



# Chase River Pump Station Upgrades

## Chase River Pump Station Bypass Strategy

| 1

January 14, 2022

Regional District of Nanaimo



## Chase River Pump Station Upgrades

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Author: C. Williams  
File Name:

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### Document history and status

Revision	Date	Description	Author	Reviewed	Approved
0	June 2021	Issued For Construction	CW	JG	JG
1	January 2022	Issued For Construction	CW	JG	JG

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- Appendix B. Pump Datasheet and System Curve
- Appendix C. Site Specific Bypass Strategy Drawings

## 1. Introduction

The Chase River Pump Station Upgrade Project consists of the following work:

- Replacement of 2 of the existing Motor Control Centers (MCC1 and MCC 2) with a new MCC, including Variable Frequency Drives (VFD).
- Replacement of existing Programmable Logic Controller (PLC) panel CP-100 with a new Compact Logix PLC and Panel View HMI.
- Replacement of wet well piping from pump bases to just inside of the wet well wall.
- Replacement of the steel operating platform and supports.

To facilitate the above work, the Chase River Pump Station will be shut down and a system bypass will be installed. The Contractor will be responsible for validating the design and design requirements, installation, operation and maintenance of the bypass system.

This Chase River Pump Station Bypass Strategy provides a bypass strategy based on existing information and anticipated construction activities. This plan provides a framework at a strategic level, providing general requirements and addressing identified challenges. The Contractor is required to develop and submit a detailed Bypass Plan for review prior to construction as outlined in the Contract Documents.

## 2. Bypass System Requirements

The bypass system is to be designed to meet the following requirements:

- Maximum Flowrate – 400 L/s
- Forcemain Total Dynamic Head – 30 m
- Hours of Operation – 24 hrs/day, 7 days per week
- Redundancy – 100% redundancy

## 3. Bypass Strategy

The bypass is to be installed to utilize existing infrastructure as much as possible and to minimize impact on construction activities. The strategy has been developed with the assumption the new valve enclosure will be installed at the time of this wet well bypass installation.

- Wet Well Isolation

The wet well will be isolated upstream in two locations to ensure double isolation. One isolation will be accomplished by closing the actuated 1066 mm diameter sluice gate valve in the Junction Chamber. The second isolation will be accomplished by installing a 1067 mm diameter inflatable plug in the sewer influent pipe at the wet well. Plug shall be installed with pressure monitoring and additional anchoring.

The wet well will be isolated downstream by closing three mainline valves in the new valve enclosure (which are typically open) and maintaining the closure of two valves (which are typically closed). Having



all valves in new valve chamber closed provides double isolation between the bypass valves and the downstream wet well.

Isolation requirements are described in more detail in Table 1. Refer to Appendix A for the valve location drawings.

Table 1 – Valve Isolation Requirements

Valve ID Number	Nominal Diameter (mm)	Description	Isolation Requirements
P-1	1067	Wet Well Influent Pipe	Inflatable Isolation Plug
V-1	1066	Junction Chamber	Close valve. Require isolation plug (P-1) downstream in wet well influent pipe.
V-2	500	Mainline Isolation Valve	Close valve (typically open)
V-3	500	Flow Meter Bypass Valve	Valve to remain close
V-4	500	Mainline Isolation Valve	Close valve (typically open)
V-5	450	Forcemain #2 Isolation Valve	Valve to remain close
V-6	500	Mainline Isolation Valve	Close valve (typically open)
V-7	300	Bypass Valve	Open for use
V-8	300	Bypass Valve	Open for use

- Pump Selection

The bypass system will pump from the existing 500 mm x 2400 mm rectangular Junction Chamber. The maximum chamber depth is 8.9 m (bottom elevation of -4.4 m). The Junction Chamber can surcharge to an elevation of 1.5 m without impacting upstream operation.

Two 200 L/s trailer mounted vacuum assisted, end suction centrifugal diesel pumps have been selected to operate in parallel for the bypass operation. 250 mm diameter smooth bore hose suction and discharge piping are to be installed. The proposed pump datasheet and system curves are included in Appendix B. Table 2 summarizes the system curve details. The Contractor may propose alternative pumps that meet the stated bypass system requirements.

Table 2– Pump and System Details

Criteria	Per Pump
Maximum Chamber Depth	8.9 m
Flowrate	200 L/s
Suction Lift Required	3 to 8.9 m
Suction Pipe Length	10 m
Suction Pipe Diameter	250 mm
Suction Velocity	4 m/s
Discharge Length	45 m
Bypass Discharge Pipe Diameter	250 mm

Bypass Discharge Velocity	4 m/s
Total System Dynamic Head	40 m

The pumps are to be automatically controlled by a pressure sensor or submersible level transducer, which maintains the sewage level in the Junction Chamber within the set parameters (maximum EL 1.5 m). The pumps are to be operated monitored and manned by trained personnel full time during operation.

- Bypass Connections

The 250 mm diameter suction hoses shall be installed and supported in the Junction Chamber. Existing platforms and infrastructure shall be removed by the Contractor to facilitate suction installation. The Junction Chamber shall be cleaned, with any sludge and debris removed prior to bypass installation.

The 250 mm diameter bypass hoses will connect back into the forcemain system via the new valve enclosure using the two bypass valves. One discharge line will connect to the newly installed HDPE Forcemain #1 via the partnering 300mm diameter plug valve in the new valve enclosure. The other discharge line to connect to the adjacent 300mm diameter plug valve which will convey flow to the ductile iron Forcemain #2.

The proposed site specific bypass strategy drawings are included in Appendix C.

## 4. Construction Sequencing

The suggested sequence of construction described herein is based on Jacobs' knowledge of the design components and not on experience in the construction of such Work.

The Contractor may on his own initiative submit an alternate proposed sequence of construction for review. **Note**  
**Forcemain #1 is the mainline.**

Suggested construction sequence:

- Inspect existing works, locate existing valves and exercise valves to confirm operational. Coordinate inspection with Regional District of Nanaimo (RDN) operations staff. This may require exposing tie-in points to confirm condition of existing pipework.
- Inspect Junction Chamber and internal platforms and appurtenances. Confirm what needs to be removed for the installation of the 250 mm diameter suction hoses and how hoses will be installed and supported.
- Submit bypass plan for review and acceptance.
- Following acceptance, clean Junction Chamber and appurtenances including removing any sludge and debris at the base of chamber and sump. Install and support suction piping.
- Position trailer mounted diesel pumps, connect suction piping and install pressure/level sensor in Junction Chamber
- Connect bypass hose to pumps and lay hose above ground to connection points for tie-in.

- Connect one bypass hose to 300mm plug valve (V-8) within new valve enclosure. Will require check valve and 250 x 300 mm reducer. This will convey flow to the 600 mm diameter HDPE forcemain (Forcemain #1).
- Connect one bypass hose to 300mm plug valve (V-7) within new valve enclosure. Will require check valve and 250 x 300 mm reducer. This can convey flow to the 450 mm diameter DI forcemain (Forcemain #2).
- Coordinate with RDN operations staff the upcoming bypass works. Coordinate requirements for septage facility collection. Confirm date for CRPS wet well isolation and pump shut down. Plan work during low flow conditions monitoring upcoming weather conditions.
- On agreed date, RDN to close Junction Chamber sluice gate valve, V-1, during low flow conditions.
- RDN to switch off CRPS pumps and close valves V-2, V-4 and V-6 in new valve enclosure. Valves V-3 and V-5 to remain close.
- Contractor to open bypass valve V-8 to Forcemain #1 in the new valve chamber and start associated bypass pump. Drain pipework in new valve chamber to reduce septicity.
- Use sump pumps to drain CRPS wet well with discharge to Junction Chamber and to remain operating until inflatable plug P-1 has been installed and wet well has been cleaned and drained.
- Install inflatable plug, P-1, in the sewer influent pipe. Clean and prepare wet well for work.
- Open bypass valve V-7 to Forcemain #2 in readiness for use.
- Carry out works at the CRPS facility.
- Once CRPS works have been completed (accepted and commissioned) plan decommissioning of bypass piping.
- Remove inflatable plug, P1.
- Open Junction Chamber sluice gate valve, V-1
- Stop bypass pumps and close valves V-7 and V-8 for each bypass hose.
- Open valves V-2, V-4 and V-6 and use CRPS to pump flow through Forcemain #1.
- Drain Forcemain #2.
- Disconnect bypass hoses and remove overland bypass hoses, pumps and suction hoses.
- Replace platforms within Junction Chamber and complete restoration.

## 5. System Operation Monitoring

The Contractor shall provide a full time monitor of the bypass system while in operations. Should the pumps experience a problem, the Contractor will mobilize a service technician to troubleshoot the problem. All provisions and precautions to be taken during installation, operation and decommissioning the system in order

to prevent sewage backups, overflows or spills. The pumps are to be monitored constantly while in operation and the connecting piping to be check hourly.

## 6. Installation and Teardown

Prior to removal the system shall be flushed with potable water and clean up measures to be documented. Installation of the bypass system will be supervised by a qualified profession. The placement of pumps and hoses will be according to the actual site conditions encountered at the time construction. The bypass system is to be installed in a manner not to obstruct site or construction access to the wet well or valve station construction sites.

## Appendix A. Valve Location Drawings

VALVE LOCATION DRAWINGS  
PAGE 1 OF 3

VERIFY SCALES  
BAR IS BASED ON  
ORIGINAL DRAWING  
0 20mm  
IF NOT 20mm ON  
THE SHEET, ADJUST  
SCALES ACCORDINGLY

RECORD DRAWING - NOT TO BE USED FOR  
CONSTRUCTION OF ALTERATIONS. ALL ITEMS  
SHOWN, MATERIALS, AND DIMENSIONS TO  
BE CONFIRMED ON SITE

NO.	DATE	ENG.	BY	SUBJECT
2	23 AUG 02	P.D.G.	S.T.	RECORD DRAWING
1	JAN 04/01	MB/AL	PL	PLATFORMS & ELEC. OPERATOR
0		L.P.	S.T.	
REVISIONS				
PROJECT NO.		982819-603		
SCALE		AS SHOWN		
DRAWN		S.T.		
DESIGNED		L.P.		
CHECKED		L.W.P.		
APPROVED				
APPROVED				
DATE		DEC 2001		

ASSOCIATED  
ENGINEERING

DISTRICT PROJECT NUMBER  
0810-20-CRPS-04

DISTRICT DRAWING NUMBER  
CRPS-C-109

REGIONAL DISTRICT  
OF NANAIMO

CHASE RIVER  
PUMPING STATION UPGRADE

CIVIL  
JUNCTION CHAMBER - MODIFICATIONS

DRAWING NUMBER	REV. NO.	SHEET
CH3-105	2	

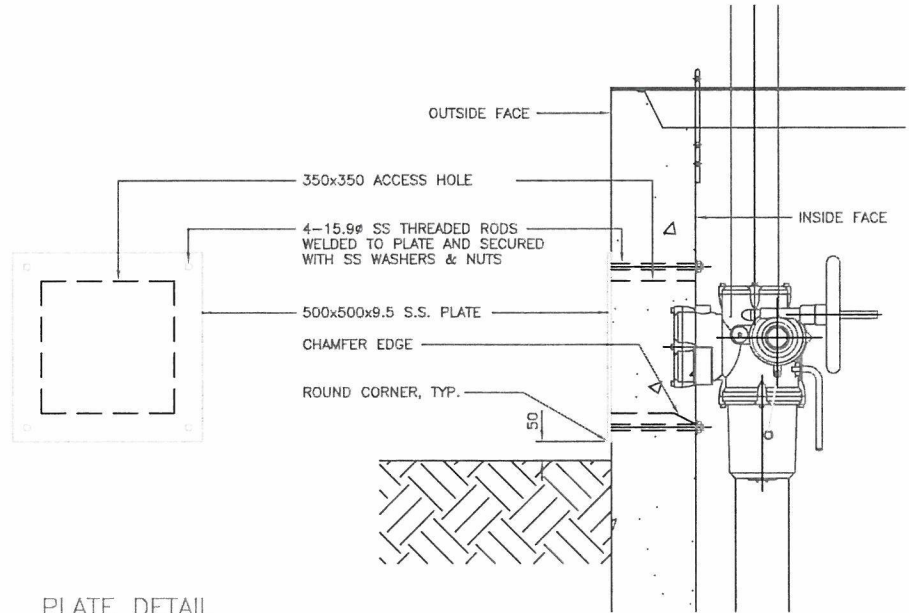
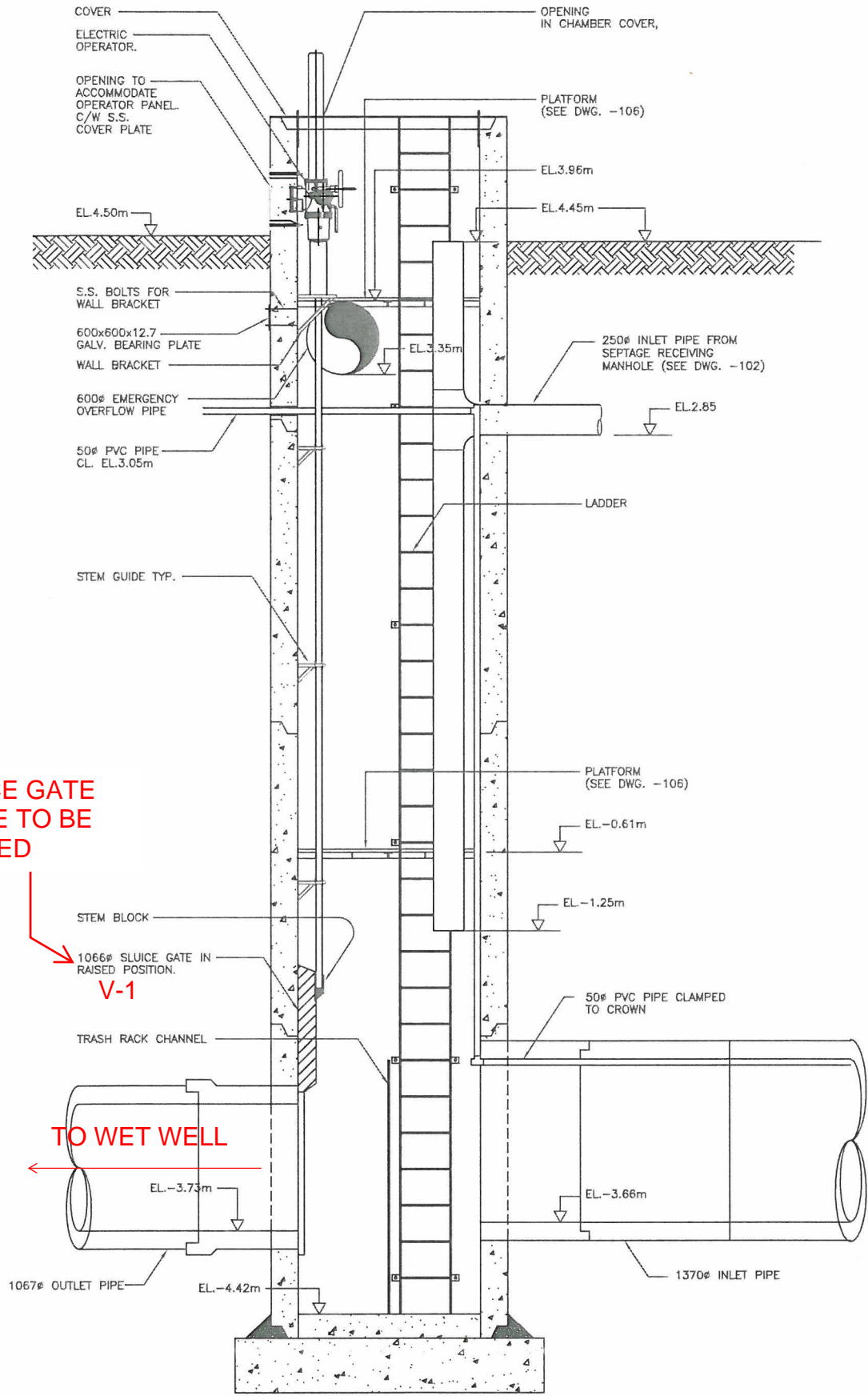


PLATE DETAIL  
SCALE: 1:10

GATE ACTUATOR SPECIFICATIONS:

- TAG: G-120
- MANUFACTURER: ROTORK CONTROLS
- MAKE: IQ SERIES.
- SPEED: 362 mm/minute
- POWER: 575 VAC 3 PHASE, CURRENT 13.5A
- APPROVAL: CSA
- DUTY: CAPABLE OF 60 STARTS PER HOUR.
- CLASSIFICATION: ZONE 1, DIV 1, GROUP D EXPLOSION PROOF AND RATED FOR IP68.
- ATMOSPHERE: AIR WITH H2S GAS, METHANE GAS, AND MOISTURE.
- LOCAL OPERATORS: LOCAL/OFF/REMOTE AND OPEN/CLOSE SELECTOR SWITCHES.
- MANUAL OPERATOR: SIDE MOUNTED HANDWHEEL WITH CLUTCH.
- LOCAL INDICATION: LCD WITH NUMERIC AND ICON DISPLAY.
- POSITION TRANSMITTER: 4 - 20 mA ACTUATOR POWERED REPRESENTING GATE POSITION IN % OPEN
- POSITION SWITCHES: 4 CONFIGURABLE DRY CONTACT POSITION SWITCHES.
- CONFIGURATION: INCLUDE AN INFRARED REMOTE CONTROL IQ SETTING TOOL.
- CONTROL MODE: OPEN/STOP/CLOSE MAINTAINED CONTROL WITH INTERNALLY FED 120 VAC CIRCUITS.
- WARRANTY: 2 YEARS.
- MOUNTING: 316 SS OR COATED STEEL PEDESTAL TO SUIT LOCATION AND PROVIDE ACCESS TO THE HANDWHEEL.
- STEM COVER: 316 SS STEM COVER TO ENCLOSE THE PROTRUDING GATE SHAFT COMPLETELY WHEN THE GATE IS FULLY OPEN.
- GATE STEM: 316 STAINLESS STEEL DIAMETER STEM SHAFT FOR 1,066 mm CAST IRON GATE TO SUIT DESIGN AND SITE CONDITIONS.
- STEM GUIDES: CAST IRON WITH COATING AND AS DESIGNED BY ARMTEC.
- MOUNTING: CAST IRON WITH COATING FOR ACTUATOR WALL MOUNTING BRACKET.
- COATING: COATING MENTIONED ABOVE TO BE: SHOP PRIMED AND COATED WITH COAL-TAR EPOXY TO A MINIMUM OF 16-MILS.
- SHOP DRAWING: SUBMIT SHOP DRAWINGS AND INCLUDE FIELD MEASUREMENTS REQUIRED FOR CONFIRMATION OF GATE STEM LENGTH, ACTUATOR PIPE STAND LENGTH, PIPE STAND WALL BRACKET LOCATION, STEM GUIDE LOCATIONS AND LOCATION OF ACCESS HOLE FOR ACTUATOR.

