5013 CVRD Sewer Conveyance Project

Environmental Spill Investigation

Date of Incident: Tuesday, May 26th, 2026

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Background Information

The Maple Knappet Joint Venture (MKJV) was contracted to design and construct upgrades to the Comox Pump Station (CxPS), which included some restoration work within the existing pump wet-well, replacing existing pumps, and upgrading electrical infrastructure. To complete this work, the existing pump station would need to be taken offline, making it necessary to install a temporary pumping system (the bypass).

A unique challenge with performing bypass pumping at the CxPS is that the bypass pumping system is discharging into a pressurized sewer pipe (the forcemain) which experiences pressure fluctuations as other pump stations turn on and off. The bypass pumps would need to overcome the dynamic pressure in the forcemain, and similarly, the piping would need to withstand the fluctuating pressure.

To connect the bypass to the existing forcemain, a 'hot tap' was completed by MKJV, which left a gate valve where the bypass would be connected. To facilitate the piping installation, a coupling was used to join the piping just above the gate valve.

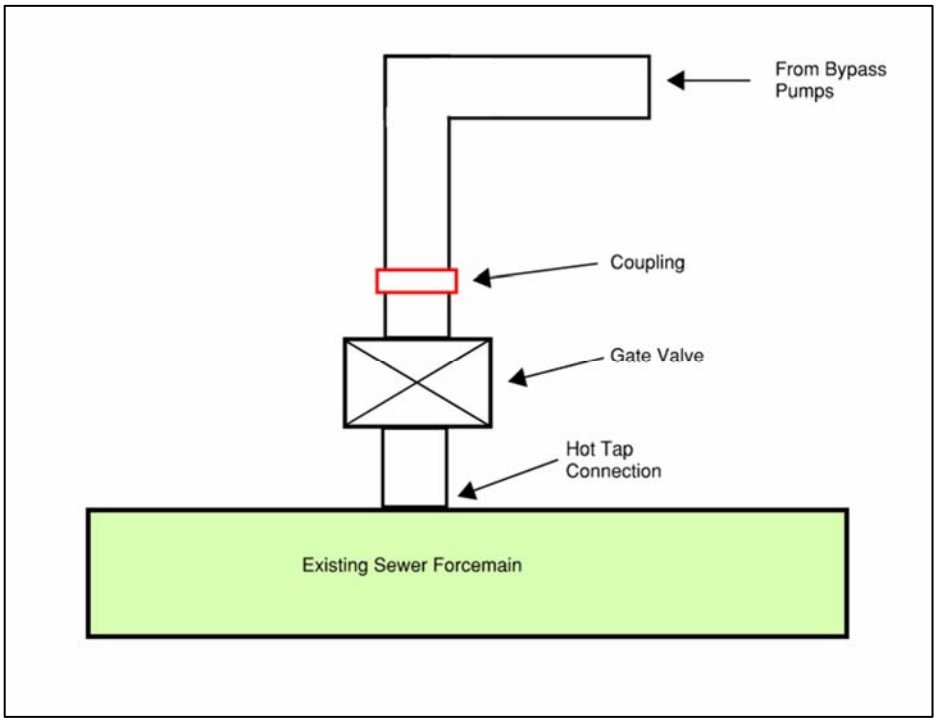

Figure 1 - Sketch of Bypass Connection to Sewer Forcemain

Maple-Knappett Joint Venture
2660 Argentia Road, Mississauga, ON, L5N 5V4

MKJV subcontracted the bypass pumping system to NCS Fluid Systems (NCS), including supply of the pumps and piping, installation, and 24/7 monitoring of the system during operation. The subcontract included a requirement for a bypass plan stamped by a Professional Engineer (refer to Appendix A). MKJV's design Engineer, AECOM, provided system curves for the sewer forcemain, which showed the pressure and flow for various bypass pumping operating conditions, to inform NCS' design.

Some photos of the bypass pumping system are included below.

Figure 2 - Bypass Pumping System, Pumps

Figure 3 - Bypass Pumping System, Discharge Piping

Figure 4 - Bypass Pumping System, Connection to Forcemain

Upon installation of the bypass pumping system, NCS performed testing to ensure there were no leaks. These tests were completed prior to opening the valve that connects the bypass system to the live force main Several leaks were found which necessitated some repairs and re-testing. One of the leaks that proved difficult to seal was at a coupling near the exiting force main 'hot tap' connection and isolation gate valve. This coupling was eventually replaced with a different coupling (further details are provided in sections below).

