrator, pursuant to paragraph 6.4 of this agreement. The Administrator shall, within three (3) days, provide for the selection of an available Arbitrator to hear said dispute within this time period. Upon good cause shown and determined by the Administrator, an additional three (3) day extension for said hearing shall be granted at the sole discretion of the Administrator. Only upon mutual agreement of all parties may the Administrator extend the hearing for a period in excess of the time frames contemplated under this Paragraph. Business days are defined as Monday through Friday, excluding contract holidays.

6.7 The primary concern of the Process shall be the adjustment of jurisdictional disputes arising out of the Project. A sufficient number of Arbitrators shall be selected from list of approved Arbitrators as referenced Sec. 6.2 and shall be assigned per Sec. 6.8. Decisions shall be only for the Project and shall become effective immediately upon issuance and complied with by all parties. The authority of the Arbitrator shall be restricted and limited specifically to the terms and provisions of Article VI and generally to this Agreement as a whole.

6.8 The Arbitrator chosen shall be randomly selected based on the list of Arbitrators in Sec. 6.2 and geographical location of the jurisdictional dispute and upon his/her availability, and ability to conduct a Hearing within two (2) business days of said notice. The Arbitrator may issue a "bench" decision immediately following the Hearing or he/she may elect to only issue a written decision, said decision must be issued within two (2) business days subsequent to the completion of the Hearing. Copies of all notices, pleadings, supporting memoranda, decisions, etc. shall be provided to all disputing parties and the Illinois State Federation of Labor.

Any written decision shall be in accordance with this Process and shall be final and binding upon all parties to the dispute and may be a "short form" decision. Fees and costs of the arbitrator shall be divided evenly between the contesting parties except that any party wishing a full opinion and decision beyond the short form decision shall bear the reasonable fees and costs of such full opinion. The decision of the Arbitrator shall be final and binding upon the parties hereto, their members, and affiliates.

In cases of jurisdictional disputes or other disputes between a signatory labor organization and another labor organization, both of which is an affiliate or member of the same International Union, the matter or dispute shall be settled in the manner set forth by their International Constitution and/or as determined by the International Union's General President whose decision shall be final and binding upon all parties. In no event shall there be an abandonment of work.

6.9 In rendering a decision, the Arbitrator shall determine:

(a) First, whether a previous agreement of record or applicable agreement, including a disclaimer agreement, between National or International Unions to the dispute or agreements between local unions involved in the dispute, governs;

- (b) Only if the Arbitrator finds that the dispute is not covered by an appropriate or applicable agreement of record or agreement between the crafts to the dispute, he shall then consider the established trade practice in the industry and prevailing practice in the locality. Where there is a previous decision of record governing the case, the Arbitrator shall give equal weight to such decision of record, unless the prevailing practice in the locality in the past ten years favors one craft. In that case, the Arbitrator shall base his decision on the prevailing practice in the locality. Except, that if the Arbitrator finds that a craft has improperly obtained the prevailing practice in the locality through raiding, the undercutting of wages or by the use of vertical agreements, the Arbitrator shall rely on the decision of record and established trade practice in the industry rather than the prevailing practice in the locality; and,
- (c) Only if none of the above criteria is found to exist, the Arbitrator shall then consider that because efficiency, cost or continuity and good management are essential to the well being of the industry, the interests of the consumer or the past practices of the employer shall not be ignored.
- 6.10 The Arbitrator shall set forth the basis for his/her decision and shall explain his/her findings regarding the applicability of the above criteria. If lower ranked criteria are relied upon, the Arbitrator shall explain why the higher-ranked criteria were not deemed applicable. The Arbitrator's decision shall only apply to the Project. Agreements of Record, for other PLA projects, are applicable only to those parties signatory to such agreements. Decisions of Record are those that were either attested to by the former Impartial Jurisdictional Disputes Board or adopted by the National Arbitration Panel.
- 6.11 All interested parties, as determined by the Arbitrator, shall be entitled to make presentations to the Arbitrator. Any interested labor organization affiliated to the PLA Committee and party present at the Hearing, whether making a presentation or not, by such presence shall be deemed to accept the jurisdiction of the Arbitrator and to agree to be bound by its decision. In addition to the representative of the local labor organization, a representative of the labor organization's International Union may appear on behalf of the parties. Each party is responsible for arranging for its witnesses. In the event an Arbitrator's subpoena is required, the party requiring said subpoena shall prepare the subpoena for the Arbitrator to execute. Service of the subpoena upon any witness shall be the responsibility of the issuing party.