RENUMBERED FROM 982819-603-1-105 TO ---

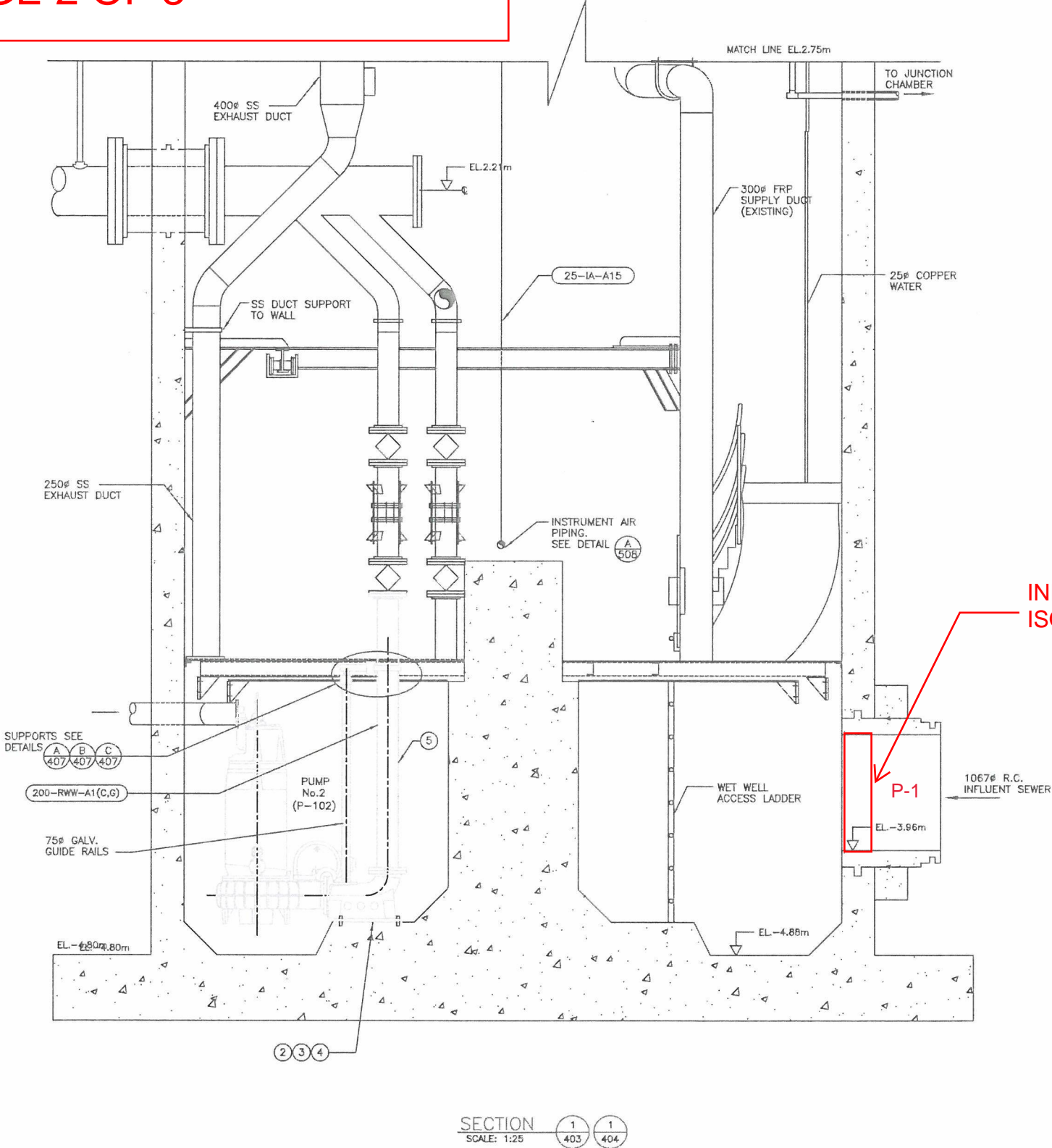
SLUICE GATE  
VALVE TO BE  
CLOSED

TO WET WELL

05.dwg  
20920ST - Q: 98281  
2002/11/18 16:32:13 ST  
1=1  
DRAWING IS DATA-LINKED



VALVE LOCATION DRAWINGS  
PAGE 2 OF 3



KEY NOTES:

1. CONTRACTOR TO INSTALL OWNER SUPPLIED PUMP No. 2 AND ACCESSORIES AS SPECIFIED.
2. MODIFY PUMP BASE PLATE WITH FLAT WASHERS WELDED TO PLATE, TO FIT EXISTING ANCHOR FRAME BOLT PATTERN.
3. USE MACHINE BASE GROUT TO LEVEL PUMP BASE PLATE.
4. FASTEN BASE TO EXISTING 25 DIA. GALV. BOLTS WITH 25 DIA. NYLON COATED SS LOCK NUTS.
5. REPLACE 200 DIA. (8 IN) SECTION OF PIPE WITH NEW STEEL PIPE SECTION (EPOXY LINED AND COATED) AND FLANGES. LENGTH TO SUIT. ADJUST PIPE AS REQUIRED TO SUIT ALIGNMENT.
6. REPLACE ALL DAMAGED GASKETS.
7. REPLACE ALL EXISTING BOLTS AND NUTS ON SUPPORTS AND FASTENERS WITH SS BOLTS AND NUTS TO SUIT.
8. REMOVE EXISTING PIPING, PUMP BASE PLATE AND MISCELLANEOUS METALS FROM WET WELL AND DELIVER TO OWNER'S WORKS YARD.

VERIFY SCALES  
BAR IS BASED ON  
ORIGINAL DRAWING  
0 20mm  
IF NOT 20mm ON  
THE SHEET, ADJUST  
SCALES ACCORDINGLY

RECORD DRAWING - NOT TO BE USED FOR  
CONSTRUCTION OF ALTERATIONS. ALL ITEMS  
SHOWN, MATERIALS, AND DIMENSIONS TO  
BE CONFIRMED ON SITE.

THIS DRAWING IS A REPRODUCTION FROM  
ORIGINAL DESIGN DRAWINGS. ACTUAL EQUIPMENT,  
MATERIALS OF CONSTRUCTION, LOCATIONS AND  
DIMENSIONS ARE UNKNOWN. CONTRACTOR IS  
RESPONSIBLE FOR CONFIRMATION OF ALL  
INFORMATION SHOWN ON DRAWING.

NO.	DATE	ENG.	BY	SUBJECT
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1	23 JUNE 00	K.M.	S.T.	ISSUED FOR CONSTRUCTION
0	14 APR 00	K.M.	S.T.	ISSUED FOR TENDER

REVISIONS	
PROJECT NO.	982818-602
SCALE	AS SHOWN
DRAWN	S.T.
DESIGNED	K.M./S.F.
CHECKED	D.P.
APPROVED	
APPROVED	
DATE	MARCH 2000

ASSOCIATED  
ENGINEERING



DISTRICT PROJECT NUMBER

0810-20-CRPS-04

DISTRICT DRAWING NUMBER

CRPS-M-211

REGIONAL DISTRICT  
OF NANAIMO

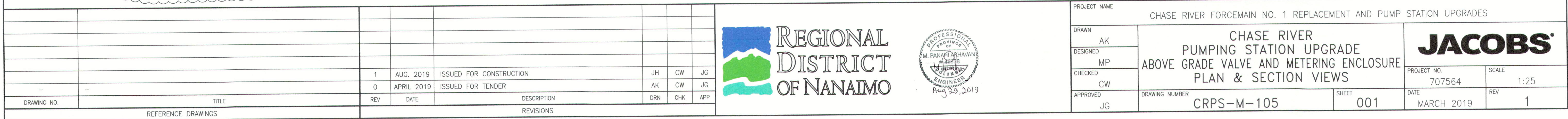
CHASE RIVER  
PUMPING STATION UPGRADE

PROCESS: MECHANICAL  
PUMP NO. 2 SECTION

DRAWING NUMBER	REV. NO.	SHEET
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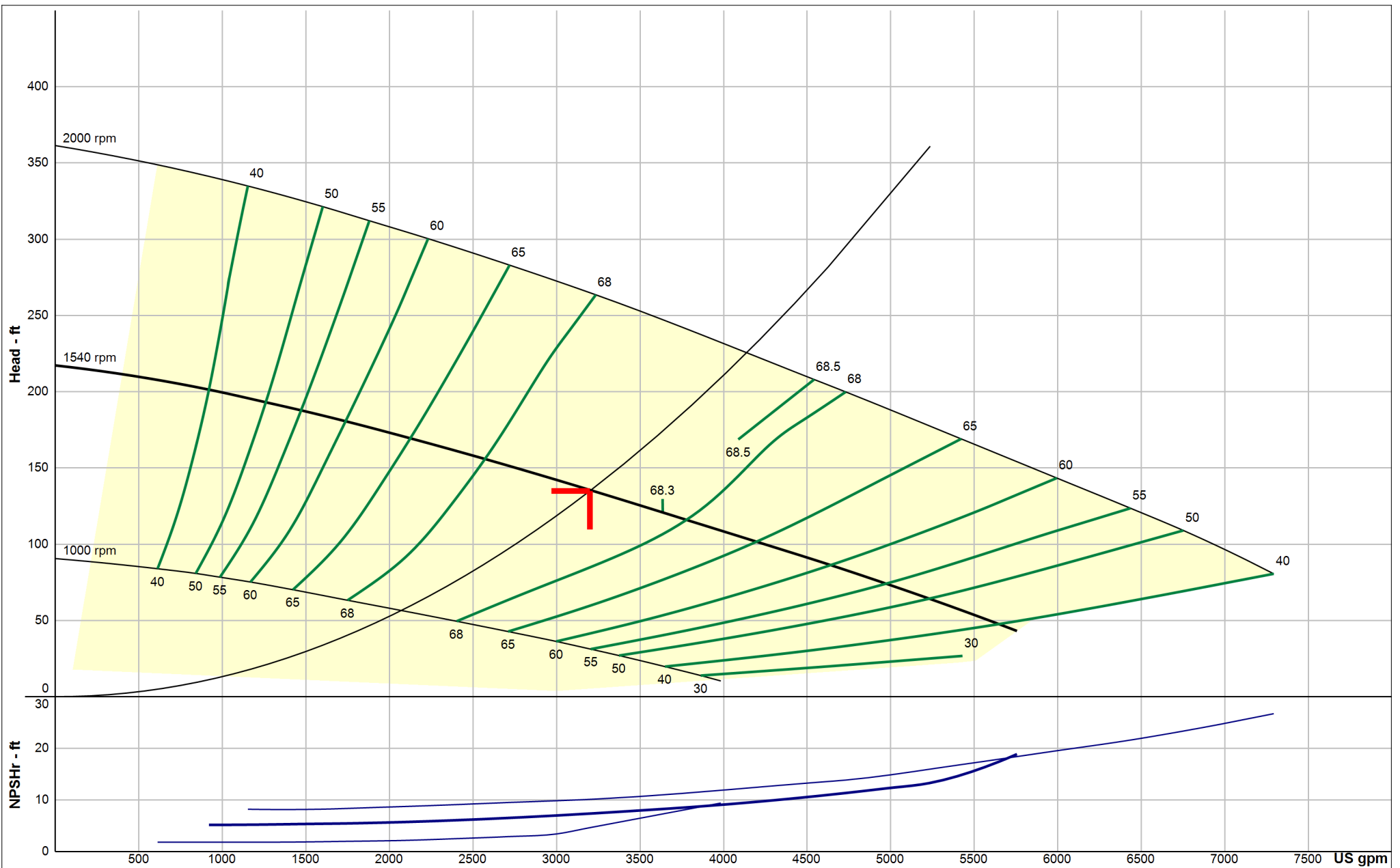
RENUMBERED FROM 982818-602-1-408 TO 1-409







## Appendix B. Pump Datasheet and System Curve



Company: Jacobs Engineering  
 Name: Pump Curve  
 Date: 04/14/2020

Pioneer Pump  
 Catalog: Pioneer Pump.60, Vers 1.2  
 Pioneer Prime - Adjustable  
 Design Point: 3200 US gpm, 135 ft  
 Static Head: 0 ft

Model: PP108S17-16"  
 Speed: 1540 rpm  
 Dia: 16 in  
 Curve: 09823HQ  
 Size: 10x8



# Pump Data Sheet - Pioneer Pump

Company: Jacobs Engineering  
Name: Pump Curve  
Date: 04/14/2020



## Pump:

Model: PP108S17-16" Dimensions: Suction: 10 in  
Type: Pioneer Prime Discharge: 8 in  
Synch Speed: Adjustable  
Dia: 16 in  
Curve: 09823HQ  
Size: 10x8

## Fluid:

Name: Water  
SG: 1 Vapor Pressure: 0.256 psi a  
Density: 62.4 lb/ft³ Atm Pressure: 14.7 psi a  
Viscosity: 1.1 cP  
Temperature: 60 °F

## Search Criteria:

Flow: 3200 US gpm Near Miss: ---  
Head: 135 ft Static Head: 0 ft

## Pump Limits:

Temperature: --- Sphere Size: 3.5 in  
Wkg Pressure: ---

## Motor:

Consult Pioneer Pump to select a motor for this pump.

## Pump Selection Warnings:

None

### --- Duty Point ---

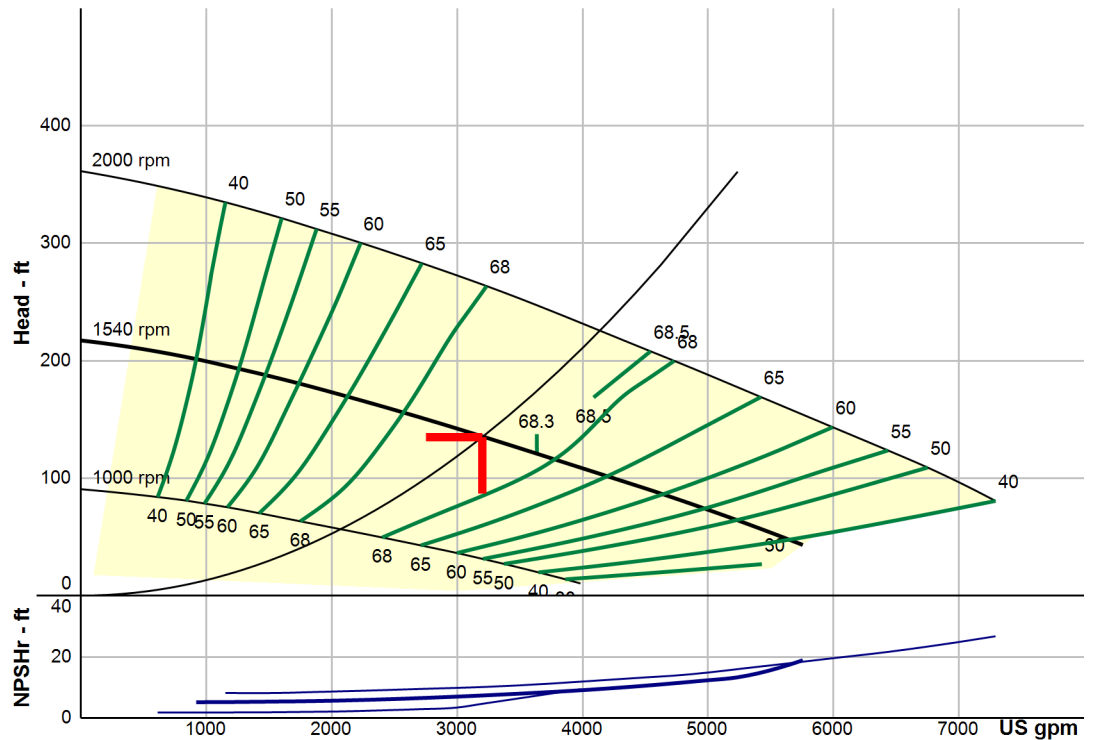
Flow: 3202 US gpm  
Head: 135 ft  
Eff: 68.2%  
Power: 157 hp  
NPSHr: 7.47 ft  
Speed: 1540 rpm

### --- Design Curve ---

Shutoff Head: 217 ft  
Shutoff dP: 94.1 psi  
Min Flow: --- US gpm  
BEP: 68.3% @ 3636 US gpm  
NOL Power:  
175 hp @ 5755 US gpm

### --- Max Curve ---

Max Power:  
372 hp @ 6751 US gpm



## Performance Evaluation:

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
3840	1540	114	67.6	163	8.73
3200	1540	135	68.2	157	7.46
2560	1540	156	67.9	149	6.3
1920	1540	175	62.4	136	5.61
1280	1540	193	50.5	123	5.26



Pioneer Prime

## PP108S17L71



Typical Pump Configuration

### Performance

#### Pioneer Prime series - vacuum assisted, end suction centrifugal pump

Bare shaft, frame mounted, fully automatic dry priming, vacuum assisted, run dry, heavy duty solids handling pump

Size	10" x 8" 250 x 200 mm
Flow, Max	7,600 USgpm 1750 m <sup>3</sup> /h 480 l/s
Head, Max	450 feet 140 meters
Flow at BEP	4,600 USgpm 1060 m <sup>3</sup> /h 290 l/s
Efficiency at BEP	80%
Solids Handling, Max	3.5" 89 mm
Operating Speed, Max	2000 rpm
Suction Connection	10" (250 mm) 150 ANSI Flanges
Delivery Connection	8" (200 mm) 150 ANSI Flanges
Bearing Lubrication	Oil STD Grease optional
Fasteners	Imperial

### Applications

Dirty water	Raw water pumps
Sewage bypass	Flood pumps
Silt returns	Mine dewatering
Cooling pumps	

#### High pressure, high flow, heavy duty solids handling pump

Designed to run over a broad range of performance while delivering outstanding suction lift, the PP108S17 is the solid choice. The rugged construction and modular design provide proven reliability and flexibility in the most demanding applications.