Once the leak testing was completed and NCS was satisfied that leaks had been addressed, the gate valve at the exiting force main 'hot tap' connection was opened so that the bypass pumps could be tested in preparation for the bypass system to be put into service.

Moments after the gate valve was opened, and the bypass piping was exposed to the pressure from the forcemain, the piping separated at the Romac coupling just above the gate valve. This resulted in an open-ended pipe, spilling roughly 5,800 m3 of wastewater into the environment. Eventually, the spill was controlled enough to permit a diver to enter the excavation and close the gate valve, which ended the spill.

Detailed Sequence of Events

Week of 19 May — Initial Installation and Testing

Installation commenced with a Victaulic 905 coupling (see Appendix B) fitted directly above the 12" HDPE flange at the base of the excavation pit, at the point where the bypass system connects to the hot-tapped force main. Two leak tests were conducted; the coupling failed to seat on both attempts. Water loss through the Victaulic was sufficient to prevent pressure from building elsewhere in the system, meaning any leaks further upstream would have been undetectable at this stage.

An electrofusion coupler was subsequently attempted at the same connection. The hot tap flange had been installed eccentrically relative to the pipe centerline. The misalignment prevented the coupler from forming a proper seal. Two fusion attempts were carried out; the manufacturer-specified maximum number of fusion attempts for installation, and neither produced a leak-free connection.

Cumulative leak test count at this stage: approximately six.

Friday 22 May — Tee Leaks Identified; East Side Patched

During testing with the electrofusion coupler, two pinhole leaks were identified on the HDPE fused tee upstream of the forcemain connection. The leaks were attributed to over-pressure during the original tee fusion, which had produced an oversized weld. The two isolated leaks were plugged over the following days.

Note: All tee repairs were applied upstream of the Romac coupling and forcemain flange connection. The tee is a distinct and separate location from the point of ultimate failure.

Saturday 23 May — Romac Coupling Installed

NCS cut back the existing fittings at the force main flange and installed a 12" Romac coupling (see Appendix C) directly on the 12" HDPE flange at the base of the pit. This is the lowest point of the installed system and the direct interface with the live forcemain.

The eccentric installation of the hot tap flange meant the Romac coupling could not achieve a centered seating position relative to the HDPE pipe. Ratchet straps were applied to the down-leg to provide bracing against vertical and lateral forces. Leak tests 7 and 8 showed no active leaks on the Romac coupling. The crew completed a half-day shift and took Saturday afternoon and Sunday off; the system was drained before departure.

Monday 25 May — Tee Leak Resolved

Crews returned and spent the morning attempting to seal the final of the two leaks. By end of shift the system appeared fully closed and dry. The crew departed at approximately 18:15.

Tuesday 26 May — Day of Incident

07:00 — Arrival and Pre-Commissioning Checks

NCS arrived at approximately 06:55, completed Field Level Hazard Assessments, and safety documentation. MKJV crews arrived at approximately 07:30–07:40, having conducted their own safety documentation at a separate site. MKJV commenced work on sound barrier insulation, with assistance from NCS.

An NCS employee descended into the excavation and checked and re-tightened the Romac coupling and flange fittings. He had noted from the manufacturer's product documentation that rubber seals can require follow-up tightening. He then moved through the system conducting a visual inspection of all fittings.

08:00 — Fresh Water Test; New Tee Crack Identified

Freshwater testing commenced via a Chicago coupler. The previously plugged leak at the tee was found to have a slow drip, and so NCS raised the pipe using a telehandler to provide access for the repair. An additional plug was installed into the crack. The tee was considered repaired and testing continued.

Note: this was the same leak identified previously at the manifold tee, not a newly identified leak.

08:00–08:05 — Engagement with MKJV

MKJV Supervisors confirmed the crew were clear to proceed with commissioning when ready, directing them to co-ordinate with the MKJV crew on the valve operation.

09:15 — Valve Opening Directed

NCS directed MKJV crew to open the gate valve. Within a short period after the direction was given, NCS observed that the previously repaired tee crack had reopened and was weeping. As this was a minor leak NCS attempted an on-the-fly repair of the tee with the system fully connected to the forcemain.

09:15–09:30 — Valve Fully Opened

Due to the below-ground location of the gate valve and the nature of the valve operator, the valve opening process took between five and ten minutes from the time the direction was given to the point of full open. During this period, the Romac coupling would have been exposed to the pressure in the live forcemain. Up to this point the bypass pumps had not been turned on yet.