Attorneys shall not be permitted to attend or participate in any portion of a Hearing.

The parties are encouraged to determine, prior to Hearing, documentary evidence which may be presented to the Arbitrator on a joint basis.

- 6.12 The Order of Presentation in all Hearings before an Arbitrator shall be
- I. Identification and Stipulation of the Parties
 - II. Unions(s) claiming the disputed work presents its case
 - III. Union(s) assigned the disputed work presents its case
 - IV. Employer assigning the disputed work presents its case
 - V. Evidence from other interested parties (i.e., general contractor, project manager, owner)
 - VI. Rebuttal by union(s) claiming the disputed work
 - VII. Additional submissions permitted and requested by Arbitrator
 - VIII. Closing arguments by the parties
- 6.13 All parties bound to the provisions of this Process hereby release the Illinois State Federation of Labor and IDOT, their respective officers, agents, employees or designated representatives, specifically including any Arbitrator participating in said Process, from any and all liability or claim, of whatsoever nature, and specifically incorporating the protections provided in the Illinois Arbitration Act, as amended from time to time.
- 6.14 The Process, as an arbitration panel, nor its Administrator, shall have any authority to undertake any action to enforce its decision(s). Rather, it shall be the responsibility of the prevailing party to seek appropriate enforcement of a decision, including findings, orders or awards of the Arbitrator or Administrator determining non-compliance with a prior award or decision.
- 6.15 If at any time there is a question as to the jurisdiction of the Illinois Jurisdictional Dispute Resolution Process, the primary responsibility for any determination of the arbitrability of a dispute and the jurisdiction of the Arbitrator shall be borne by the party requesting the Arbitrator to hear the underlying jurisdictional dispute. The affected party or parties may proceed before the Arbitrator even in the absence or one or more stipulated parties with the issue of jurisdiction as an additional item to be decided by the Arbitrator. The Administrator may participate in proceedings seeking a declaration or determination that the underlying dispute is subject to the jurisdiction and process of the Illinois Jurisdictional Dispute Resolution Process. In any such proceedings, the non-prevailing party and/or the party challenging the jurisdiction of the Illinois Jurisdictional Dispute Resolution Process shall bear all the costs, expenses and attorneys' fees incurred by the Illinois Jurisdictional Dispute Resolution Process and/or its Administrator in establishing its jurisdiction.

ARTICLE VII - WORK STOPPAGES AND LOCKOUTS

- 7.1 During the term of this PLA, no Union or any of its members, officers, stewards, employees, agents or representatives shall instigate, support, sanction, maintain, or participate in any strike, picketing, walkout, work stoppage, slow down or other activity that interferes with the routine and timely prosecution of work at the Project site or at any other contractor's or supplier's facility that is necessary to performance of work at the Project site. Hand billing at the Project site during the designated lunch period and before commencement or following conclusion of the established standard workday shall not, in itself, be deemed an activity that interferes with the routine and timely prosecution of work on the Project.

7.2 Should any activity prohibited by paragraph 7.1 of this Article occur, the Union shall undertake all steps reasonably necessary to promptly end such prohibited activities.

7.2.A No Union complying with its obligations under this Article shall be liable for acts of employees for which it has no responsibility or for the unauthorized acts of employees it represents. Any employee who participates or encourages any activity prohibited by paragraph 7.1 shall be immediately suspended from all work on the Project for a period equal to the greater of (a) 60 days; or (b) the maximum disciplinary period allowed under the applicable collective bargaining agreement for engaging in comparable unauthorized or prohibited activity.