### UltraPrime™ Priming System

Priming System	Mechanically Driven Diaphragm Style Vacuum Pump
Air Removal Capability	50 CFM
Priming Chamber	Single chamber with positive sealing air separation PosiValve™ with stainless steel float ball & linkage.
Discharge Check Valve	Swing Style - ductile iron with Buna-n Disc

### Other Specifications

Mechanical Seal	Single seal w/ tungsten carbide vs. silicon carbide seal faces, Viton® elastomers, 300 series stainless steel hardware and spring, designed for indefinite dry running	
Pump End Bearing	Single Row Ball	
Drive End Bearing	Double Row Angular Contact	
Shaft	17-4 PH Stainless Steel	

### Construction Materials

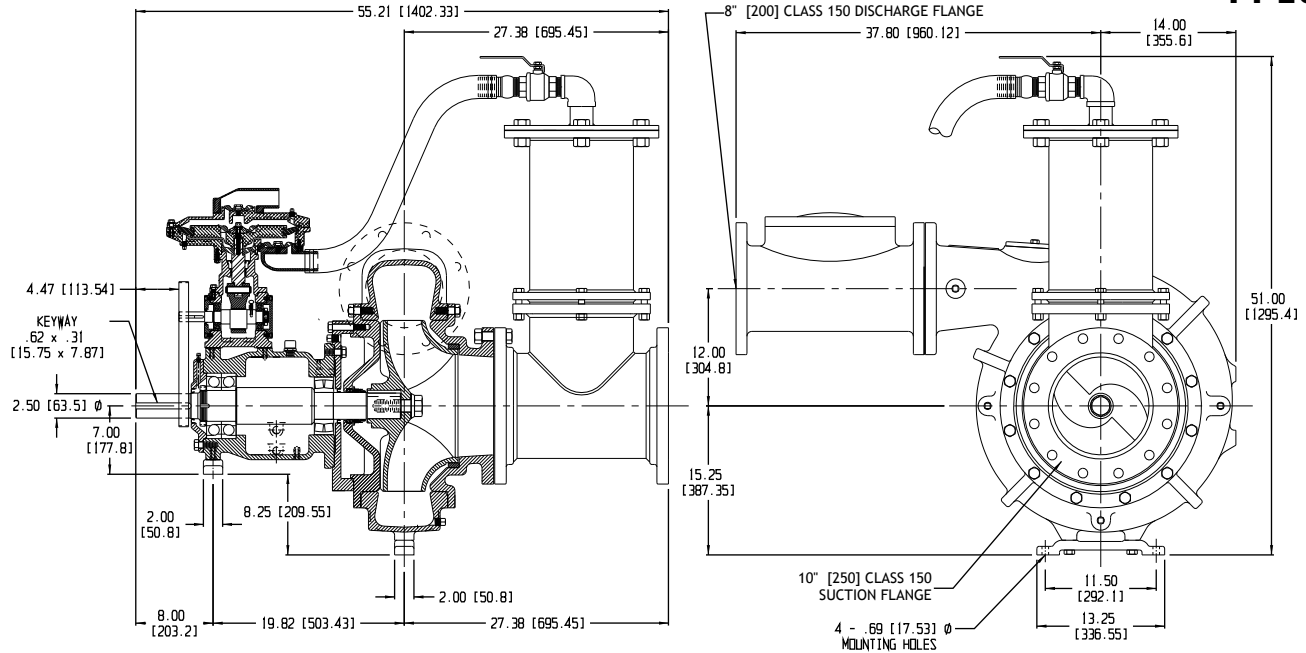
	Standard Construction	CD4MCu Stainless Steel
Impeller	CA6NM SS	CD4MCu
Volute	Ductile Iron ASTM A536 65-45-12	CD4MCu
Wear Ring	ASTM A48 Class 40 Gray Iron	316 SS
Suction Cover	Ductile Iron ASTM A536 65-45-12	CD4MCu
Bracket	Ductile Iron ASTM A536 65-45-12	CD4MCu
Backplate	Ductile Iron ASTM A536 65-45-12	CD4MCu

## Mechanical Dimensions



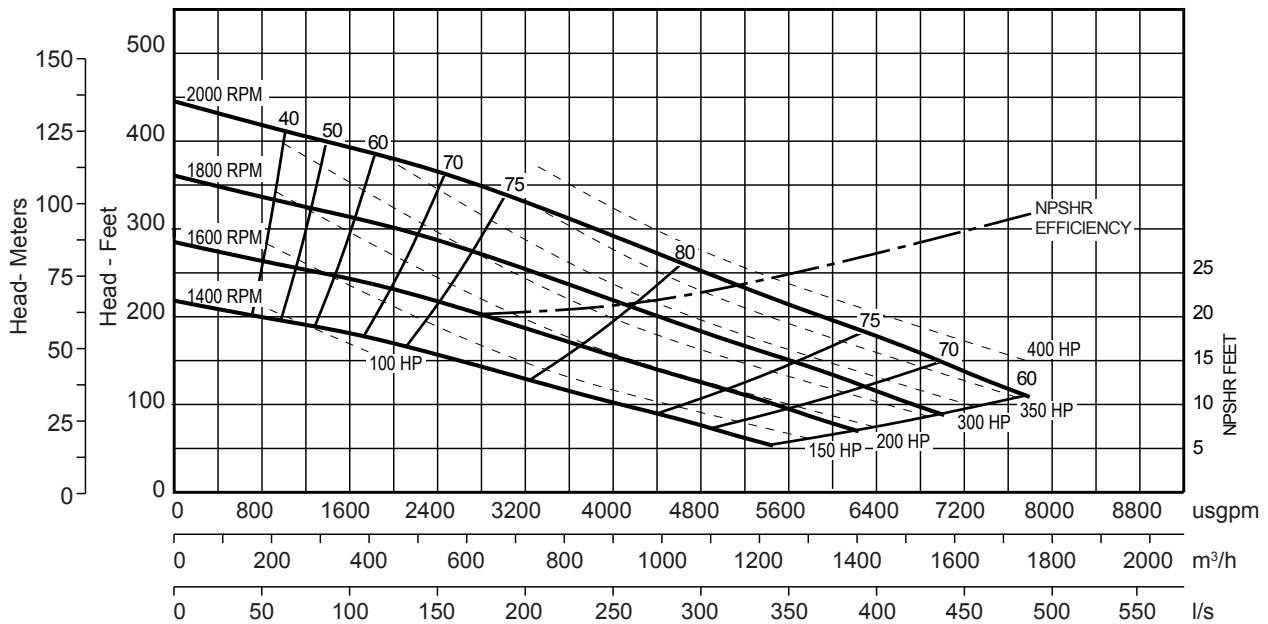
Typical Pump Configuration

### PP108S17



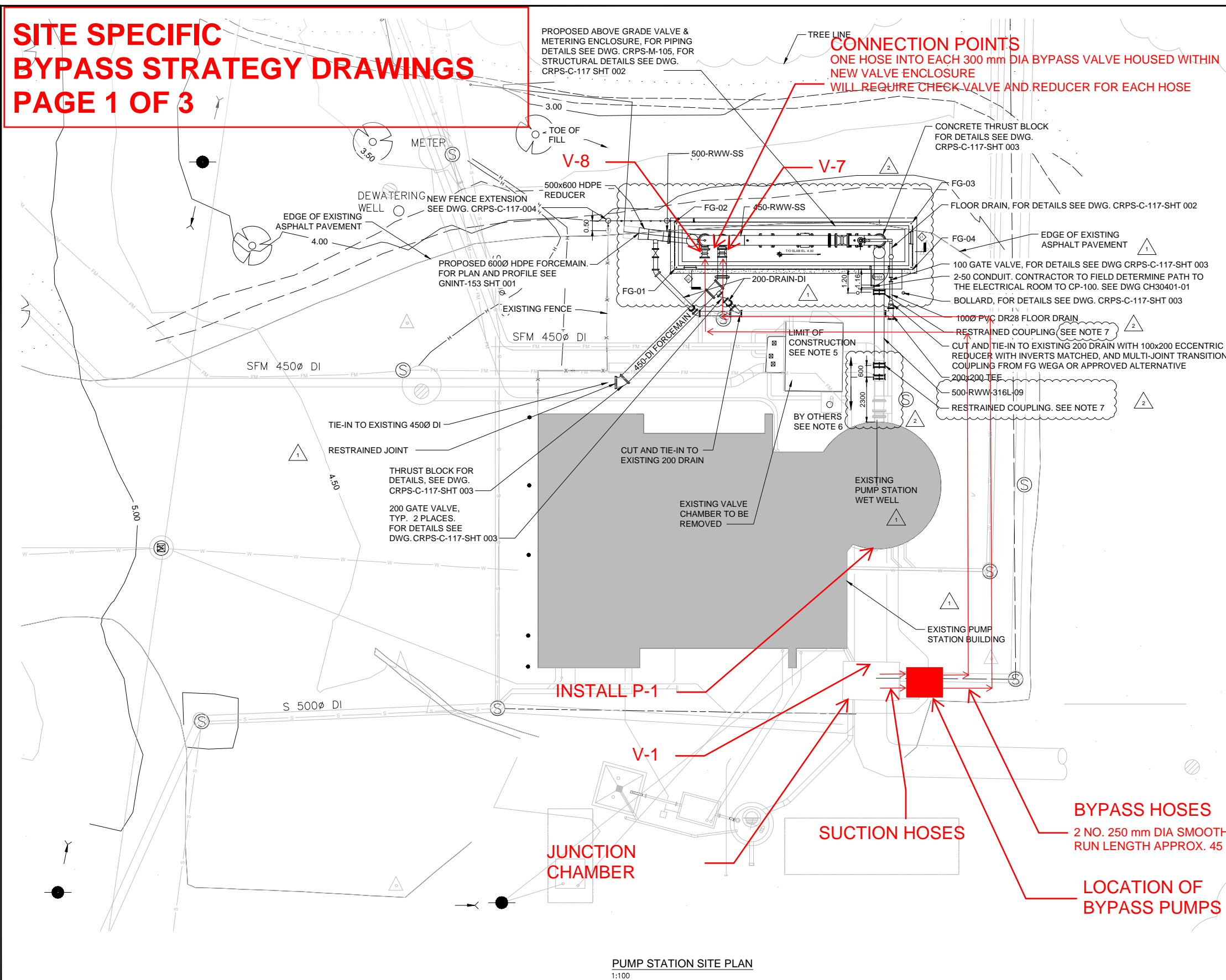
## Performance Curve

Model: PP108S17	Impeller Dia: 17.5"	Speed: Variable	Solids Size: 3.5"	Curve #07997HQ
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## Appendix C. Site Specific Bypass Strategy Drawings

# SITE SPECIFIC BYPASS STRATEGY DRAWINGS PAGE 1 OF 3



FINISHED GRADE POINT SCHEDULE				
FG NUMBER	GROUND COORDINATES (UTM-10)		ELEVATION (m)	REMARKS
	NORTHING	EASTING		
FG-01	5444583.6957	432965.3134	4.300	ENCLOSURE CORNER
FG-02	5444586.1357	432965.3134	4.300	ENCLOSURE CORNER
FG-03	5444586.1357	432977.5034	4.300	ENCLOSURE CORNER
FG-04	5444583.6957	432977.5034	4.300	ENCLOSURE CORNER

NOTES:


1. ALL DIMENSIONS SHOWN IN PLAN AND COORDINATES ARE METRIC MEASUREMENTS AND ARE IN METERS. SEE NOTE 3 GENERAL NOTES GNINT-152-001.
2. THE CONTRACTOR SHALL VERIFY ON SITE ALL THE EXISTING FIELD CONNECTIONS, DIMENSIONS AND ELEVATIONS PRIOR TO COMMENCING WORK. ANY DISCREPANCY SHALL BE REPORTED TO THE OWNER'S REPRESENTATIVE IMMEDIATELY. DO NOT SCALE DRAWINGS.
3. FOR CIVIL AND STRUCTURAL NOTES REFER TO NOTES AND SPECIFICATION SHEET, GNINT-152 SHEET 001.
4. SURFACES TO BE RESTORED TO MATCH ADJACENT PAVEMENT.
5. LEAVE GROOVED PIPE FOR FUTURE CONNECTION WITH A FLEXIBLE GROOVED COUPLING STYLE W77AGS.
6. INSTALLATION OF CONNECTING FLEXIBLE GROOVED COUPLING BY OTHERS.
7. RESTRAINED COUPLINGS TO BE FLEXIBLE GROOVED COUPLING STYLE W77AGS.

## BYPASS HOSES

— 2 NO. 250 mm DIA SMOOTH BORE.  
RUN LENGTH APPROX. 45 m EACH

## LOCATION OF BYPASS PUMPS

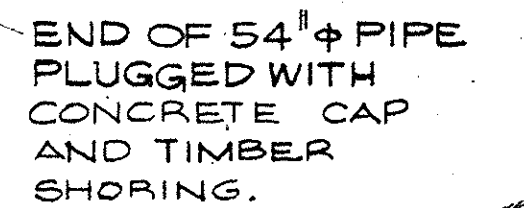
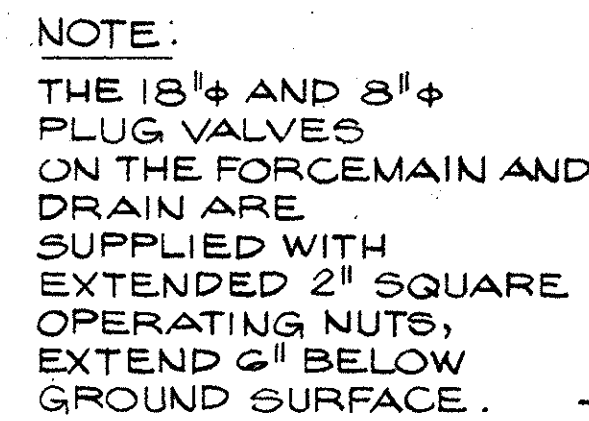
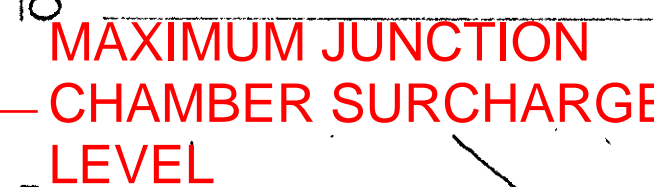
PUMP STATION SITE PLAN  
1:100

CH30401-01									
CRPS-M-105	ABOVE GRADE VALVE AND METERING ENCLOSURE: PLAN AND SECTION VIEWS								
GNINT-153 SHT 001	FORCEMAIN NO.1 & WATER REPLACEMENT-PLAN AND PROFILE								
CRPS-C-117 SHT 002	VALVE AND METERING ENCLOSURE - FOUNDATION PLAN, SECTION AND DETAILS	2	JUN 2021	ISSUED FOR INFORMATION			SS	JH	JG
CRPS-C-117 SHT 003	VALVE AND METERING ENCLOSURE - SECTIONS AND DETAILS	1	AUG 2019	ISSUED FOR CONSTRUCTION			JH	MC	JG
CRPS-C-117 SHT 004	TYPICAL FENCING DETAILS	0	APR 2019	ISSUED FOR TENDER			RO	LC	JG
DRAWING NO.	TITLE	REV	DATE	DESCRIPTION			DRN	CHK	APP
	REFERENCE DRAWINGS			REVISIONS					



PROJECT NAME											
CHASE RIVER FORCEMAIN NO. 1 REPLACEMENT AND PUMP STATION UPGRADES											
DRAWN		CHASE RIVER PUMP STATION UPGRADES SITE PLAN				<b>JACOBS®</b>					
SS											
DESIGNED											
MP											
CHECKED		PROJECT NO.				SCALE					
CW											
APPROVED		DRAWING NUMBER				SHEET		DATE		REV	
JG		CRPS-C-117				001		FEB 04, 2019		2	



[illegible]

SCALE: HORIZ: NTS , VERT: 1" = 5'  
DRAWING No. 122.46.2  
SHEET 3 OF 23 ISSUE B  
N-INT 085

N-INT-085



SITE SPECIFIC  
BYPASS STRATEGY DRAWINGS  
PAGE 3 OF 3

VERIFY SCALES  
BAR IS BASED ON  
ORIGINAL DRAWING  
0 20mm  
IF NOT 20mm ON  
THE SHEET, ADJUST  
SCALES ACCORDINGLY

RECORD DRAWING - NOT TO BE USED FOR  
CONSTRUCTION OF ALTERATIONS. ALL ITEMS  
SHOWN, MATERIALS, AND DIMENSIONS TO  
BE CONFIRMED ON SITE

2	23 AUG 02	P.D.G.	S.T.	RECORD DRAWING
1	JAN 04/01	MB/AL	PL	PLATFORMS & ELEC. OPERATOR
0		L.P.	S.T.	
NO.	DATE	ENG.	BY	SUBJECT
REVISIONS				
PROJECT NO.		982819-603		
SCALE		AS SHOWN		
DRAWN		S.T.		
DESIGNED		L.P.		
CHECKED		L.W.P.		
APPROVED				
APPROVED				
DATE		DEC 2001		

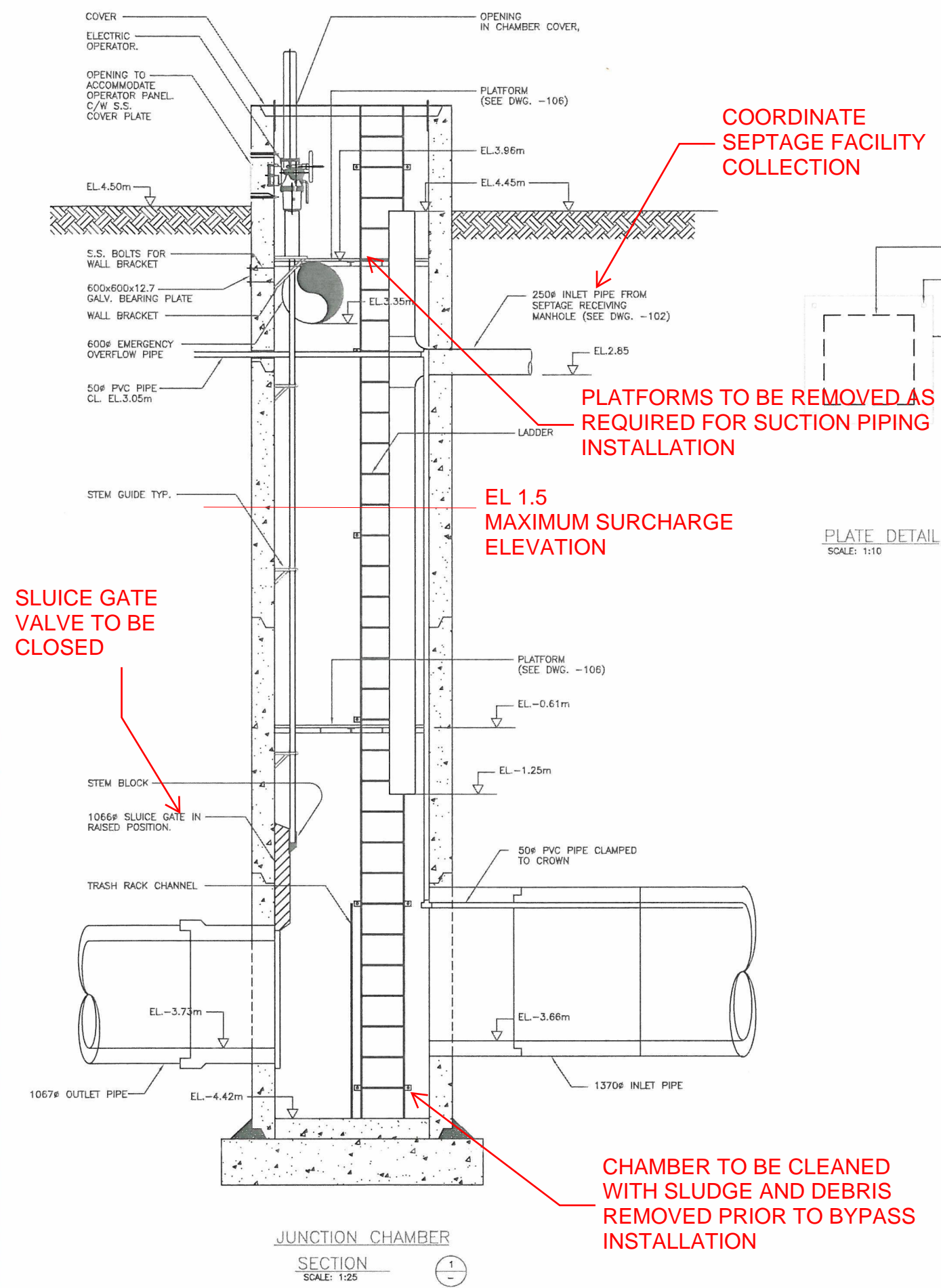
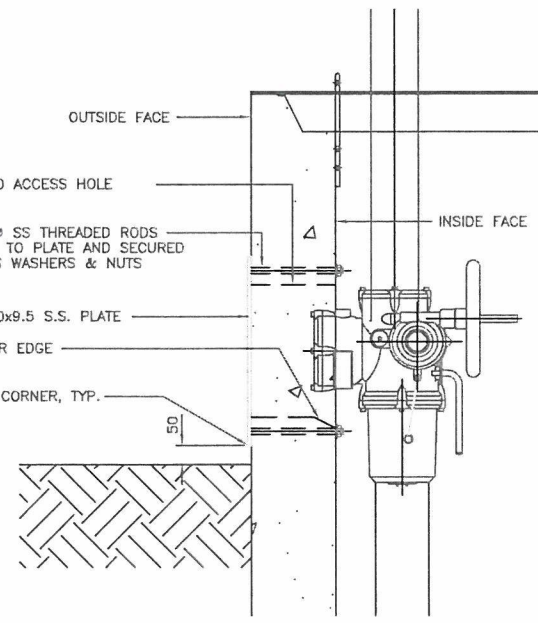