09:30-09:35 — Incident

Minutes after the MKJV crew member finished opening the gate valve, the Romac coupling separated from the 12" HDPE pipe at the base of the pit. The fitting was propelled approximately 10–15 feet into the air. No audible warning preceded the event. The MKJV crew member had exited the trench box and was positioned near the electric generator when the separation occurred.

09:40 — Notifications and Response

Notifications were made to all relevant parties, who began arriving on site. MKJV, CVRD, Plant Operators, and many others worked on the response and recovery.

Root Cause Analysis

The direct cause of the pipe failure and the spill was the pipe separating at the Romac coupling connection. According to the Romac Macro coupling manufacturer's literature, it is rated for a working pressure up to 260 psi; however, the installation instructions note that the coupling does not protect against possible pullout of pipe ends. In hindsight, the Romac coupling could have been used in this application, but it did require the pipe to be restrained to the coupling. The coupling was ultimately inadequately restrained to the pipe. Note, the two previous couplings that NCS attempted to install (the Victaulic 905 and the electrofusion coupling) were self-restraining, so had either of those been successful, it seems the failure would not have occurred.

The reason NCS had changed couplings was due to some fit issues in the piping, which were causing a leak at the original Victaulic 905 coupling that could not be sealed. Bypass pumping systems/piping are typically field-fit due to the nature of existing site conditions and site constraints, and so Engineered drawings of pipe layout and assembly are not typically provided.

It is unclear whether the Subcontract between MKJV and NCS required an Engineered design of the pipe system, or just the hydraulic calculations and pump selection. Had an Engineer, or a qualified person, been involved with the pipe layout and review, the missing restraint would likely have been identified.

The root cause can be illustrated using a Why analysis:

Spill Occurred	
Why?	The pipe ends separated.
Why?	There was nothing restraining the pipe. The coupling was not self-restraining.
Why?	The pipe coupling application/installation was not reviewed by a qualified person.

In addition to performing an adequate inspection of the bypass system, a pressure test is typically performed on pipe systems as a quality control check. Pressure tests are usually performed with clean water in a controlled condition, prior to putting the pipe into service, so that any material defects or assembly issues are identified and can be corrected before more serious failures occur. Although some leak testing was completed with clean water in this case, it appears that the tests may not have followed a formal procedure and were not conducted at an adequate pressure. A proper quality control procedure for temporary piping systems would have likely identified the deficiencies within the Romac coupling installation.

Corrective Actions

After completing a thorough review of the spill and the root causes, MKJV has developed a list of critical corrective actions that will be implemented to ensure the pipe system does not fail again. In addition to the critical actions, we have also identified several other improvements during our investigation, which will also be implemented. According to our root cause analysis, had these improvements been implemented previously, we do not believe they would have prevented the failure, but it would seem to be prudent to implement them out of due diligence.

Critical Corrective Actions

1. An Engineer will complete a field review and issue a stamped memo confirming that the bypass system, including piping, has been installed in accordance with their design. They will also confirm that it will withstand the appropriate pressure, prior to putting the system into service.
2. A pressure test procedure will be submitted to the Engineer, and the test will be witnessed by MKJV, prior to making the final connection to the sewer forcemain.

Other Improvements

1. A detailed start-up sequence and checklist for the bypass system will be developed and followed.
2. A valve extension will be added to the existing bypass gate valve. This will allow someone to open & close the valve from ground-level, which improves safety and allows a quicker response in an emergency.
3. An air release valve will be installed on the high point of the bypass pipe to allow for air release during pressure testing.
4. A check valve will be installed just upstream of the gate valve near the hot tap, as an added protection in case of any failure in the bypass piping.

It should be noted that bypass pumping is an inherently risky activity. While we are confident that the corrective actions and improvements noted above will address the problems which led to the failure on May 26th, there are many risks in operating the bypass that cannot be fully mitigated. MKJV is actively reviewing the bypass plan, and specifically the operation of the bypass pumps, to find other improvements and to mitigate other risks.

Summary

On May 26, 2026, a wastewater spill of approximately 5,800 m^3 occurred at the Comox Pump Station (CxPS) during commissioning of a temporary bypass pumping system installed by NCS Fluid Systems (NCS), a subcontractor to the Maple Knappet Joint Venture (MKJV). The spill was caused by the separation of a Romac coupling inside an excavation, at the point where the bypass piping connected to the live sewer forcemain.

The root cause of the failure was the use of an unrestrained coupling in an application that required pipe restraint. The Romac coupling was installed as a replacement for two earlier couplings (a Victaulic 905 and an electrofusion coupler) that had failed to seal properly due to an eccentrically installed hot tap flange. While the Romac coupling could withstand the system's working pressure, its manufacturer's installation instructions explicitly note that it does not prevent pullout of pipe ends. No restraint was added, and this requirement was not identified or flagged prior to commissioning.