7.2.B Neither the PLA Committee nor its affiliates shall be liable for acts of employees for which it has no responsibility. The principal officer or officers of the PLA Committee will immediately instruct, order and use the best efforts of his office to cause the affiliated union or unions to cease any violations of this Article. The PLA Committee in its compliance with this obligation shall not be liable for acts of its affiliates. The principal officer or officers of any involved affiliate will immediately instruct, order or use the best effort of his office to cause the employees the union represents to cease any violations of this Article. A union complying with this obligation shall not be liable for unauthorized acts of employees it represents. The failure of the Contractor to exercise its rights in any instance shall not be deemed a waiver of its rights in any other instance.

During the term of this PLA, the Prime Contractor and its Subcontractors shall not engage in any lockout at the Project site of employees covered by this Agreement.

7.3 Upon notification of violations of this Article, the principal officer or officers of the local area Building and Construction Trades Council, and the Illinois AFL-CIO Statewide Project Labor Agreement Committee as appropriate, will immediately instruct, order and use their best efforts to cause the affiliated union or unions to cease any violations of this Article. A Trades Council and the Committee otherwise in compliance with the obligations under this paragraph shall not be liable for unauthorized acts of its affiliates.

7.4 In the event that activities in violation of this Article are not immediately halted through the efforts of the parties, any aggrieved party may invoke the special arbitration provisions set forth in paragraph 7.5 of this Article.

7.5 Upon written notice to the other involved parties by the most expeditious means available, any aggrieved party may institute the following special arbitration procedure when a breach of this Article is alleged:

7.5.A The party invoking this procedure shall notify the individual designated as the Permanent Arbitrator pursuant to paragraph 6.8 of the nature of the alleged violation; such notice shall be by the most expeditious means possible. The initiating party may also furnish such additional factual information as may be reasonably necessary for the Permanent Arbitrator to understand the relevant circumstances. Copies of any written materials provided to the arbitrator shall also be contemporaneously provided by the most expeditious means possible to the party alleged to be in violation and to all other involved parties.

- 7.5.B Upon receipt of said notice the Permanent Arbitrator shall set and hold a hearing within twenty-four (24) hours if it is contended the violation is ongoing, but not before twenty-four (24) hours after the written notice to all parties involved as required above.
- 7.5.C The Permanent Arbitrator shall notify the parties by facsimile or any other effective written means, of the place and time chosen by the Permanent Arbitrator for this hearing. Said hearing shall be completed in one session. A failure of any party or parties to attend said hearing shall not delay the hearing of evidence or issuance of an Award by the Permanent Arbitrator.
- 7.5.D The sole issue at the hearing shall be whether a violation of this Article has, in fact, occurred. An Award shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without a written opinion. If any party desires a written opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the Award. The Permanent Arbitrator may order cessation of the violation of this Article, and such Award shall be served on all parties by hand or registered mail upon issuance.
- 7.5.E Such Award may be enforced by any court of competent jurisdiction upon the filing of the Award and such other relevant documents as may be required. Facsimile or other hardcopy written notice of the filing of such enforcement proceedings shall be given to the other relevant parties. In a proceeding to obtain a temporary order enforcing the Permanent Arbitrator's Award as issued under this Article, all parties waive the right to a hearing and agree that such proceedings may be ex parte. Such agreement does not waive any party's right to participate in a hearing for a final order of enforcement. The Court's order or orders enforcing the Permanent Arbitrator's Award shall be served on all parties by hand or by delivery to their last known address or by registered mail.
- 7.6 Individuals found to have violated the provisions of this Article are subject to immediate termination. In addition, IDOT reserves the right to terminate this PLA as to any party found to have violated the provisions of this Article.
- 7.7 Any rights created by statute or law governing arbitration proceedings inconsistent with the above procedure or which interfere with compliance therewith are hereby waived by parties to whom they accrue.
- 7.8 The fees and expenses of the Permanent Arbitrator shall be borne by the party or parties found in violation, or in the event no violation is found, such fees and expenses shall be borne by the moving party.