PLATE DETAIL  
SCALE: 1:10



ACCESS HOLE DETAIL  
SCALE: 1:10

GATE ACTUATOR SPECIFICATIONS:

- TAG: G-120
- MANUFACTURER: ROTORK CONTROLS
- MAKE: IQ SERIES.
- SPEED: 362 mm/minute
- POWER: 575 VAC 3 PHASE, CURRENT 13.5A
- APPROVAL: CSA
- DUTY: CAPABLE OF 60 STARTS PER HOUR.
- CLASSIFICATION: ZONE 1, DIV 1, GROUP D EXPLOSION PROOF AND RATED FOR IP68.
- ATMOSPHERE: AIR WITH H2S GAS, METHANE GAS, AND MOISTURE.
- LOCAL OPERATORS: LOCAL/OFF/REMOTE AND OPEN/CLOSE SELECTOR SWITCHES.
- MANUAL OPERATOR: SIDE MOUNTED HANDWHEEL WITH CLUTCH.
- LOCAL INDICATION: LCD WITH NUMERIC AND ICON DISPLAY.
- POSITION TRANSMITTER: 4 - 20 mA ACTUATOR POWERED REPRESENTING GATE POSITION IN % OPEN
- POSITION SWITCHES: 4 CONFIGURABLE DRY CONTACT POSITION SWITCHES.
- CONFIGURATION: INCLUDE AN INFRARED REMOTE CONTROL IQ SETTING TOOL.
- CONTROL MODE: OPEN/STOP/CLOSE MAINTAINED CONTROL WITH INTERNALLY FED 120 VAC CIRCUITS.
- WARRANTY: 2 YEARS.
- MOUNTING: 316 SS OR COATED STEEL PEDESTAL TO SUIT LOCATION AND PROVIDE ACCESS TO THE HANDWHEEL.
- STEM COVER: 316 SS STEM COVER TO ENCLOSE THE PROTRUDING GATE SHAFT COMPLETELY WHEN THE GATE IS FULLY OPEN.
- GATE STEM: 316 STAINLESS STEEL DIAMETER STEM SHAFT FOR 1,066 mm CAST IRON GATE TO SUIT DESIGN AND SITE CONDITIONS.
- STEM GUIDES: CAST IRON WITH COATING AND AS DESIGNED BY ARMTEC.
- MOUNTING: CAST IRON WITH COATING FOR ACTUATOR WALL MOUNTING BRACKET.
- COATING: COATING MENTIONED ABOVE TO BE: SHOP PRIMED AND COATED WITH COAL-TAR EPOXY TO A MINIMUM OF 16-MILS.
- SHOP DRAWING: SUBMIT SHOP DRAWINGS AND INCLUDE FIELD MEASUREMENTS REQUIRED FOR CONFIRMATION OF GATE STEM LENGTH, ACTUATOR PIPE STAND LENGTH, PIPE STAND WALL BRACKET LOCATION, STEM GUIDE LOCATIONS AND LOCATION OF ACCESS HOLE FOR ACTUATOR.

ASSOCIATED  
ENGINEERING

DISTRICT PROJECT NUMBER  
0810-20-CRPS-04

DISTRICT DRAWING NUMBER  
CRPS-C-109

REGIONAL DISTRICT  
OF NANAIMO

CHASE RIVER  
PUMPING STATION UPGRADE

CIVIL  
JUNCTION CHAMBER - MODIFICATIONS

DRAWING NUMBER	REV. NO.	SHEET
CH3-105	2	

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2002/11/18 16:32:13 ST  
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DRAWING IS DATA-LINKED

RENUMBERED FROM 982819-603-1-105 TO ---

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## 1. General

### 1.1. Summary

- 1.1.1. This specification outlines general requirements for the supply and installation of process piping, valves, fittings and related appurtenances at the Regional District of Nanaimo (RDN) Facilities. More detailed requirements are contained in other specifications. This specification must be referenced to and interpreted simultaneously with all other specifications pertinent to the Work.
- 1.1.2. When details are not provided in the design package, the Contractor shall design, select, locate and provide expansion joints, pipe guides and anchors required for pipe lines included in the Work.
- 1.1.3. All materials not specifically listed or specified but required to complete the installation are the responsibility of the Contractor.

### 1.2. References

#### 1.2.1. Definitions

- a) Maximum working pressure: The greatest continual pressure at which the piping system operates.
- b) Design Package: Issued For Construction Drawings; Specifications and Engineering Work Package (EWP), Scope of Work (SOW) or other written description of the Work to be done.
- c) Test pressure: The hydrostatic pressure used to determine system compliance.
- d) Interior: Within an environmentally controlled enclosure where the temperature is maintained above 5°C.
- e) Submerged: Regularly or occasionally immersed in liquid; or within 3.0 m above maximum water level within a structure or lagoon/pond.

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- f) Outdoor: Exposed, above ground, outside or within an enclosure that is not environmentally controlled.
- g) Buried: Placed directly in soil and/or granular fill.
- h) Engineer: The Engineer or Engineering Firm responsible for the design.
- i) Owner's Representative: The Engineer responsible for the general design of the Work and contractually acting as The Consultant on behalf of the RDN, or other named agent of the RDN responsible for managing or coordinating the Work.
- j) Contractor's Engineer: A professional engineer registered in the Province of British Columbia who is qualified and retained to perform detailed piping design for the Work, including but not limited to thermal expansion design, at the Contractor's cost.

#### 1.2.2. Reference Standards

- a) Conform with the most recent version of all standards referenced in this Section.
- b) ANSI B1 .1: Unified Inch Screw Threads, UN and UNR Thread Form
- c) ANSI/AWWA C606: Grooved and Shouldered Joints
- d) ASME B31.3: Process Piping
- e) ASTM B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
- f) ASTM A193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications  
ASTM A194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- g) ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

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- h) ASTM A354: Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
- i) ASTM A563: Carbon and Alloy Steel Nuts
- j) ASTM B32: Solder Metal
- k) ASTM B633: Electrodeposited Coatings of Zinc on Iron and Steel (m) ASTM B766: Electrodeposited Coatings of Cadmium

### 1.3. Coordination

- 1.3.1. Prior to construction, the Contractor must coordinate with others, if required, to locate openings and place sleeves in cast in place concrete and/or masonry.

### 1.4. Required Contractor Submittals to RDN - For Review in Advance of Fabrication/Construction

- 1.4.1. Before fabrication, provide materials certificates for each type of pipe material and for each fitting, valve, coupling, and all specified appurtenances used to complete the work covered in this section.
- 1.4.2. Isometric spool drawings must be prepared by the fabricator for all piping systems greater than 50 mm in diameter to indicate assembly details; pipe size, shop and field weld locations, flanges, couplings, valve placement, valve operating wheels, vents and drains, cathodic protection, seismic restraint system, expansion joints, guides, anchors, supports and provisions for thrust restraint, wall penetrations, as well as any other pertinent details. When piping isometrics are prepared by the Engineer and provided in the design package, the electronic files for such isometrics may be provided to the fabricator for their convenience, at the discretion of the RDN.
- 1.4.3. Provide details of any shop fabricated pipe and fittings.
- 1.4.4. Where directed by the Owner's Representative, provide mill test results or product samples.

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- 1.4.5. For restrained, mechanical, and expansion joints provide manufacturer's catalogue data, shop drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.
  - 1.4.6. If requested, the piping fabricator shall submit a demonstrated fillet and butt weld on a test sample of pipe to be examined and approved by a certified inspection company. The test specimens will be submitted to the RDN's inspection company at the RDN's expense. Any retesting required by the RDN shall be completed at the Contractor's expense.
  - 1.4.7. Catalogue cut sheets and/or shop drawings for each type of valve indicating the valve data and pressure rating, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.
  - 1.4.8. Where valves cannot be supplied as specified in the Design Package, in advance of construction, the Contractor is to provide a Detailed Valve Specification Sheet and indicate with check marks where the proposed valve meets the requirements specified and with written amendments where the product differs from the specification. This submission will be reviewed by the Engineer. This submission does not guarantee approval, and the Engineer could recommend an alternative valve.
- 1.5. Required Contractor Submittals to RDN – For Information
- 1.5.1. Submit radiographic weld test and other shop inspection and test results, indicating that the Work meets the specifications.
  - 1.5.2. Provide current and complete documentation of welder's qualifications prior to the commencement of any welding. All welders involved in the Work must provide the correct documentation, including but not limited to Welding Certifications.
  - 1.5.3. Prior to commencing any welding of stainless-steel pipe, submit a Welding Procedure Specification (WPS) including a written description of welding techniques including but not limited to materials, methods, and quality control. Certify that the technique is acceptable for the intended service condition. Written procedures must be signed and sealed at the Contractor's cost by a professional engineer registered in BC qualified for welding design.
  - 1.5.4. When not provided in the Design Package, provide hanger, joint restraint, expansion joint, guide, anchor, support and seismic restraint system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a professional engineer registered in the Province of British Columbia



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1.5.5. Submit manufacturer's catalogue data and assembly drawings for mechanical, restraint and expansion joints confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.

1.5.6. Submit Operating and Maintenance data for valves. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.

#### 1.6. Quality Assurance

1.6.1. Review the drawings prior to installation of piping, conduit services, and fixtures, identify any conflicts and cooperate with the Owner's Representative to determine the adjustments necessary to resolve these conflicts.

1.6.2. Provide complete, fully tested and operational process piping systems.

1.6.3. Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.

1.6.4. All welding of pipe and fittings shall be undertaken by welders certified for pipe welding for each applicable pipe welding procedure through the Industry Training Authority (ITA) and holding a Level A or Level B interprovincial Red Seal Ticket. For stainless steel welding, a Level A Red Seal Ticket is required.

1.6.5. Any fabricators supplying goods for the Work shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.

1.6.6. All pipe fabrication and welding shall be in accordance with ASME B31.3 Process Piping for Normal or Category D fluid service as indicated on the drawings.

1.6.7. Perform visual examinations of all welding to reveal any surface or root defects, unacceptable weld fit-ups, arc strikes, weld spatter, or insufficient heat tint removal.

1.6.8. Perform visual examination of shop welding before shipping.

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- 1.6.9. Radiographic inspections of all piping included in the Work must be completed to meet the welding standards cited in this specification.
  
- 1.6.10. Spot-radiographic inspection of welds, or alternative method, may be conducted at the option and at the expense of the RDN. The Owners Representative will designate such company to carry out inspection of welds at the site of erection, and the Contractor shall fully co-operate with the Owner's Representative in supplying such labour and working space as may be required. Welding judged unacceptable shall be repaired using a method satisfactory to the Engineer at no additional cost to the Owner. The Contractor shall pay for the spot inspection of all welds which are judged unacceptable.
  
- 1.6.11. For each defective weld, two additional radiographic inspections at locations identified by the Owner's Representative will be required, plus a radiograph of the repair. Costs for such additional radiographic inspections including the radiograph of the repair shall be borne by the Contractor.
  
- 1.6.12. The RDN may use any method of inspection necessary to establish quality control and ensure adherence to welding procedures. Any weld test specimen coupons submitted shall clearly identify the welder(s).
  
- 1.6.13. Fabricating Tolerances for pipefittings and assemblies shall conform to the Pipe Fitters Institute Standard ES-3.

## 1.7. Delivery, Storage and Handling

- 1.7.1. Store on site as recommended by materials manufacturer to prevent damage, undue stresses, or weathering. Store materials a minimum of 200 mm above ground with sufficient supports to prevent bending.
  
- 1.7.2. Protect non-UV light inhibited plastic materials from sunlight.
  
- 1.7.3. Provide shipping devices to maintain the face-to face dimension of each expansion joint during shipment, storage and installation.

## 2. Products

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## 2.1. Bolts and Studs

2.1.1. Provide hex head bolts and studs, threads to ANSI B1.1, standard coarse thread series.

2.1.2. Connecting stainless steel to stainless steel: Grade B8 ASTM A193, C1.1.

2.1.3. Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, zinc plated to ASTM B633. Bolt sizes to AWWA C110.

2.1.4. Connecting steel, or unless otherwise specified:

2.1.4.1. Provide carbon steel bolts and studs, Grade B to ASTM A307, heavy hex, zinc plated to ASTM B633

2.1.4.2. Bolt sizes to AWWA C110.

2.1.5. Axial stress in bolts shall not exceed 40% or material yield strength based on the unthreaded body area.

## 2.2. Nuts and Washers

2.2.1. Provide hex head nuts, threads to ANSI B1.1, standard coarse thread series. Greater than 25 mm, provide heavy hex.

2.2.2. Connecting stainless steel to stainless steel: Provide nuts to ASTM A194 Grade 8.

2.2.3. Connecting stainless steel to steel or cast/ductile iron: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be zinc plated to ASTM B633. Always include washers.

2.2.4. Connecting steel, or unless otherwise specified: Provide carbon steel nuts, Grade A to ASTM A563. Provide flat hardened steel washers to ASTM F436. Nuts and washers to be zinc plated to ASTM B633



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#### 2.2.5. Tie-rods

- 2.2.5.1. Provide tie-rods continuously threaded to ASTM A354 and fabricated in accordance with 81.1 (screw threads, coarse thread series). Tie rods to be steel zinc plated to ASTM B633.

#### 2.3. Fittings

- 2.3.1. Provide fittings with wall thickness equal to or greater than the pipe, of the same material, coating, lining and pressure rating as pipe or better.
- 2.3.2. Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.
- 2.3.3. Provide concentric reducers in vertical lines unless indicated otherwise.
- 2.3.4. Provide smooth flow standard radius elbows for process air service unless otherwise specified on the drawings.

#### 2.4. Joints — Flanges

- 2.4.1. Flanges for mating to equipment or valves must be compatible with those items. In all situations similar faced flanges only shall be mated.
- 2.4.2. Class 150 (default, unless specified otherwise on the drawings) — raised face weld neck with ring gaskets, unless mating to, lap joint flanges or equipment with flat faced flanges.
- 2.4.3. Class 300 — Not used.
- 2.4.4. Where dissimilar metals are to be connected, furnish dielectric fittings and/or isolating flanges, including major bolt sleeves and washers.

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#### 2.4.5. Gaskets

2.4.5.1. Conform to ASTM B1621 and AWWA C228 Table 1.

2.4.5.2. Minimum gasket thickness 3.175 mm.

2.4.5.3. Provide full face gaskets for full/flat faced flanges

2.4.5.4. Provide ring type gaskets for raised face flanges.

2.4.5.5. Provide gasket materials suitable for the temperature, pressure and corrosivity of the fluid conveyed in the pipeline.

2.4.5.5.1. Provide liquid service gaskets of EPDM or neoprene.

2.4.5.5.2. Provide air service gaskets of compressed Kevlar with neoprene binder, suitable for service conditions.

#### 2.5. Joints — Threaded Couplings

2.5.1. Provide screwed joints with American Standard threads.

2.5.2. Provide Teflon tape suitable for pipe material and service.

#### 2.6. Joints — Grooved Joint Coupling

2.6.1. Provide pipe grooving, couplings and gaskets conforming to ANSI/AWWA C606. Victaulic or approved equal.

2.6.2. Provide for liquid service Victaulic Grade “E” EPDM flush seal gasket or approved equal.

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- 2.6.3. Provide cut grooves on schedule 40, standard wall or thicker pipe, roll grooves for Sch 10 and Sch 5 stainless steel Grooved joint flange adapters shall be used only where specifically indicated.

## 2.7. Joints — Flexible and Restrained Joint Couplings

- 2.7.1. Provide cylindrical center ring, two follower rings, two resilient gaskets, and connecting bolts. Robar, Dresser or equal.

- 2.7.2. If joint restrained add restraining rods and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure, as recommended by the manufacturer.

- 2.7.3. Provide gasket suitable for service conditions.

## 2.8. Joints - Welding

- 2.8.1. Use welding materials conforming to CSA W48.

- 2.8.2. Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

## 2.9. Lining and Coating

- 2.9.1. Do not paint or line stainless steel pipe.

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### 3. Execution

#### 3.1. Preparation

- 3.1.1. Prior to installation, inspect and field measure to ensure that conflicts or other irregularities do not impede the proper installation of piping.
- 3.1.2. Make all minor modifications required to suit equipment and structural element locations and elevations, at no expense to the RDN.
- 3.1.3. Advise the Owner's Representative of all modifications. Indicate all intended piping modifications on the shop drawings submitted prior to fabrication or installation. Do not commence work on related piping until the Owner's Representative's approval has been received.
- 3.1.4. Prior to valve and pipe appurtenance installation, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that valve location and orientation provides suitable access to all valve operators. Ensure that sufficient easily disassembled joints are provided to allow for removal and replacement of all valves and pipe appurtenances.

#### 3.2. Pipe Handling

- 3.2.1. Inspect each pipe, fitting and piping appurtenance prior to installation. Do not install damaged material or materials with damaged linings or coatings.
- 3.2.2. Repair pipe with damaged protective coatings according to coating manufacturer's directions and to the Owner's Representative's satisfaction.
- 3.2.3. Remove all foreign matter from inside of piping and piping appurtenances prior to installation.
- 3.2.4. Use proper implements, slings, tools and facilities for the proper protection of the pipe and fittings. Exercise care in the installation so as to avoid damage to pipe or coatings.

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### 3.3. Conflicts

- 3.3.1. For any field run pipe, confirm the pipework routing with Owner's Representative prior to commencement of fabrication and installation. Advise Owner's Representative of any conflicts with existing services, structures, or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict, as instructed by Owner's Representative

### 3.4. Buried Pipe Installation

- 3.4.1. For buried stainless steel pipe apply tape to buried pipe and welded joints. Use Polyken, Tec-Tape or Denso tape consisting of primer and tape applied to minimum thickness of 0.90 mm in accordance with AWWA C209.
- 3.4.2. For flanged or coupled joints and for fittings use petrolatum primer, mastic and tape; Polyken, Tec-Tape or Denso, in accordance with AWWA C217.

### 3.5. Above Ground Pipe Installation

- 3.5.1. Make adequate provision in piping runs for expansion, contraction, slope and anchorage.
- 3.5.2. Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag and stress.
- 3.5.3. Provide temporary supports as necessary during construction to prevent overstressing equipment, valves or pipe.
- 3.5.4. Accurately cut all piping for fabrication using field measurements.
- 3.5.5. Install pipes in straight alignment. Variance from the true alignment shall not exceed 10 mm in any direction or as required in ASME B31.3 whichever is less.
- 3.5.6. Fabricate and assemble pipe runs to ensure that pipework is not stressed to achieve the designed alignment and that no stresses are transferred to equipment or equipment flanges. "Springing" of pipework to ensure alignment is not permitted.

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3.5.7. The Contractor shall undo and subsequently remake all pipework connections where so instructed by the Owner's Representative to ensure that springing does not occur.

3.5.8. Take care not to damage equipment, piping appurtenances, valves, flanges, or other joints.

### 3.6. Connections to Equipment and Existing Piping

3.6.1. Verify fit and materials at each connection prior to making the connection. Where joining piping to existing equipment, confirm flange type on the equipment and install matching pipe flanges to suit.