A key contributing factor was the absence of engineering oversight over the field-fit piping system, including a documented pressure testing plan. The subcontract between MKJV and NCS required a bypass plan stamped by a Professional Engineer; however, this requirement appears to have applied to hydraulic calculations and pump selection rather than the physical layout and assembly of the piping

system. Had an Engineer reviewed the field-installed components, the unrestrained coupling connection would likely have been identified and corrected before commissioning.

The spill was brought under control when a diver entered the excavation and closed the gate valve at the hot tap location. Response and recovery efforts were undertaken by MKJV, CVRD, plant operators, and other stakeholders.

To prevent recurrence, MKJV will ensure that all field fit piping components receive a documented field review by an Engineer, and an approved pressure testing procedure is followed. These measures are intended to ensure that engineering accountability is maintained throughout the bypass pumping system from design through commissioning. Additional improvements to the bypass system will include a detailed start-up checklist, installation of an air release valve at the high point of the bypass piping, addition of a valve extension to allow gate valve operation from outside the excavation, and a check valve installed directly to the gate valve at the hot tap location.

Maple-Knappett Joint Venture

Cam Morris, P.Eng

Construction Manager

Maple-Knappett Joint Venture

Jenn Racine, AScT, GSC

Project Manager

Appendix A – NCS Bypass Plan

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Tel: 403-366-5704

Date: 2026-05-14

NCS Fluid Handling System Inc.
23853 Fraser Highway Langley BC

Attn: Adam MacDonald

Subject: Bypass Plan for COMOX PS, BC Rev 7

PMO Global Services was contracted by NCS Fluid Handling Systems to review Bypass Plan for COMOX PS in BC, Rev 7. The scope of this review is limited to hydraulic design, only.

PMO Global services has reviewed and confirmed the suitability of the submitted plan for the peak and intermittent flow rates stated in the document.

Any changes to this plan will void the review and it will be subject to re-verification before any work can proceed.

For any comment or question please contact us.

Sincerely;

Nader Zarabi, P. Eng. Process Engineer
E G B C member 55648

2026-05-14

Full Spectrum Projects Ltd.
Permit Number 1002347

Submitted on behalf of:
Adam MacDonald
Director of Operations, BC
236-464-3744
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May 2026

CVRD - Comox PS Bypass Plan Rev7

Job Scope:

Maple Reinders Constructors Ltd. has identified the need for bypass pumping during work on the Comox Pump Station (PS).

Bypass pumping is expected to be performed from approximately middle of May 2026. This Revision 7 (May 2026) supersedes Rev 6 and incorporates corrected hydraulic analysis per AECOM review.

Project Manager:
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1.0 HYDRAULIC DESIGN

1.0 INTRODUCTION

The team at NCS Fluid Handling Systems is pleased to present this Revision 7 bypass plan to Maple Reinders Constructors Ltd. for the temporary diversion of all incoming sanitary flows at the Comox Pump Station (PS) during the planned rehabilitation works on behalf of the Comox Valley Regional District (CVRD).

This revision supersedes Rev 6 dated March 23, 2026. The primary revision addresses a critical hydraulic design concern raised by AECOM (Adib Eider, P.Eng. and Peter Ellingsen, P.Eng.) regarding the discharge configuration. Rev 6 calculated Total Dynamic Head (TDH) assuming a free-discharge point 20 m from the pump. The bypass discharge is connected via a 450 mm tee to the existing forcemain system, which ultimately conveys flow to the Comox Valley Water Pollution Control Centre (CVWPCC). This configuration imposes significantly higher system backpressure that must be accounted for in the pump selection and hydraulic analysis. All hydraulic calculations in this revision have been performed using the updated system curves provided by AECOM and the Hazen-Williams friction method, consistent with the AECOM design basis.

1.2 BASIS OF DESIGN

NCS will design, supply, install, operate, and maintain a temporary bypass pumping system for the Comox Pump Station. The configuration consists of three (3) PIONEER PP108S17 10x8" diesel-driven pumps arranged in a 2+1 configuration (two primary, one standby), connected via 12" DR17 HDPE suction and discharge piping to the client-supplied 14" tee and flange valve at the existing 450 mm forcemain tie-in point. Scope includes installation of double-blocked sewer plugs in the existing 600 mm inlet pipe, fusion of HDPE discharge piping, connection to the forcemain tie-in, 24/7 staffed operation and monitoring, commissioning testing, and demobilization upon completion of station rehabilitation works.