ARTICLE VIII – TERMS OF AGREEMENT

- 8.1 If any Article or provision of this Agreement shall be declared invalid, inoperative or unenforceable by operation of law or by any of the above mentioned tribunals of competent jurisdiction, the remainder of this Agreement or the application of such Article or provision to persons or circumstances other than those as to which it has been held invalid, inoperative or unenforceable shall not be affected thereby.
- 8.2 This Agreement shall be in full force as of and from the date of the Notice of Award until the Project contract is closed.

- 8.3 This PLA may not be changed or modified except by the subsequent written agreement of the parties. All parties represent that they have the full legal authority to enter into this PLA. This PLA may be executed by the parties in one or more counterparts.
- 8.4 Any liability arising out of this PLA shall be several and not joint. IDOT shall not be liable to any person or other party for any violation of this PLA by any other party, and no Contractor or Union shall be liable for any violation of this PLA by any other Contractor or Union.
- 8.5 The failure or refusal of a party to exercise its rights hereunder in one or more instances shall not be deemed a waiver of any such rights in respect of a separate instance of the same or similar nature.

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Addendum A

IDOT Slate of Permanent Arbitrators

1. Bruce Feldacker
2. Thomas F. Gibbons
3. Edward J. Harrick
4. Brent L. Motchan
5. Robert Perkovich
6. Byron Yaffee
7. Glenn A. Zipp

Execution Page

Illinois Department of Transportation

Omer M. Osman, Director of Highways

Michael A. Forti, Chief Counsel

Erica J. Borggren, Acting Secretary

(Date)

Illinois AFL-CIO Statewide Project Labor Agreement Committee, representing the Unions listed below:

(Date)

List Unions:

****RETURN WITH BID****

Exhibit A - Contractor Letter of Assent

(Date)

To All Parties:

In accordance with the terms and conditions of the contract for Construction Work on [Contract No. **76G99**], this Letter of Assent hereby confirms that the undersigned Prime Contractor or Subcontractor agrees to be bound by the terms and conditions of the Project Labor Agreement established and entered into by the Illinois Department of Transportation in connection with said Project.

It is the understanding and intent of the undersigned party that this Project Labor Agreement shall pertain only to the identified Project. In the event it is necessary for the undersigned party to become signatory to a collective bargaining agreement to which it is not otherwise a party in order that it may lawfully make certain required contributions to applicable fringe benefit funds, the undersigned party hereby expressly conditions its acceptance of and limits its participation in such collective bargaining agreement to its work on the Project.

(Authorized Company Officer)

(Company)

****RETURN WITH BID****

REVISIONS TO THE ILLINOIS PREVAILING WAGE RATES

The Prevailing rates of wages are included in the Contract proposals which are subject to Check Sheet #5 of the Supplemental Specifications and Recurring Special Provisions. The rates have been ascertained and certified by the Illinois Department of Labor for the locality in which the work is to be performed and for each craft or type of work or mechanic needed to execute the work of the Contract. As required by Prevailing Wage Act (820 ILCS 130/0.01, et seq.) and Check Sheet #5 of the Contract, not less than the rates of wages ascertained by the Illinois Department of Labor and as revised during the performance of a Contract shall be paid to all laborers, workers and mechanics performing work under the Contract. Post the scale of wages in a prominent and easily accessible place at the site of work.

If the Illinois Department of Labor revises the prevailing rates of wages to be paid as listed in the specification of rates, the contractor shall post the revised rates of wages and shall pay not less than the revised rates of wages. Current wage rate information shall be obtained by visiting the Illinois Department of Labor web site at <http://www.state.il.us/agency/idol/> or by calling 312-793-2814. It is the responsibility of the contractor to review the rates applicable to the work of the contract at regular intervals in order to insure the timely payment of current rates. Provision of this information to the contractor by means of the Illinois Department of Labor web site satisfies the notification of revisions by the Department to the contractor pursuant to the Act, and the contractor agrees that no additional notice is required. The contractor shall notify each of its subcontractors of the revised rates of wages.