3.6.2. Modifications to either new or existing materials required to make connections shall be approved by the Owner's Representative in writing prior to the connections being made.

### 3.7. Pipe Joints

#### 3.7.1. General

3.7.1.1. Provide joints that can be readily disassembled at the minimum within 1.0 m of any connection to equipment, on both sides of structural penetrations, and within 0.6 m of all threaded end valves.

3.7.1.2. Allow a minimum of 150 mm to face or 75 mm to edge of flanges or grooved joint couplings from wall, floor or ceiling unless otherwise shown.

#### 3.7.2. Threaded

3.7.2.1. Unless specifically noted on the Drawings, threaded couplings shall only be used on piping with nominal diameters less than 65 mm.

3.7.2.2. Ream the ends of all pipes to remove all burrs and cuttings when fabricating threaded joints.

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3.7.2.3. Clean out pipe prior to joining.

3.7.2.4. Apply Teflon tape to male threads and join pipe. Do not use extra tape to make up for slack in the joint.

3.7.2.5. Install threaded pipe with as few joints as possible. Short lengths of pipe coupled together shall not be used, except where a union is specifically shown on the drawings.

3.7.2.6. If it is necessary to back off a screwed joint after it is made, the thread shall be cleaned, and new Teflon tape applied.

3.7.2.7. Threads shall not be caulked.

3.7.2.8. Bushings shall not be used.

3.7.2.9. Nipples in threaded piping shall be shoulder nipples. Close nipples shall not be used unless specifically indicated.

### 3.7.3. Flanged

3.7.3.1. Clean flanges and gaskets prior to connection.

3.7.3.2. Lubricate gaskets with soapy water and apply anti-seize compound to bolts.

3.7.3.3. Bring flanges into close parallel and lateral alignment.

3.7.3.4. Tighten bolts progressively, proceeding from side to side of the flange. Wrenches used for tightening bolts shall be in good condition and properly sized to prevent rounding of nut and bolt heads. Apply manufacturer's torque recommendations when connecting to valves and equipment. Do not over torque bolts.

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3.7.3.5. Do not use washers to take up excess bolt length.

3.7.3.6. Bolt projection beyond nuts shall be approximately two full threads.

3.7.3.7. Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on equipment.

3.7.3.8. Install flange adapters in accordance with manufacturer's recommendations.

3.7.3.9. Install lap joint flanges in vibration free service only. Do not install in buried or submerged environments.

#### 3.7.4. Grooved Joint Couplings

3.7.4.1. Install grooved joints and grooved joint flange adapters as recommended by manufacturer using manufacturer's recommended lubricants on gaskets.

3.7.4.2. All grooving tools and accessories to be manufactured by grooved product supplier.

### 3.8. Welding – General

3.8.1. Metal surfaces in and adjacent to the welding groove shall be dry before welding commences and kept dry and free from dirt, loose scale, slag, grease or any other foreign contaminant.

3.8.2. All welds after welding is complete must be cleaned and surface prepared as required for the final coating, finish or passivation method to be applied.

3.8.3. The end of each pipe shall be carefully fitted to butt accurately with proper gap to the preceding pipe or fitting. Before placing the pipe in position, the ends of the pipe shall be made truly circular by an approved method and, if necessary, for large pipes "spiders" shall be placed in each to keep them truly circular.

3.8.4. All welds for piping butt joints shall be full penetration.



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- 3.8.5. All stainless steel pipe welding shall be completed using a full purge TIG (GTAW) process.

### 3.9. Field Welding

- 3.9.1. In general, field welding should be avoided except where necessary. Field welding may be performed with the prior written consent of the Owner's representative, as indicated by the approval of the Contractor's shop drawings.
- 3.9.2. Field welding shall conform to the general requirements of AWWA C206 "Field Welding of Steel Water Pipe Joints", and the quality requirements under "Welding- General" in this specification.
- 3.9.3. Field welding shall not be done under conditions that will negatively affect the completed weld including but not limited to: moisture; blowing sands or dust; high winds; low temperatures. If in the Owner's Representative's opinion, protection from prevailing weather conditions is necessary, then all welding shall cease until this protection is provided at the Contractor's cost, and welds done under poor conditions shall be re-made. The Contractor shall be prepared for such events and will not be compensated for downtime associated with delays of this nature
- 3.9.4. When the ambient temperature is below 0°C all welding operations shall cease unless an appropriate welding procedure has been submitted. Written procedures to be signed and sealed at the Contractor's cost by a professional engineer registered in BC qualified for welding design.
- 3.9.5. In general, field welds shall be butt type, suitably beveled to the satisfaction of the Owner's Representative.
- 3.9.6. Pipes cut in the field for closing pieces and other field joints shall be cut to a smooth uniform level. Edges shall be smooth and not serrated and shall be ground smooth if they are rough after cutting.

### 3.10. Pipe Structural Penetrations

- 3.10.1. Refer to Structural Drawings and Specifications.

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3.10.2. Coordinate with other divisions to locate and place sleeves or cast-in-place pipe sections prior to the construction of concrete and masonry building elements.

### 3.11. Drains, Vents, Flushing Connections, Sample Points

3.11.1. Provide manual air vents at the high points of each reach of pipeline.

3.11.2. Provide manual drains at the low points of each reach of pipeline. Pipe drains shall be routed to a sump, gutter floor drain, or other approved collection point.

### 3.12. Testing

3.12.1. All piping shall be pressure tested as per ASME B31.3 and the test witnessed by the Owner's Representative.

3.12.2. Review pipe pressure testing procedures with Owner's Representative at least 1 week prior to commencement of pressure testing. Initial service leak testing for Category D fluid service is acceptable where approved by the Owner's Representative.

3.12.3. Give Owners Representative 24 hours' notice of testing.

3.12.4. Thoroughly clean all piping prior to pressure testing.

3.12.5. Prior to pressure testing ensure piping is adequately restrained.

3.12.6. Do not insulate, bury, concrete surround or otherwise conceal work until piping systems are tested and accepted.

3.12.7. Supply all equipment, gauges and materials including fluids for pressure testing.

3.12.8. Install fittings for air relief, gauges and drainage as needed to complete testing. After testing remove and plug fittings.

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3.12.9. Cap and plug all lines that are normally open ended. Remove on completion of testing.

3.12.10. Isolate all low pressure equipment or pipeline appurtenances during testing to protect the equipment or pipeline appurtenances from damage.

3.12.11. Repair and replace any defective work using new material.

3.12.12. General Testing Criteria:

3.12.12.1. When information is not provided on a Piping Line List the test pressure shall be 1.5 times the maximum working pressure. Confirm system working pressure with Consultant prior to pipe testing.

3.12.12.2. Test duration: 10 minutes or as defined by ASME B31.3.

3.12.12.3. There shall be no loss of pressure during testing, and no visual evidence of leakage.

### 3.13. Cleaning and Flushing

3.13.1. After installation and prior to testing, perform initial cleaning of process and utility pipelines.

3.13.2. Unless waived in writing by the Owner's Representative, clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline. Remove instrumentation or piping appurtenances that may be damaged by this procedure and replace after cleaning.

3.13.3. Give lines smaller or equal to 150 mm an initial flush with clean water for piping normally conveying liquid commodities, or purge with air or inert gas for piping normally conveying air or gas.

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- 3.13.4. Flush with clean water and drain pipes conveying liquid commodities after testing. Dispose of testing and flushing water in a manner approved by the Owner's Representative that causes no damage to buildings or siteworks.
  
- 3.13.5. For piping conveying air or gas less than or equal to 150 mm diameter, purge with air and/or inert gas before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream.

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## 1. General

### 1.1. Summary

1.1.1. This Specification section applies to supply, fabrication, and installation of austenitic (304 or 316) stainless steel process piping for Regional District of Nanaimo (RDN) water and wastewater systems.

1.1.2. This specification must be referenced to and interpreted simultaneously with all other specifications pertinent to the Work described herein.

#### 1.1.3. Related Requirements

- a) Process Piping General      SP-P-0001
- b) Process Valves General      SP-P-0101

### 1.2. Reference Standards

1.2.1. Conform with the most recent version of all standards referenced in this Section.

- a) ASME B31.3 Process Piping
- b) ANSI/ASME B16.5: Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
- c) ANSI/ASME B16.9: Factory Made Wrought Buttwelding Fittings
- d) ANSI/ASME B16.11: Forged Fittings, Socket-Welding and Threaded
- e) ANSI/ASME B16.21: Nonmetallic Flat Gaskets for Pipe Flanges
- f) ANSI/ASME B36.19: Stainless Steel Pipe
- g) ASTM A182: Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings and Valves and Parts for High Temperature Service

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- h) ASTM A240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
- i) ASTM A312: Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
- j) ASTM A380: Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems
- k) ASTM A403: Wrought Austenitic Stainless Steel Piping Fittings
- l) ASTM A480: General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
- m) ASTM A778: Welded, Unannealed Austenitic Stainless Steel Tubular Products
- n) ASTM A967: Chemical Passivation Treatments for Stainless Steel Parts
- o) AWWA C220: Stainless Steel Pipe ½" (13 mm) and Larger
- p) AWWA C226: Stainless-Steel Fittings for Waterworks Service, Sizes ½" through 72" (13 mm through 1,800 mm)
- q) AWWA C227: Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe
- r) AWWA C606: Grooved and Shouldered Joints

### 1.3. Delivery, Storage and Handling

1.3.1. Protect materials from contamination from dirt or road salt by shrink wrap or other suitable packaging, and end caps, prior to shipment.

1.3.2. Store materials in such a way to prevent scratching and scoring of the surface and to avoid contact with dirt or carbon steel.

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#### 1.4. Design Conditions

##### 1.4.1. Use the following design conditions:

- a) Normal commodity temperature range: 2 to 25°C.
- b) Normal ambient temperature range: Indoor 0 to 40°C. Outdoor -20 to 40°C.
- c) Normal service operating pressure range: 0 to 400 kPa

## 2. Products

2.1. **When detailed piping bill of materials are not provided on the design drawings**, provide piping systems with components as detailed in the table below, suitable for the design and operating conditions:

Item	Size	Description
Pipe	50 mm & smaller	Schedule 40S: ASTM A312/A312M, Type 316 seamless, pickled and passivated.
	60 mm & larger	Schedule 10S: ASTM A778, "as-welded" grade, Type 316L.
Joints	50 mm & smaller	Socket weld, except where alternate joint type required to mate with equipment or piping appurtenances.
	60 mm & larger	Butt-welded or flanged.
Fittings	50 mm & smaller	Socket weld forged, except as noted in Joints above: 1,000 CWP, ASTM A182/A182M, Grade F316L.
	60 mm & larger	Butt-Welded: ASTM A774/A774M Grade 316L conforming to MSS SP 43, "as-welded" grade, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.
Branch Connections	50 mm & smaller	Tee or reducing tee in conformance with Fittings above.
	60 mm & larger	Butt-welding tee or reducing tee in accordance with Fittings above.
Flanges	All	Forged Stainless Steel: ASTM A182/A182M, Grade F316L, ASME B16.5 or B16.47 Class 150, slip-on or weld neck. Raised face for Class 150. Flat face for flange connecting to ductile/cast iron Class 125 flanges or other equipment and appurtenances requiring such.

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Item	Size	Description
Unions	50 mm & smaller	Socket weld forged: ASTM A182/A182M, Grade F316, 13800 or 20700 kPag WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11, bore to match pipe.
Bolting	All	Forged Flanges: Type 316 stainless steel, ASTM A320/A320M Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	All Flanges	Flanged 5 mm thick, unless otherwise specified, black rubber (EDPM), hardness 80 (Shore A), rated 93 degrees C minimum, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.  Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange.
Thread Lubricant	50 mm & smaller	Teflon tape.

### 3. Execution

#### 3.1. Stainless Steel Pipe Welding and Fabrication

- 3.1.1. Stainless steel fabrication shall be done in an approved fabrication shop set up to handle, fabricate and weld stainless steel using handling procedures designed to eliminate carbon contamination of the stainless steel including but not limited to: the use of stainless steel tools including wire brushes, chisels, files and hammers, welding gloves and grinding wheels. Only 300 series stainless steel brushes or wheels shall be used on austenitic stainless steel alloys.
- 3.1.2. Areas used for fabrication of austenitic and nickel alloys shall be separated from carbon steel areas by methods suitable to prevent contamination by dirt, carbon steel shavings, grinding dust and sparks, and zinc dust from painting operations. Welding gloves and tools used during the fabrication of stainless steel shall not have been used on previous carbon steel work.
- 3.1.3. Where tape is used for backing purge gas the tape shall use an adhesive backing such that when no longer required it can be completely removed with residual adhesive removed by a suitable solvent or abrasive.
- 3.1.4. Clean piping to a pre-weld zone extending 50 mm on either side of the weld with alcohol or acetone.
- 3.1.5. All welds for piping butt joints shall be full penetration.



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- 3.1.6. All welding of the root pass of austenitic stainless steel pipe shall be done using the Gas Tungsten Arc Weld (GTAW) process with shielding gas protection of the backside of the weld sufficient to reduce oxygen content to a level that can avoid granulation and ensure a high quality corrosion resistant weld. Large bore piping may be internally back welded to achieve the same result.
- 3.1.7. Clean welds after fabrication in accordance with ASTM A380.
- 3.1.8. Pickle and passivate welds after fabrication in accordance with AWWA C220, ASTM A380 and ASMT A967 by immersing in a liquid bath of pickling solution. Large bore piping shall be cleaned with a pickling paste.
- 3.1.9. Any noticeable discolouration on the piping after welding shall be removed by pickling.
- 3.1.10. Once sufficient pickling time has elapsed to re-passivate the stainless steel surface, clean the piping of all acids by thoroughly rinsing the pipe with water.
- 3.1.11. Thread stainless steel pipe in accordance with threading machine manufacturer's instructions.
- 3.1.12. Fabricating Tolerances for pipefittings and assemblies shall conform to the Pipe Fitters Institute Standard ES-3.

### 3.2. Pipe Grooving

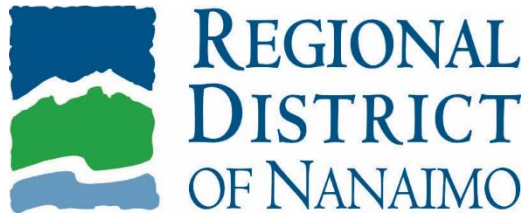
- 3.2.1. Groove stainless steel pipe in accordance with grooving machine manufacturer's instructions.
- 3.2.2. Contamination from iron particles by pressure contact with rollers or tooling should, if at all possible, be avoided. Where stainless steel rollers or tools are unavailable, adhesive plastic films or tape can be used to prevent direct contact. They shall be removed after fabrication. In all cases, if iron contamination is suspected, the piping must be pickled to remove the contamination and prevent rust staining.

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### 3.3. Fabricated Fittings

- 3.3.1. Shop fabricated fittings made from rolled stock in accordance with ASTM A240 shall be in a solution annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C220, ASTM A312, ASTM A778. Design standard shall be in accordance with AWWA C226 and thickness of all reinforcement collars and pads shall be determined by the appropriate formula in the latest edition of AWWA M11.

- 3.4. Pipe Coating: Do not paint stainless steel piping unless clearly indicated on the drawings.



# STRUCTURAL STEEL COATING SPECIFICATION

Indoor Wastewater Service Applications

Revision 0

December 30, 2021

 <b>REGIONAL DISTRICT OF NANAIMO</b>	<b>Structural Steel Coating Specification</b> <b>Indoor Wastewater Service</b> <b>Applications</b>	Date: December 30, 2021 Revision: 0 Ref. No: SP-S-0101
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## 1. Part One - General

### 1.1. Summary

This document serves as the governing specification for the surface preparation, shop coating application and field touch up repair for indoor carbon steel structures in immersed, semi-immersed and intermittently immersed wastewater service.

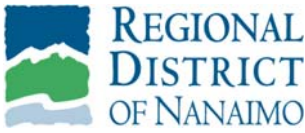
1.1.1. All material product data sheets and manufacturers' recommended procedures and application specifications shall also form part of the requirements of this specification.

1.1.2. Approved coating system alternatives are summarized in Appendix 1. The work will generally include the following:

- Performing initial surface preparation operations.
- Performing surface finishing to welds, edges, and appurtenances.
- Performing final surface preparation operations
- Removal of spent abrasive media & debris from surfaces prior to coating application.
- Application of coating materials, including touch-up where necessary.
- Performing and documenting all Quality Control Inspections.

### 1.2. References

The latest approved editions of the following codes and standards shall form an integral part of this specification. It is the responsibility of the Vendor to obtain the most recent revisions of the documents listed below, unless specified otherwise.

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**American Society for Testing and Materials**

- ASTM D4285: Standard Test Method for Indicating Oil or Water in Compressed Air
- ASTM D4414: Standard Test Method for Measurement of Wet Film Thickness using Notch Gages
- ASTM D4417: Standard Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel

**Association for Materials Protection and Performance (AAMP)**

Note: AAMP is formerly Steel Structural Painting Council / Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) / NACE International, The Corrosion Society)

- NACE SP0178: Standard Practice Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service
- NACE SP0188: Standard Practice Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- SSPC-AB 1: Abrasive Standard No. 1 - Mineral and Slag Abrasives
- SSPC-AB 2: Abrasive Standard No. 2 - Cleanliness of Recycled Ferrous Metallic Abrasives
- SSPC-AB 3: Abrasive Standard No. 3 - Ferrous Metallic Abrasive
- SSPC-VIS 1: Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
- SSPC-SP 1: Surface Preparation Specification No. 1 - Solvent Cleaning

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- SSPC-SP 2: Surface Preparation Specification No. 2 - Hand Tool Cleaning
- SSPC-SP 3: Surface Preparation Specification No. 3 - Power Tool Cleaning
- SSPC-SP 10/NACE No. 2: Joint Surface Preparation Standard - Near-White Metal Blast Cleaning
- SSPC-SP 11: Surface Preparation Specification No. 11 - Power Tool Cleaning to Bare Metal
- SSPC-PA 1: Paint Application Specification No. 1 - Shop, Field and Maintenance Coating of Metals
- SSPC-PA 2: Paint Application Specification No. 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements
- SSPC-PA 11: Paint Application Guide No. 11 - Protecting Corners, Edges, Crevices, and Irregular Steel Geometries by Stripe Coating
- SSPC-PA Guide 10: Paint Application Guide No. 10 - Guide to Safety and Health Requirements for Industrial Painting Projects

### 1.3. Definitions

- 1.3.1. The term Coating is used in this specification to mean the material provided by the coating manufacturer, to be applied to the service outlined in Part 1 above.
- 1.3.2. Coating Manufacturer shall mean the Manufacturer of the Coating (preferred) or their authorized technical representatives (Coating Supplier and or Distributor).
- 1.3.3. Quality Assurance Inspector shall mean a NACE Certified Coating Inspector Level 3 retained by RDN.
- 1.3.4. Quality Control Inspector shall mean a NACE Certified Coating Inspector Level 1 or 2 retained by the Vendor.

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1.3.5.RDN shall mean the representative or agent of the Regional District of Nanaimo authorized with responsibility for the work being performed under the project named in the contract documents.

1.3.6.Vendor shall mean a company or individual contracted to perform specific work or services for RDN.

#### 1.4. Submittals

1.4.1.The selected Vendor must supply the following submittals within 14 calendar days after contract award:

1.4.1.1. An Inspection and Testing Plan (ITP) indicating the quality control measures to be performed, the test methods used, frequency at which the testing will be performed and acceptance criteria. Refer to the quality control requirements in this specification outlined below.

1.4.2.The Vendor shall not commence work until the ITP has been developed, approved the RDN, and reviewed with the Vendor by the Quality Assurance Inspector.

1.4.3.Prior to receiving payment, the Vendor shall provide RDN with completed, signed and dated set of Quality Control Reports. Section 1.5 describes Quality Control Reporting requirements.

#### 1.5. Quality Control

1.5.1.The Vendor is responsible for the quality of all work performed and for assuring compliance with these specifications. Vendor is responsible to stop operations and promptly notify RDN when conditions develop which could adversely affect the quality of the work.

1.5.2.The Vendor shall follow the project-specific Inspection and Test Plan (ITP) as described in Section 1.4.1.1.

1.5.3.The Vendor shall maintain Quality Control Reports and allow RDN to view any such documentation at any time during the project, as well as provide copies to RDN on a weekly basis at a minimum.



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1.5.4. The Vendor will perform and document the following Quality Control Inspections at a minimum. Additional testing may be requested at the discretion of RDN.

- 1.5.4.1. Prior to commencement of abrasive blast cleaning, all areas to receive coating shall be inspected and if necessary, be prepared in accordance with NACE SP0178 Condition D. Sharp edges shall have a smooth radius of at least 3.2 mm (1/8 in).
- 1.5.4.2. Prior to commencement of abrasive blast cleaning, all areas to receive coating shall be prepared in accordance with SSPC-SP 1. Solvent in this definition is inclusive of water as well as chemical-based products.
- 1.5.4.3. The steel surface temperature, ambient air temperature, humidity and dew point shall be verified at a minimum of every 4 hours and always immediately before coating application.
- 1.5.4.4. Compressor air supply shall be tested for cleanliness daily in accordance with ASTM D4285.
- 1.5.4.5. Surface cleanliness shall be evaluated prior to coating application. SSPC-VIS 1 may be used to assist in evaluation of the prepared surfaces; however, the written surface preparation standards shall prevail.
- 1.5.4.6. Surface profile depth shall be verified prior to the application of coating in accordance with ASTM D4417, Method C.
- 1.5.4.7. The Vendor shall monitor and record coating material batch numbers and material temperatures immediately prior to mixing any coating materials. Any induction times required by the coating products shall be documented, including length of time mixing and quantity of material mixed.
- 1.5.4.8. Wet Film Thickness (WFT) shall be performed during application in accordance with ASTM D4414 as required to achieve acceptable Dry Film Thickness.
- 1.5.4.9. Dry Film Thickness (DFT) verification shall be performed accordance with SSPC-PA 2. The Vendor shall make adjustment accordingly to ensure the final DFT meets SSPC-PA 2 restriction level 2. DFT shall not exceed the maximum limits as per the Coating Manufacturer's recommendations.
- 1.5.4.10. Discontinuity (holiday) testing shall be performed after cure of the topcoat in accordance with NACE SP0188 (High-Voltage), Voltage Selection per Section 4, Table 1. Any holidays shall be repaired and re-tested.

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## 1.6. Quality Assurance

1.6.1. In addition to the Vendor's inspections, RDN or their designated representative(s) may perform any inspection necessary to verify compliance with this specification.

1.6.1.1. Inspection may include all work, equipment, inspection equipment, materials, or procedures and may be conducted at the discretion of RDN.

1.6.2. The Vendor shall provide RDN or their designated representative(s) safe access to all work areas for purpose of inspection.

1.6.3. The Vendor shall provide RDN or their designated representative(s) sufficient time within the work schedule to perform inspections identified on the ITP as described in Section 1.4.1.1.

1.6.4. The Vendor shall correct any work that RDN has determined to be in non-compliance with the requirements of this specification. Corrections shall be made without additional cost to RDN.

1.6.5. The failure of RDN or the Quality Assurance Inspector to discover or reject defective work or materials does not constitute acceptance of such work or materials by RDN.

1.6.6. The provisions of this specification shall also apply to any work performed by subcontractors to the Vendor.

## 1.7. Delivery, Storage and Handling

1.7.1. Coating materials shall be delivered in the original, sealed and undamaged containers bearing the product name, date of manufacture, date of expiration and batch numbers.

1.7.2. Store all project materials in their original containers with their original labels visible and readable. All coating materials shall be stored in a clean, dry, well-ventilated area, protected from sparks, flame, direct rays of the sun and heat or cold. If stored on a concrete floor the material shall be elevated (e.g. on a pallet) while being stored. Storage conditions shall be as specified by the Coating Manufacturer's recommendations.

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1.7.3. Do not use materials which have exceeded their shelf life or which have deteriorated in storage.

1.7.4. The Vendor shall have latest copies of the Coating Manufacturer's product data sheet and SDS for all materials on-site. In accordance with WHMIS regulations, suitable labelling of coating and solvent containers must be provided.

## 1.8. Sequencing and Scheduling

1.8.1. The Vendor shall complete all work within the schedule as provided by RDN.

## 2 Part Two - Products

### 2.1. Cleaning Materials

2.1.1. Supply all abrasive and any abrasive additives required.

2.1.2. Provide RDN with certificates indicating compliance with SSPC-AB 1 or AB 3 for the abrasive media prior to project start.

2.1.3. The abrasive selected shall be capable of imparting a sharp and angular profile.

2.1.4. The abrasive supplied shall be of sufficient size to achieve the cleanliness and surface profile requirements of the surface preparation specification.

2.1.5. All abrasives selected shall have <1% free silica (Class A) and shall not contain any hazardous toxic materials, or foreign matter.

2.1.6. Any recycling of ferrous abrasives shall satisfy the requirements of SSPC-AB 2.

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## 2.2. Coating and Materials

2.2.1. The Vendor shall supply all cleaning materials, coating materials, curing agents and thinners.

2.2.2. Coating systems or products from one manufacturer shall not be mixed with coating systems or products from another manufacturer.

2.2.3. Substitution of materials is not permitted. All coating materials shall be as specified by Coating Manufacturer's Recommendations for the coating system, including equipment wash, tool cleaner and any internal storage lubricants that may be required.

2.2.4. Each coat in a multi-coat system shall be of a different colour when supported by manufacturer's product line.

2.2.5. Final finish colour must be approved by RDN prior to application.

## 2.3. Labour, Supervision and Equipment

2.3.1. The Vendor shall furnish all labour, materials, supervision and equipment necessary to complete the work. This includes but is not limited to providing safe access to all work areas, containment, pre cleaning; surface preparation, coating application, heating, dehumidification, ventilation, and curing of applied materials.

2.3.2. It is the responsibility of the Vendor to meet the requirements of this specification in its entirety, to use equipment capable of meeting these requirements, supply adequately trained and experienced staff to perform the requirements, and to perform all inspections necessary to ensure compliance prior to inspection by RDN.

2.3.3. It is the responsibility of the Vendor to perform all work in a manner meeting the requirements of all local, provincial and federal regulations applicable to each activity.

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### 3 Part Three - Execution

#### 3.1 Pre-Job Conference

3.1.1.A Pre-Job conference shall be held prior to commencing any work on the project. Mandatory attendance is required of the Vendor, the Quality Assurance Inspector, the Quality Control Inspector and RDN's representative or agent.

3.1.1.1. The Pre-Job conference, location, date & time shall be established by RDN after receipt of Vendor submittals as required in Section 1.4.

#### 3.2 Field Work

3.2.1.The Vendor shall notify RDN immediately if there are any as-found defects or if the configuration of the application area will prevent the requirements of this specification from being satisfied.

3.2.2.The Vendor is responsible for preventing damage to the local application area, surrounding structure and environment while conducting operations as required under the specification.

3.2.2.1. Areas within or outside of the work scope that receive damage from the Vendor's installation, or field repair activities shall be repaired at the Vendor's expense.

#### 3.3 Conflicting Information

3.3.1.In the event of conflict between the Specification, purchase order, Coating Manufacturer's product data sheets, or any other supplemental specifications or standards, the Vendor shall notify RDN in writing of the basis of the conflict.

The Vendor shall follow the more stringent requirements of the conflict until clarification is provided by RDN.

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### 3.4 Coating Manufacturer Requirements

3.4.1. The Coating Manufacturer is required to provide on-site evaluations of the work being done, at RDN's request. The Coating Manufacturer may be required to provide the following technical assistance:

- 3.4.1.1. Be on site when coating application begins and visit the site periodically during application.
- 3.4.1.2. Respond to any technical requests or application problems, in writing, as requested by RDN.

### 3.5 Pre-Surface Preparation

3.5.1. Prior to surface preparation, the Vendor shall perform surface finishing of welds, edges, and surface irregularities to ensure all welds meet or exceed NACE SP0178 Condition D surface finish. Sharp edges shall be ground to a smooth radius of at least 3.2 mm ( $\frac{1}{8}$  in).

### 3.6 Surface Preparation – General

3.6.1. All foreign material and debris generated during or deposited after completion of surface preparation and cleaning shall be removed prior to applying any coating materials.

3.6.2. All air supply used during surface preparation activities or in the cleaning of surfaces of debris and spent abrasive prior to coating must be clean, dry and free from oil per ASTM D4285. The Vendor is responsible to provide all necessary equipment to ensure air quality meets this requirement.

3.6.3. All areas cleaned to the surface preparation requirements shall be coated within 8 hours or the prepared surface deteriorates.

- 3.6.3.1. Regardless of any time limits, all surfaces to receive coating are meet the requirements of Section 3.7.2 immediately prior to coating application.

### 3.7 Surface Preparation – Specific, Shop Work

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3.7.1. The surface profile shall be dense, sharp and angular, with a depth as specified on the Coating Manufacturer's product data sheet.

3.7.1.1. The Vendor shall correct any surface profile found to be in non-compliance with the requirements of this specification. Corrections shall be made without additional cost to RDN.

3.7.2. The degree of surface cleanliness shall be SSPC-SP 10/NACE No. 2 or as specified on the Coating Manufacturer's product data sheet. The more-stringent surface cleanliness requirement shall apply.

### 3.8 Surface Preparation – Specific, Field Work

3.8.1. All existing coating surrounding a repair area shall be abraded to roughen and de-gloss using SSPC-SP 2 or SSPC-SP 3 methods. The transition overlap area shall extend for a nominal radius of 50 mm (2 in.) beyond the repair.

3.8.2. Shop coated areas that have become damaged shall be prepared in accordance with SSPC-SP 11 with a surface profile depth as specified on the Coating Manufacturer's product data sheet.

3.8.3. Threaded fasteners shall be prepared in accordance with SSPC-SP 2 or SSPC-SP 3 as a minimum. SSPC-SP 11 shall be performed whenever practicable.

### 3.9 Temperature, Humidity, and Moisture Limitations

3.9.1. Coating application shall not be permitted to proceed when the air temperature, surface temperature, material temperature, or relative humidity is below or above that specifically permitted in the Coating Manufacturer's instructions.

3.9.1.1. At a minimum, surface preparation or coating application shall not be performed when the substrate temperature is less than 3°C above the dew point or when the relative humidity is greater than 85%.

3.9.1.2. The Vendor shall maintain the specified ambient conditions and ventilation after application to ensure cure of the coating system. The cure period shall be as recommended by the Coating Manufacturer, based on time and temperature.

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### 3.10 Mixing

- 3.10.1. All mixing shall be performed in strict accordance with the Coating Manufacturer's instructions.
- 3.10.2. Induction times shall comply with the Coating Manufacturer's instructions.
- 3.10.3. Do not use any material which has reached its pot life as specified by the Coating Manufacturer's product data sheet.

### 3.11 Application - General

- 3.11.1. All surfaces not to receive coating are to be adequately protected against drips, spatter, spills and over-spray. The Vendor will be responsible for removing any over-spray at his own expense.
- 3.11.2. Coatings shall be applied as specified in Appendix 1, in accordance with SSPC-PA 1, the Coating Manufacturer's instructions and including, but is not limited to: application methods, application equipment, and minimum/maximum recoat times.
- 3.11.3. Coated surfaces that have become contaminated and are to receive additional coating materials shall have the coated surface cleaned using a procedure that is compliant with SSPC-SP 1 and in accordance with the Coating Manufacturer's instructions.
- 3.11.4. All coating materials shall be applied to achieve a smooth, uniform appearing, continuous film that is free of visual defects. Defects include, but are not limited to; debris inclusions, runs, drips, sags, blisters, pinholes, blushing, craters, hazing, lack of opacity, dry spray, overspray, discontinuities, crazing, bubbling and lack of adhesion.
- 3.11.5. Edge and weld Stripe coat: The Vendor shall apply a stripe coat via brush and brushed in in accordance with SSPC-PA 11 prior to the application of the primer coat.
- 3.11.6. Allow each coat to cure as specified on the Coating Manufacturer's printed instructions prior to application of successive coats.
- 3.11.7. Materials shall not be applied if it is anticipated that environmental conditions will not meet the Coating Manufacturer's minimum criteria during cure.



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3.11.8. The Vendor shall repair damage to any coat before application of additional coats.

3.11.9. The Vendor shall repair all deficiencies identified in Section 3.11.4 in accordance with the Coating Manufacturer's written repair procedure.

### 3.12 Environmental

3.12.1. The Vendor shall ensure that all surface preparation and application is performed in a manner that prevents the release of cleaning materials, coatings or other potentially deleterious substances into the aquatic or terrestrial environments.

3.12.2. The Vendor shall provide any containment required for cleaning, surface preparation and coating application operations.

3.12.3. All waste abrasive, coating materials, solvents, containment materials, filters, containers, packaging and all other debris generated during the cleaning, surface preparation and coating operation shall be disposed of by the Vendor in accordance with all local, provincial and federal regulations.

### 3.13 Safety

3.13.1. The Vendor shall provide all safe work procedures, personal protective equipment, personal hygiene requirements and workspace ventilation necessary to comply with local, provincial and federal regulations.

3.13.2. All cleaning, surface preparation and coating operations shall be performed in accordance with, SSPC-PA Guide 10 and WorkSafeBC requirements.

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#### APPENDIX 1 - APPROVED COATING SYSTEM ALTERNATIVES

Manufacturer	Product	Chemistry	Volume Solids	# Coats	Total DFT (mils)
1. Sherwin-Williams	<a href="#">Sher-Glass FF</a>	Reinforced Amine Epoxy	76% ± 2%	2	16-24
2. SPC	<a href="#">SP-9888 Stripe Coating</a>	Novolac Epoxy	100%	2+	16-20
3. Tnemec	<a href="#">Perma-Glaze Series G435</a>	Modified Polyamine Epoxy	100%	1+	15-25

Note: The above systems are single product systems (e.g. same coating material for primer coat, stripe coat and topcoat)

## SECTION 01600

### MATERIAL AND EQUIPMENT

#### PART 1 GENERAL

##### 1.1 PRODUCTS

- A. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock and may also include existing materials or components required for reuse.
- B. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
- C. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

##### 1.2 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.
- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

##### 1.3 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current progress schedule and coordinate to avoid conflict with the Work and conditions at site.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable. Include ULC labels on products so specified.
- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at site. Inspect for completeness and evidence of damage during shipment.

- D. Remove damaged products from site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

#### 1.4 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in Contractor provided approved storage yards or sheds. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- C. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 15 degrees C. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage. Connect and operate continuously all space heaters furnished in electrical equipment.
- D. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- E. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- F. Hazardous Materials: Prevent contamination of personnel, storage building, and site. Meet requirements of product specification, codes, and manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment Finish:
  - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
  - 2. If manufacturer has no standard color, provide equipment with white finish as approved by Owner.
- G. Bolted Connections: Project bolt ends minimum 3 mm but not more than one bolt diameter beyond nut faces.
- H. Flanges: Arrange with bolt holes straddling vertical centreline.

## 2.2 FABRICATION AND MANUFACTURE

- A. General:
  - 1. Manufacture parts to North American standard sizes and gauges.
  - 2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
  - 3. Design structural members for anticipated shock and vibratory loads.
  - 4. Use 6 mm minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
  - 5. Modify standard products as necessary to meet performance Specifications.

## 2.3 SOURCE QUALITY CONTROL

- A. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- B. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

### 3.2 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Repaint painted surfaces that are damaged prior to equipment acceptance.
- D. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at site, available for review at all times.

### 3.3 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

END OF SECTION

## SECTION 02220

### DEMOLITION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Equipment and materials scheduled for demolition are as shown on the Drawings.

##### 1.2 SUBMITTALS

- A. Information Submittals:
  - 1. Methods of demolition and equipment proposed to demolish each structure.
  - 2. Copies of any authorizations and permits required to perform the Work including transportation to the disposal site/s and the use disposal site/s. Any payments necessary to obtain the authorization and permits shall be borne by the Contractor.
  - 3. The Contractor shall also arrange for any inspections necessary from relevant authorities for proper execution and demolishing works. All costs associated with these shall be met by the Contractor.

#### PART 2 PRODUCTS (Not Used)

#### PART 3 EXECUTION

##### 3.1 DEMOLITION

- A. Drawings define minimum portion of materials to be removed. Unless otherwise shown, rough cuts or breaks may be made exceeding limits of demolition shown.
- B. Remove all materials associated with existing equipment that is to be removed or relocated.
- C. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 20 mm below final finished surface.
- D. Carry out demolition in accordance with requirements of provincial and municipal authorities.
- E. At end of each work shift leave work in safe condition so that no part of remaining structure is in danger of toppling, collapsing, or falling.

### 3.2 DISPOSAL

- A. Dispose of debris and other nonsalvaged materials offsite in licensed landfills. The debris and non salvaged material from site shall be removed as quickly as possible. Burning of debris or selling of materials on site will not be permitted.
- B. If the disposal site is not a licensed landfill, Contractor shall submit details of this site. Necessary written approval from relevant authorities shall be submitted.

### 3.3 SALVAGE

- A. Equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of Contractor.

END OF SECTION



## SECTION 03600

### GROUT AND MISCELLANEOUS CONCRETE WORK

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes
  - 1. Grouting including:
    - a. Filling tie holes.
    - b. Filling openings and blockouts.
    - c. Grouting under base plates for equipment and fittings and structural steel.
    - d. Through bolt openings.
    - e. Grouted-in dowels for connecting to existing concrete.
  - 2. Alterations and modifications to existing structures, including:
    - a. Removing existing concrete.
    - b. Cutting construction joint keys in existing structures.
    - c. Finishing of existing concrete.
    - d. Refinishing.
- B. Comply with the the following statutes codes and standards and all amendments thereto.
  - 1. American Society for Testing and Materials International (ASTM):
    - a. C230/C230M, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
    - b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
    - c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
    - d. C579, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
    - e. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
    - f. C939/C939M, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
    - g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
    - h. C1107/C1107M-17, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
    - i. C1181/C1181M, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
    - j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

## 1.2 SUBMITTALS

- A. Shop Drawings:
  - 1. Product data of grouts including installation, application, and maintenance instructions.
  - 2. Proposed method for keeping existing concrete surfaces wet prior to placing hydraulic cement grout.
  - 3. Forming method for fluid grout placements.
  - 4. Curing method for grout.
- B. Quality Control Submittals:
  - 1. Manufacturer's printed Instructions:
    - a. Adding fiber reinforcing to batching.
    - b. Water/Cementing material ratio of grout.
    - c. Mixing of grout.
  - 2. Manufacturer's proposed training schedule for grout work.
  - 3. Manufacturer's Certificate of Compliance:
    - a. Grout free from chlorides and other corrosion-causing chemicals.
    - b. Nonshrink hydraulic cement grout properties of Types II and III, verifying expansion at 3 or 14 days will not exceed the 28-day expansion and nonshrink properties are not based on gas or gypsum expansion.
  - 4. Manufacturer's Certificate of Proper Installation.
  - 5. Statements of Qualification: Nonshrink grout manufacturer's representative.
  - 6. Test Reports for Nonshrink Hydraulic Cement Grout:
    - a. Test results and service report from demonstration and training session.
    - b. Field test reports and laboratory test results for field-drawn samples.
  - 7. Load Test Results for Grouted in Dowels:
    - a. Submit load test results of grouted - in dowels.

## 1.3 QUALIFICATIONS

- A. Nonshrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1 year experience that has resulted in successful installation of grouts similar to those for this Project.

## 1.4 GUARANTEE

- A. Manufacturer's guarantee containing disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished will not be accepted.
- B. Manufacturer guarantees participation with Contractor in replacing or repairing grout found defective due to faulty materials, as determined by industry standard test methods.

## PART 2 PRODUCTS

### 2.1 NONSHRINK HYDRAULIC CEMENT GROUT AND EPOXY GROUT SCHEDULE

A. Furnish grout of type specified for applications in the following schedule:

	Temperature Range	Maximum Placing Time	
Application	4 to 38 ° C	20 minutes	Greater than 20 minutes
Filling tie holes	I	I	I
Blockouts for gate guides	I or II		II
Column base plates single-storey	I or II		II
Bases for precast wall sections	II	II	II
Base plates for columns over one storey	II	II	II
Through-bolt openings	II	II	II
Baseplates and/or soleplates with vibration, thermal movement, etc.	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout

### 2.2 NONSHRINK HYDRAULIC CEMENT GROUT

A. Type I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107/C1107M:
  - a. Flowable consistency 140 percent, five drops in 30 seconds, in accordance with ASTM C230.
  - b. Flowable for 15 minutes.
4. No bleeding of grout at maximum allowed water.
5. Minimum strength of flowable grout,
  - a. 20 MPa at 3 days,
  - b. 35 MPa at 7 days,
  - c. 48 MPa at 28 days.
6. Manufacturers and Products:
  - a. BASF.; MasterFlow 100.
  - b. Euclid Chemical Co.; NS Grout.
  - c. Dayton Superior Corp.; 1107 Advantage Grout.

B. Type II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. No segregation or settlement of aggregate at fluid consistency at specified times or temperatures.

4. Test in accordance with ASTM C1107/C1107M:
  - a. Fluid consistency 20 to 30 seconds in accordance with ASTM C939/C939M.
  - b. Temperatures of 5, 27, and 38 degrees C.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout,
  - a. 25 MPa at 1 day
  - b. 30 MPa at 3 days
  - c. 52 MPa at 28 days.
7. Maintain fluid consistency when mixed in 1 to 7 m<sup>3</sup> loads in ready-mix truck.
8. Manufacturers and Products:
  - a. BASF.; Master Flow 928.
  - b. Euclid Chemical Co.; Hi-Flow Grout.
  - c. Dayton Superior Corp.; Sure-Grip High Performance Grout.

C. Type III:

1. Metallic and nongas-liberating.
2. Prepackaged aggregate grout requiring only the addition of water.
3. No segregation or settlement of aggregate at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
  - a. Fluid consistency 20 to 30 seconds in accordance with ASTM C939/C939M.
  - b. Temperatures of 5 and 38 degrees C.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout,
  - a. 28 MPa at 1 day
  - b. 35 MPa at 3 days
  - c. 62 MPa at 28 days.
7. Maintain fluid consistency when mixed in 1 to 7 m<sup>3</sup> loads in ready-mix truck.
8. Manufacturer and Product:
  - a. BASF; MasterFlow 885
  - b. Euclid Chemical Co.: Hi Flow Metallic Grout

## 2.3 NONSHRINK EPOXY GROUT

- A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.
- B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.
- C. Premeasured, prepackaged system.
- D. Flowable.
- E. Minimum compressive strength in accordance with ASTM C579 Method B, 65 MPa at 23 degrees C at 7 days, 76 MPa at post cure.

- F. Maximum creep resistance in accordance with ASTM C1181/C1181M at 4 MPa, 60 degrees C; 6.0 by  $10^{-3}$  mm/mm.
- G. Minimum bond strength in accordance with ASTM C882/C882M, 14 MPa.
- H. Minimum tensile strength in accordance with ASTM C307, 14MPa.
- I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 23 degrees C to 99 degrees C, 41.4 by  $10^{-6}$  mm/mm/degrees C.
- J. Working Time: Minimum 2 hours at 10 degrees C; 1.5 hours at 21 degrees C; 50 minutes at 32 degrees C.
- K. Good chemical resistance.
- L. Good effective bearing area.
- M. Noncorrosive.
- N. Moisture insensitive.
- O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.
- P. Manufacturer and Product:
  - 1. BASF; MasterFlow 648.
  - 2. Dayton Superior Corp.; Pro-Poxy 2000 Normal Set.

## 2.4 DOWELLING GROUT

- A. Hydraulic Cement Grout:
  - 1. MasterEmaco T 545 by BASF.
  - 2. Epoxy grout:
  - 3. Approved by an ICC Evaluation Services Report for conformance to CSA A23.3 Annex D requirements for doweling of steel reinforcing bars in cracked concrete.
  - 4. Suitable for long-term loads as well as for wind and seismic loads.
  - 5. Meet requirements of ASTM C881/C881M.
  - 6. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
  - 7. Disposable, Self-Contained Cartridge System:
    - a. Capable of dispensing both components in proper mixing ratio.
    - b. Fit into manually or pneumatically operated caulking gun.
  - 8. Manufacturers and Products:
    - a. Hilti, Inc.; HIT RE 500 SD (ELC 3814) or HIT HY 200 (ELC 3187) Adhesive Anchors.
    - b. Powers Fasteners; Power PURE110+ Epoxy Adhesive Anchor System (ELC 3298).
    - c. Simpson Strong-Tie Co., Inc.; SET-XP Epoxy Adhesive Anchors (ESR 2508).

## PART 3 EXECUTION

### 3.1 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's representative's printed training instructions.
- B. Epoxy Grout: Concrete slab shall be fully cured for 28 days to ensure excess water has evaporated. Test concrete surface for moisture in accordance with ASTM D4263 before epoxy grout is placed.
- C. Form Tie or Through-Bolt Holes: Provide nonshrink hydraulic cement grout, Type I and II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes coordinate dry pack dense grout application with vinyl plug.
- D. Grouting Machinery Foundations:
  - 1. Use nonshrink hydraulic cement grout except where equipment supplier specifically recommends nonshrink epoxy grout.
  - 2. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by abrasive blasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
  - 3. For nonshrink hydraulic cement grout, thoroughly clean concrete surface and metal surfaces to be in contact with grout to remove all paint, oil, grease, loose rust, and all other foreign matter.
  - 4. For nonshrink epoxy grout, thoroughly clean concrete surface and abrasive blast metal surfaces to be in contact with grout unless grout manufacturer states in writing that abrasive blasting is not necessary.
  - 5. Set machinery in position and wedge to elevation with steel wedges or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
  - 6. Form with watertight forms at least 50 mm higher than bottom of plate.
  - 7. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.
  - 8. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.
  - 9. Radius all corners of grout pad.
  - 10. Install expansion joints for epoxy grout placement in accordance with manufacturer's written instructions.

### 3.2 GROUTED-IN DOWEL FOR CONNECTING TO EXISTING CONCRETE

- A. Using a Hydraulic Cement Based Dowelling Grout:
  - 1. Drill hole in existing concrete of diameter equal to diameter of dowel bar plus [20] mm.
  - 2. Clean hole of dust and debris.
  - 3. Fill hole to surface with dowelling grout.
  - 4. Install dowel bar and wipe away overflow.

5. Secure dowel bar firmly in position and do not disturb bar for minimum of 24 hours after installation.

B. Using an Epoxy Type Dowelling Grout:

1. Drill hole and install dowel in accordance with manufacturer's printed instructions.

### 3.3 ALTERATIONS TO EXISTING CONCRETE

A. General:

1. Cut out, remove, or modify parts of existing concrete structures, roughen surfaces, cut keys, weld bars, and carry out other items of work as required.
2. Use satisfactory methods which will not result in damage to equipment or other parts of the structures by vibration, dust, water, or other contaminants.
3. Verify actual conditions before beginning alterations.
4. After alterations are done, repair surface defects and damaged areas and finish surface to match adjacent areas.

B. Cutting Construction Joint keys in Existing Concrete:

1. Where slabs or walls are placed against existing concrete cut a 40 mm deep continuous standard key.
2. Roughen surface and provide thoroughly bonded concrete.

C. Finishing of Existing Concrete Surfaces:

1. As a result of alterations where previously exterior faces become interior, abrasive blast and clean entire surface.
2. Patch surface depressions with sand-cement mortar.
3. Grind smooth fins and protrusions.
4. Apply sack-rubbed finish to entire exposed surface to match adjacent interior surfaces.

D. Refinishing:

1. Refinish cut edges of openings flush and smooth, with a bonding agent and concrete or with a non-shrink non-ferrous pre-blended hydraulic cement grout of same colour as adjacent concrete.
2. Cut back exposed reinforcing bars 25 mm from the finished surface level. Fill voids at each bar with grout. Grind edges smooth after repairs and modifications have been completed.

E. Existing Reinforcing Dowels Encased in Lean Concrete or Lime Mortar:

1. Break out existing encasement and expose reinforcing dowels. Clean individual bars to bare metal by abrasive blast cleaning. Straighten bars as required.
2. Report any missing or damaged reinforcing bars to the Engineer before proceeding further.

### 3.4 FIELD QUALITY CONTROL

A. Evaluation and Acceptance of Nonshrink Hydraulic Cement Grout:

1. Inspect the surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.
5. Perform flow cone and bleed tests, and make three 50 mm by 50 mm cubes for each cubic metre of each type of nonshrink grout used. Use restraining caps for cube. Use restraining caps for cube molds in accordance with ASTM C1107/ C1107M.
6. For large grout applications make three additional cubes and one more flow cone test. Include bleed test for each additional cubic metre of nonshrink grout placed.
7. Consistency: Grout with consistencies outside range requirements will be rejected.
8. Segregation: Grout when aggregate separates will be rejected.
9. Tests must show that strength attained by non shrink grout cubes is equal to or greater than minimum strength specified.
10. Strength Test Failures: Remove and replace non shrink grout work failing strength tests.
11. Perform bleeding test in accordance with ASTM C940 to demonstrate grout will not bleed.
12. Store cubes at 21 degrees C.
13. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
14. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
15. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
16. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
17. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
18. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
19. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
20. Inspect epoxy grout for cure.
21. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
22. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
23. Compression tests and fabrication of specimens for epoxy grout shall be made in accordance to ASTM C579, Method B, at intervals during construction as selected by the Project representative. A set of three specimens shall be made for testing at 7 days, and each earlier time period as appropriate.



24. Independent testing laboratory to prepare, store, cure, and test cubes in accordance with ASTM C579.
25. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

### 3.5 MANUFACTURER'S SERVICES GENERAL

#### A. General:

1. Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative. Allow 2 week notice to grout manufacturer's representative for scheduling purposes.
2. Provide and conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of grout.
3. Ensure necessary equipment and materials are available for demonstration.
4. Conduct training prior to equipment mount installation work on equipment pads.
5. Training for each type of grout shall be not less than 4 hours' duration.

#### B. Nonshrink Grout Training:

1. Training is required for all Type III and epoxy grout installations.
2. Provide nonshrink grout installation training by the qualified grout manufacturer's representative for Contractor's workers that will be installing nonshrink grout for baseplates and equipment mounts. Schedule training to allow Engineer's attendance.
3. Establish location at site and schedule time for grout manufacturer's demonstration and training session of proposed nonshrink grouts. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, e.g., baseplates and tie holes to provide actual on-the-job training.
4. Use minimum of two bags for each grout Type II and Type III. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1, 3, and 28 days. Use remaining grout for final Work.
5. Include recommended grout curing methods in the training.
6. Transport test cubes to independent test laboratory and obtain test reports.
7. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
8. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

#### C. Epoxy Grout Training:

1. Provide epoxy grout installation training by the qualified epoxy grout manufacturer's representative for Contractor's workers that will be installing epoxy grout for equipment mounts. Schedule training to allow Engineer's attendance.
2. Include training in:
  - a. Performance testing such as compressive strength testing of the epoxy grout.
  - b. All aspects of using the products, from mixing to application.
3. Transport test cubes to independent test laboratory and obtain test reports.

4. Training by manufacturer's representative does not relieve Contractor of overall responsibility for this portion of the work.
5. Submit a list of attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

END OF SECTION

## SECTION 05502

### METAL FABRICATIONS (STRUCTURAL)

#### PART 1 PRODUCTS

##### 1.1 STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

- A. Steel angle support frames to be embedded in concrete shall be stainless steel Type 304 unless indicated otherwise.
- B. Provide stainless steel anchors for stainless steel support frames.

##### 1.2 CHECKERED FLOOR PLATE

- A. Fabricate angle frames and border bars with the following features:
  - 1. Corners neatly fitted, welded, mitred.
  - 2. Shop welded border bars.
  - 3. Weld strap anchors to angle frames for casting into concrete.
  - 4. Size angle frames to fit floor plate with clearances between frames and floor plate not exceeding 3 mm on any side.
- B. Material:
  - 1. Stainless Steel: ASTM A793, AISI Type 304 .
  - 2. Aluminum: ASTM B632/B632M, Alloy 6061-T6.
- C. Minimum Thickness:
  - 1. Steel and Stainless Steel: 6 mm, unless shown otherwise on Drawings.
  - 2. Aluminum: 10 mm, unless shown otherwise on Drawings.
- D. Surface shall be raised-lug pattern or diamond tread, unless shown otherwise on Drawings.

##### 1.3 FIXING ANGLES

- A. Fabricate fixing angles where indicated and as detailed on the Drawings.
- B. Material:
  - 1. Stainless Steel: ASTM A793, AISI Type 304.

#### PART 2 PRODUCTS (Not Used)

## PART 3 EXECUTION

### 3.1 FIELD QUALITY CONTROL

- A. Clean off dirt on installed miscellaneous metal surfaces.

END OF SECTION

## SECTION 15060

### PIPING SUPPORT SYSTEMS

#### PART 1 GENERAL

##### 1.1 WORK OF THIS SECTION

- A. Work of this Section includes furnishing and installation of pipe support systems. Comply with support design details shown on the Drawings.

##### 1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B31.3, Process Piping.
    - b. B31.9, Building Services Piping.
  - 2. American Society for Testing and Materials (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
    - c. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - 3. Canadian General Standards Board (CGSB):
    - a. 1-GP-181, Ready-Mixed Organic Zinc-Rich Coating.
  - 4. Canadian Standards Association (CSA):
    - a. B51 Boiler, Pressure Vessel, and Pressure Piping Code.
  - 5. Manufacturers Standardization Society (MSS):
    - a. SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
  - 6. National Building Code of Canada (NBC), with Manitoba Amendments.

##### 1.3 DEFINITIONS

- A. Wetted or Submerged: Submerged, less than 300 mm above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.
- B. Design Differential Temperature: The temperature differential between the piping design temperature and outdoor winter 1 percent design temperature as defined by the governing building code.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.
- B. Support material to be as follows unless otherwise approved:
  - 1. Commercially available clamps, clevis', rods, brackets, nuts and bolts – hot-dip galvanized carbon steel;
  - 2. Fabricated structural steel members and anchor plates – hot-dip galvanized carbon steel;
  - 3. Concrete anchors – galvanized carbon steel

### 2.2 PIPE HANGERS

- A. Clevis Type:
  - 1. MSS SP-58, Type 1.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 260.
    - b. Cooper B-Line; Figure B3100.
- B. J-Hanger:
  - 1. MSS SP-58 Type 5.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 67.
    - b. Cooper B-Line; Figure B3690.
- C. Adjustable Split-Ring Type:
  - 1. MSS SP-58 Type 6.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 104.
- D. Adjustable Split-Ring Type with Turnbuckle:
  - 1. MSS SP-58 Type 11.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 108 with Figure 230.
- E. Extension Split Pipe Clamp:
  - 1. MSS SP-58 Type 12.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 138R.
    - b. Cooper B-Line; Figure B3198R or B3198H.
- F. Adjustable Yoke Pipe Roll:
  - 1. MSS SP-58 Type 43.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 181.

- b. Cooper B-Line; Figure B3110.

## 2.3 SADDLE SUPPORTS

- A. Pedestal Type – Non-Adjustable:
  - 1. MSS SP-58 Type 37.
  - 2. Schedule 40 pipe stanchion, non-adjustable saddle with U-bolt, and anchoring flange.
  - 3. Manufacturers and Products:
    - a. Anvil; Figure 259.
    - b. Cooper B-Line; Figure B3090.
- B. Pedestal Type – Adjustable:
  - 1. MSS SP-58 Type 38, with U-bolt.
  - 2. Schedule 40 pipe stanchion, adjustable saddle with U-bolt, and anchoring flange.
  - 3. Manufacturers and Products:
    - a. Anvil; Figure 265.
    - b. Cooper B-Line; Figure B3092.

## 2.4 ROLLER SUPPORTS

- A. Roller Chair:
  - 1. Manufacturers and Products:
    - a. Anvil; Figure 175.
    - b. Cooper B-Line; Figure B3120.
- B. Adjustable Roller Support:
  - 1. MSS SP-58 Type 41.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 177.
    - b. Cooper B-Line; Figure B3122.
- C. Pipe Roll:
  - 1. MSS SP-58 Type 44.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 271.
    - b. Cooper B-Line; Figure B3117SL.
- D. Adjustable Pipe Roll:
  - 1. MSS SP-58 Type 46.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 274, 274P, or 275.
    - b. Cooper B-Line; Figure B3118SL.

## 2.5 BOLTED SUPPORTS

- A. Flange Type:
  - 1. Bolts directly to pipe flange.

2. Adjustable pipe stanchion, single or double pipe supports.
3. Manufacturers and Products:
  - a. Cooper B-Line; Figure B3094.
  - b. Standon; Model S89.

## 2.6 WALL BRACKETS

- A. Welded Steel Bracket (medium duty):
  1. MSS SP-58 Type 32.
  2. Manufacturers and Products:
    - a. Anvil; Figure 195.
    - b. Cooper B-Line; Figure B3066.
- B. Welded Steel Bracket (heavy duty):
  1. MSS SP 58 Type 33.
  2. Manufacturers and Products:
    - a. Anvil; Figure 199.
    - b. Cooper B-Line; Figure B3067.

## 2.7 PIPE CLAMPS

- A. Riser Clamp:
  1. MSS SP-58 Type 8.
  2. Manufacturers and Products:
    - a. Anvil; Figure 261.
    - b. Cooper B-Line; Figure B3373.
- B. Offset Pipe Clamp:
  1. Manufacturers and Products:
    - a. Anvil; Figure 103.
    - b. Cooper B-Line: Figure B3148.
- C. Pipe Strap:
  1. MSS SP-58 Type 26.
  2. Manufacturers and Products:
    - a. Anvil; Figure 262.
    - b. Cooper B-Line: Figure B2400.

## 2.8 CHANNEL TYPE SUPPORT SYSTEMS

- A. Pre-Engineered Support System:
  1. Channel Size:
    - a. Steel: 12-gauge, 41.3 mm wide minimum.
    - b. FRP: 38.1 mm wide minimum.
  2. Members and Connections: Design for all loads with safety factor of 5.
  3. Pipe Clamps: Two-piece clamps for all pipes unless otherwise noted.
  4. Manufacturers and Products:



- a. Anvil; Power-Strut.
- b. Cooper B-Line; Strut System.
- c. UBS Industries; Unistrut.
- d. Tyco; Aickinstrut (FRP system).

## 2.9 FLOOR-MOUNTED PIPE SUPPORT SYSTEMS

- A. W, H, or HSS shapes steel sections.
- B. MI Industrial Modular Support System supplied by Hilti may be used as alternative support system.
- C. Support system shall be placed at locations not to interfere with equipment maintenance and walkways.

## 2.10 ACCESSORIES

- A. Hanger Rods, Clevises, Nuts, U-bolts, Sockets, and Turnbuckles: In accordance with MSS SP-58.
- B. Concrete Inserts:
  - 1. MSS SP-58 Type 18.
  - 2. Continuous channel insert with load rating not less than that of hanger rod it supports.
  - 3. Manufacturers and Products:
    - a. Cooper B-Line; Figure B22I, B32I, or B52I.
- C. Beam Clamps:
  - 1. MSS SP-58 Type 21, 28, 29, or 30.
  - 2. Concentric loading type which engage both sides of flange.
  - 3. Manufacturers and Products:
    - a. Anvil; Figure 133 or 292.
    - b. Cooper B-Line; Figure B3050 or B3054.
- D. Insulation Protection Saddles:
  - 1. MSS SP-58 Type 39.
  - 2. Manufacturers and Products:
    - a. Anvil; Figure 160 through 166A.
    - b. Cooper B-Line; Figure B3160 through B3165.
- E. Insulation Protection Shields:
  - 1. MSS SP-58 Type 40.
  - 2. Galvanized steel or stainless steel.
  - 3. Manufacturers and Products:
    - a. Anvil; Figure 167.
    - b. Cooper B-Line; Figure B3151.
- F. Vibration Isolation Pads:

1. Type: Neoprene waffle.
2. Manufacturers and Products:
  - a. Mason Industries; Type W.
  - b. Korfund; Korpad 40.

## 2.11 PIPE GUIDES

### A. Intermediate Guides:

1. Piping 150 mm and Smaller:
  - a. Type: Pipe clamp with oversized pipe sleeve to provide minimum 3.2 mm clearance.
  - b. Manufacturers and Products:
    - 1) Cooper B-Line; B3148 or B3180.
    - 2) Anvil; Figure 103.
2. Piping 200 mm and Larger:
  - a. Type: Specially formed U-bolts with double nuts to provide 6.4 mm minimum clearance around pipe.
  - b. U-Bolt Stock Size:
    - 1) 200 mm Pipe: 15.9 mm.
    - 2) 250 mm Pipe: 19.1 mm.
    - 3) 300 mm Through 400 mm Pipe: 22.2 mm.
    - 4) 450 mm Through 762 mm Pipe: 25.4 mm.

### B. Alignment Guides:

1. Piping 200 mm and Smaller:
  - a. Spider or sleeve type.
  - b. Manufacturers and Products:
    - 1) Anvil; Figure 255 or 256.
    - 2) Cooper B-Line; Figure B3281 through B3287.
    - 3) Flexonics; Series PGT.
2. Piping 250 mm and Larger:
  - a. Adjustable double roller type.
  - b. Manufacturers and Products:
    - 1) Anvil; Figure 177 with Figure 171.
    - 2) Cooper B-Line; Figure B3122A.

## 2.12 PIPE ANCHORS

### A. Anchor Chairs:

1. Type: Anchor chair with U-bolt strap.
2. Manufacturers and Products:
  - a. Cooper B-Line; Figure B3147A or B3147B.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### A. General:

1. Install support systems in accordance with MSS SP-58, unless shown otherwise.
2. Support piping such that the pipe loads are carried by pipe supports and not by the connected equipment.
3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
4. Support no pipe from pipe above it.
5. Support pipe at changes in direction and elevation, adjacent to flexible joints and couplings, and where shown.
6. Do not install pipe supports and hangers in equipment access areas or bridge crane areas.
7. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
8. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion, where shown and/or where required by Contractor's design.
9. Repair mounting surfaces to original condition after attachments are made.

#### B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
  - a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
  - b. Grouped Pipes: Trapeze hanger systems.
  - c. Furnish galvanized steel insulation protection shield and oversized hangers for insulated pipe.
  - d. Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.
2. Horizontal Piping Supported from Walls:
  - a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
  - b. Stacked Piping:
    - 1) Wall mounted framing system and clips acceptable for piping smaller than 75 mm minimal diameter.
    - 2) Piping clamps that resist axial movement of pipe through support not acceptable.
  - c. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported from Floors:
  - a. Stanchion Type:
    - 1) Pedestal Type, adjustable with stanchion, saddle, and anchoring flange.
    - 2) Use yoked saddles for piping whose centerline elevation is 450 mm or greater above floor and for exterior installations.
    - 3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

- b. Floor Mounted Channel Supports:
    - 1) Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
    - 2) Attach channel framing to floors with anchor bolts.
    - 3) Attach pipe to channel with clips or pipe clamps.
  - c. Concrete Cradles: Use for piping larger than 75 mm along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
  - 4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
  - 5. Standard attachments, unless indicated otherwise on the Drawings:
    - a. To Concrete Ceilings: Concrete inserts.
    - b. To Steel Beams: I-beam clamp or welded attachments.
    - c. To Wooden Beams: Lag screws and angle clips to members not less than 62.5 mm thick.
    - d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
  - 6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.
- C. Intermediate and Pipe Alignment Guides:
- 1. Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.
  - 2. Guide pipe on each side of expansion joint or loop at a distance of 4-pipe and 14-pipe diameters from each joint or loop.
  - 3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.
- D. Accessories:
- 1. Insulation Protection Shield: Install on insulated non-steel piping with oversize rollers and supports.
  - 2. Insulation Protection Saddle: Install on insulated steel pipe. Oversize rollers and supports.
  - 3. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
  - 4. Dielectric Barrier:
    - a. Install between carbon steel members and copper or stainless steel pipe.
    - b. Install between stainless steel supports and non-stainless steel ferrous metal piping.
  - 5. Electrical Isolation: Install 6.4 mm by 75 mm neoprene rubber wrap between submerged metal pipe and oversized clamps.

END OF SECTION

## SECTION 15202

### PROCESS VALVE GENERAL

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. This Supplemental Specification Section specifies supply and installation of all valves and related appurtenances installed on process piping systems. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the Work described herein.

##### 1.2 SUBMITTALS - REVIEW

- A. Provide catalogue cuts and/or shop drawings for each type of valve and actuator indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and maximum pull on actuator, and valve end configuration.
- B. Provide valve pressure/temperature rating. For bidirectional valves provide rating for both sealing directions.
- C. For butterfly and plug valves provide headloss vs. percent open curves.
- D. Canadian Registry Number (CRN) designated by the Province of British Columbia. Where applicable.
- E. A copy of the specific valve specification sections marked to indicate with check marks where the valve supplied meets the specification and with written amendments with explanation where the product differs from the specification.
- F. On piping submittals, indicate direction of sealing.

##### 1.3 SUBMITTALS - FOR OPERATIONS AND MAINTENANCE MANUALS

- A. Submit operation and maintenance data for incorporation into operation and maintenance manual, including detailed exploded views, a complete numbered list of replacement and repair parts, and supplier and parts manufacturer's contact information.

##### 1.4 QUALITY ASSURANCE

- A. If a CRN is not available, provide a letter notarized in Canada and stating:
  - 1. The standard or code under which the valve was manufactured (ANSI, MSS, AWWA, etc.)
  - 2. If not stated under the code in Item (a), state the pressure/temperature rating of the valve body, seat, and all seals.
  - 3. The quality control program under which the valve was manufactured.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver valves and unload at site using methods which do not damage casings, coatings or any valve or actuator parts.
- B. Clearly tag each valve stating size, type, coatings and mating parts.
- C. Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Provide valves of the same type, size range and service from a single manufacturer.
- B. All valves to have true alignment or bores.
- C. Unless otherwise indicated on the Process and Instrumentation drawings valves shall be the same size as the pipe run in which they are to be installed.
- D. Valves to open counter-clockwise.
- E. The process drawings indicate major process valves required for the process to operate as intended. Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but is not shown in the drawings, inform the Engineer and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the Engineer's approval.

### 2.2 VALVE ENDS

- A. Unless otherwise shown on the Drawings, valves less than 75 mm diameter to have female threaded connections conforming to ANSI B1.20.1. Valve sizes greater or equal to 75 mm to have flanged connections to ANSI B16.1 or ANSI B16.5. Valves with grooved joint ends are not to be used without the written approval of the Engineer.
- B. Lug style water body valves shall have tapped holes.

### 2.3 MANUAL LEVER OR HANDWHEEL ACTUATORS

- A. Provide operator and actuator types as specified on the Drawings.
- B. Provide lever actuators for small diameter quarter turn valves. Operator to be perpendicular to the pipe run when the valve is closed.
- C. Unless noted otherwise on the Drawings, provide lever operator for ball and butterfly valves less than 150 mm diameter, and plug valves less than 100 mm diameter, unless noted otherwise on drawings.

- D. Maximum pull on the end of the lever arm or at the rim of a handwheel not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. If greater force is required, provide suitable gear operator.
- E. Minimum Hand Wheel Diameter:
  - 1. 38 mm valve: 75 mm handwheel.
  - 2. 50 mm valve: 85 mm handwheel.
  - 3. 250 mm valves and larger: 400 mm handwheel.
- F. Minimum Lever Operator Length:
  - 1. 25 mm valve: 125 mm lever.
  - 2. 38 mm valve: 150 mm lever.
  - 3. 50 mm valve: 150 mm lever.
  - 4. 75 mm valve: 175 mm lever.
  - 5. 100 mm valve: 225 mm lever.
  - 6. 150 mm valve: 250 mm lever.

## 2.4 MANUAL GEAR ACTUATORS

- A. Provide manual gear actuators for valves not specified to have a manual lever operator.
- B. Worm gear operator to be equipped with a non-rising stem handwheel and an integrated visual indicator of the valve position.
- C. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant recommended by the gear operator manufacturer for the specific application. Gear operators for direct bury or submergence to be manufactured in accordance with AWWA C504.
- D. Equip operators with mechanical stop-limiting devices to prevent over travel of the disc, ball or plug in the open and closed positions, self-locking to hold the valve in any intermediate position between full open and full closed. Actuator components between the input and the stop limiting device shall be designed to withstand, without damage, a rim pull of 890 N for a handwheel or chainwheel and an input torque of 400 N m for wrench nuts.
- E. Actuator shall provide 1.25 times required operating torque under full rated line pressure for direct bury or submergence applications, or for commodities with 2% or greater solids content; 1.0 times required operating torque under full rated line pressure in other applications.
- F. Maximum pull at rim of hand wheel with gear operator - 300 N.
- G. Manual operators for buried service valves to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures up to 700 kPa. Where angle valve stem extensions are employed, they shall be angle geared. Provide valve stem extension to surface with cast iron valve box, lid and rock plate.
- H. Operators intended for submerged applications to be rated as such and be grease packed and fully sealed for full submergence up to depths of 7m. Use stainless steel or epoxy

- coated cast or ductile iron enclosures. All stem extensions shall be manufactured from a suitable grade of stainless steel.
- I. Actuator body to be exterior epoxy coated.
  - J. Orientation of valve as per mechanical drawings or to allow for the greatest degree of hand wheel access.
  - K. For manual valves on pipes 75 mm and greater mounted over 2 m above the operating floor, provide chain wheel gear operators, sized so that a force of 150 N is sufficient to open the valve when one side of valve is at test pressure and the other side is at atmospheric pressure. Chain pulley to mesh positively with the chain. Extend chain from valve operator to 1.2 m above the operating floor or as directed by the Engineer, with exact dimensions field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

## 2.5 ELECTRIC ACTUATORS

- A. Electric Motor Actuators:
  - 1. General:
    - a. Provide electric actuators suitable for Class 1, Division 1 or Division 2 electrical area classification service, as appropriate, when located in hazardous areas. Refer to the electrical drawings for area classification details.
    - b. All electric motor actuators to be 120 VAC unless approved by the Engineer.
    - c. Comply with AWWA C542.
    - d. Controls integral with the actuator and fully equipped as specified in AWWA 542.
    - e. Provide control interface with SCADA system using hardwired signals.
    - f. Stem protection for rising stem valves.
    - g. Suitable for -40 degrees Celsius to 45 degrees Celsius environment.
    - h. For larger valves requiring the addition of an intermediate gearbox, the gearbox shall be of the same manufacturer as the actuator.
    - i. A design that allows the gear case to be opened for inspection or disassembly without releasing the stem thrust or taking the valve out of service.
    - j. Circuitry which ensures the motor turns in the correct direction irrespective of the supply polarity connected to the power terminal; valves and operator to suffer no damage due to incorrect power connection.
    - k. Instantaneous reversal protection whereby an automatic time delay circuit limits the current surges when an actuator is signaled to instantaneously reverse its direction.
    - l. Anti-hammer protection whereby electronic torque limitation switches off the actuator when a preset load is reached due to an obstruction or end of travel.
    - m. Bi-metal thermostat embodied in the motor control transformer windings to prevent overheating due to extensive use.
    - n. Jammed valve motor protection whereby a logic circuit protects the motor from overheating by de-energizing the motor if the valve does not move after developing maximum torque.
    - o. Provide a minimum of 6 independently configurable latching relays for remote indication.
      - a) Relay 1 shall make when valve is fully closed.



- b) Relay 2 shall make when valve is fully open.
    - c) Relay 3 shall break when valve is fully closed.
    - d) Relay 4 shall break when valve is fully open.
    - e) Relay 5 for collective fault (torque fault and other electrical faults).
    - f) Relay 6 shall indicate when remote is selected.
  - p. Opto-isolators incorporated to interface with remote control inputs to protect the logic circuits from high voltage transients appearing at the actuator terminals.
  - q. Actuator shall include a diagnostic module which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. Retrieval of this information must be demonstrated in the field.
2. Open/Close Service:
- a. Size motors for continuous duty.
  - b. Actuators to be sized with a minimum 2.0 safety factor based on the maximum unseating and seating torque of the valve. The safety factor shall be demonstrated and documented at time of commissioning under real service conditions using actuator software. Motor stall torque not to exceed torque capacity of valve.
  - c. LOCAL-OFF-REMOTE Selector Switch:
    - a) Pad lockable in each position.
    - b) Integral OPEN-STOP-CLOSE selector with seal-in circuits to control valve in LOCAL position.
    - c) OPEN / CLOSE command signals from PLC to control valve in REMOTE position.
    - d) Auxiliary contact that closes in REMOTE position.
    - e) Valve end position limit switch signals for OPENED / CLOSED status.
    - f) OPENED and CLOSED indicating lights.
  - d. Valves shall close upon loss of signal or loss of power unless indicated otherwise.
  - e. AC motor with solid state reversing starter or dc motor with solid state reversing controller and built-in overload protection. Non-solid-state compliant equipment will not be acceptable. Controller capable of 1200 starts per hour.
  - f. Duty cycle limit timer and adjustable band width, or equivalent, to prevent actuator hunting.
3. Actuator Operation - General:
- a. Suitable for full 90-degree rotation of quarter-turn valves or for use on multiturn valves.
  - b. Manually override handwheel.
  - c. Valve position indication.
  - d. Operate from FULL CLOSED to FULL OPEN positions or the reverse in a minimum of 60 seconds.
  - e. Nonintrusive Electronics: Local controls, diagnostics, and calibration, including limit and torque switch settings, shall be accomplished non intrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held configuration units for every 10 actuators provided, two minimum.
4. Specific Operational requirement:

- a. Due to the nature of the wet well and the location of the valves, there is a set of LOCAL/OFF/REMOTE selectors and OPEN/STOP/CLOSE selectors on the PLC panel located at grade in the Lunch Room.
- b. Provide the interconnect wiring drawings between the said Selector switches as above and the Integral selectors on the valve actuator, to enable valve operation as detailed below for each of the 5 valves:

Mode selection at L-O-R on Actuator	Mode selection at L-O-R on PLC panel	Operation enabled
L	L	Via Control elements on Valve actuator
R	L	Via Control elements on PLC panel
R	R	From PLC
L	R	Not allowed

5. Enclosure:
  - a. Unless otherwise indicated, provide enclosure as defined in NEMA 250, Type 6P.
  - b. Contain 120-volt space heaters or electrical compartment shall be non-breathing to prevent condensation.
6. Limit Switch:
  - a. Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.
  - b. Each valve actuator to have a minimum of two transfer contacts at end position, one for valve FULL OPEN and one for valve FULL CLOSED.
  - c. Housed in actuator control enclosure.
7. Tag Nos and Qty: HSV 601, HSV 602, HSV 603, HSV 604, HSV 605 / 5 nos
8. Manufacturers and Products:
  - a. AUMA rotary Actuator (SAR Series).

## 2.6 VALVE IDENTIFICATION

- A. Tag all valves using 304 stainless steel tags with 12 mm high engraved letters and numbers. Fill numbers and letters with black paint. Attach tag to valve using a 304 stainless steel chain or braided wire. Inscription to include valve size in mm, manufacturer and model number.

## 2.7 COATING

- A. Coat all carbon steel, ductile iron and cast iron valves and actuators for corrosion protection. Use liquid or fusion bonded epoxy or approved equal.
- B. All valves and actuators to be provided with factory applied coatings rated warranted for the intended service application.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. The valve and piping arrangement indicated on the drawings is based on typical dimensions for valves of the specified type. Make all necessary modifications in the Work to allow for discrepancies between the valve dimensions shown and those supplied for the Work, at no extra cost.
- B. Ensure that valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for automatic actuators.
- C. Ensure that valve location and orientation provides sufficient space for tightening of flange and valve nuts with a standard wrench.
- D. Ensure that valve actuators can operate without conflicting with other piping, equipment, structures or insulation. Do not cut insulation to allow valve actuators to operate. Where conflicts are identified, inform the Engineer and propose modifications. Do not commence work on the affected piping run until modifications are approved.

### 3.2 INSTALLATION

- A. Install all valves in accordance with manufacturer's instructions.
- B. In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball and plug valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
- C. Mount butterfly valves and trunnion ball and plug valves with the shaft in a horizontal orientation. Plugs to rotate to top of pipe to open. Disks to swing up in direction of flow to open.
- D. Provide spool pieces between butterfly valves, swing check valves and fittings as required to allow for free disc movement.
- E. Do not over torque bolts to correct for misalignment.
- F. Support valves in position using temporary supports until valves are fixed in place.

### 3.3 COATING

- A. Repair and damage to shop coating as recommended by valve manufacturer, including and not limited to:
  - 1. Steel brushing for removal of any rust.
  - 2. Solvent cleaning of repair and surrounding area.
  - 3. Priming coat.
  - 4. Two coats of top coat.

### 3.4 TESTING

- A. All valves to be shop tested according to current applicable ANSI or AWWA Standards and the standards under which the valves were manufactured.
- B. Operate valves under simulated and/or real process conditions to ensure valves operate as intended.
- C. Pressure test valves in conjunction with the pipes in which the valves are installed.

END OF SECTION