1.2.1 AECOM HYDRAULIC DESIGN BASIS

The following hydraulic design basis has been established by AECOM (Peter Ellingsen, P.Eng., April 2026) and is adopted in full by NCS to eliminate ambiguity in the bypass hydraulic analysis. The Comox Bypass Pump Station system curve is developed based on the following confirmed assumptions:

1. The existing forcemain length from Courtenay Pump Station (PS) to Comox Pump Station (PS) is 4.9 km.
2. The existing forcemain length from Comox PS to the discharge location at the Comox Valley Water Pollution Control Centre (CVWPCC) is 4.1 km.
3. The forcemain internal diameter is: 800 mm from Courtenay PS to Comox PS; and 700 mm from Comox PS to the discharge location at CVWPCC.
4. The Comox PS bypass is connected to the main forcemain via a 450 mm pipe with an internal diameter of 400 mm.
5. A Hazen-Williams C factor of 110 has been assumed for all forcemains.

6. The assumed suction water level at Comox PS is -1.81 m. NCS applies an additional suction lift of 3 ft (0.91 m) to the pump impeller, for a total adopted static suction lift of 8.92 ft (2.72 m) used in all hydraulic calculations.

7. The assumed discharge water level at the Comox Valley Water Pollution Control Centre is +11.50 m.

Per AECOM guidance (Peter Ellingsen, April 2026), the governing system curve to be applied is the Comox system curve under the condition where Courtenay PS is discharging at 2× the Comox flow rate. This is consistent with the flow data provided by CVRD and is used as the basis for all backpressure calculations in this plan.

1.2.2 OPERATING FLOW SCENARIOS A & B

Three distinct operating conditions must be accommodated by the bypass system, as confirmed by AECOM (Adib Eider, January 2026) and cross-validated against CVRD historical flow data (2022-2025). The following parameters have been confirmed by AECOM and form the basis of all hydraulic calculations in this revision:

Bypass Route	Suction Depth ft (m)	Discharge Head (Forcemain Tie-In) ft (m)	Peak Flow US GPM (L/s)	Pump	TDH @ Peak Capacity ft
Primary System Bypass	Maximum Lift: (-1.81m) +0.91m (3ft to impeller-NCS assumed) = **2.72m (8.92 ft)**	66 ft (20 m) (NCS-installed HDPE only)	**(Sc A)**5388 GPM Total (340 L/s) 2694 GPM per primary pump (170 L/S) **(Sc B)**3454 GPM Total (218 L/s) 1727 GPM per primary pump (109 L/S)	Primary P1 PIONEER PP108S17 10x8" Primary P2 PIONEER PP108S17 10x8" Standby S1 PIONEER PP108S17 10x8"	**105.43 ft (Sc. A governing)** **115.93 ft (Sc. B)**

Table 1.2.2.1 – Design Parameters

The temporary bypass will be required for the incoming flow on the existing Comox Pump Station. The anticipated peak design flows for the sewer lines were provided by Maple Reinders Constructors Ltd. at **340 L/s (5,388 GPM).**

NCS' proposed design consists of two (2) primary PIONEER PP108S17 10x8" high-head diesel pumps to handle the designed flows, with one (1) identical standby pump providing 50% redundancy.

1.2.3 LOW-FLOW OPERATION (ADWF – SCENARIO C)

Low-Flow Operation (ADWF – 45 L/s):

During dry weather conditions **(Scenario C – ADWF ≈ 45 L/s / 713 GPM)**, a single primary pump is sufficient to meet system demand, operating against a forcemain backpressure of **13.15 m (43.1 ft, AECOM)** for a total dynamic head of **22.84 m (74.93 ft).**

It is critical to note that the pump does not operate at the **ADWF inflow rate of 45 L/s.** The 45 L/s figure represents the average rate of inflow to the suction wet well – not the pump's discharge flow rate. **Pump operation is governed by a float/level control system**: inflow accumulates to not above **1meters in height(as confirmed by AECON)** in the 1800 mm suction manhole until the high-level float energizes the duty pump, at which point the pump discharges at its natural duty point on the system curve – approximately **158–190 L/s at the Scenario C system head of 74.93 ft (22.84 m TDH)**, well within the efficient operating range of the PIONEER PP108S17. The pump then rapidly draws the wet well down to the low-level float setpoint, at which point it is de-energized. The pump therefore always operates at or near its design flow range during each run cycle, never at the low inflow rate.

This intermittent, float-controlled cycling strategy ensures the pump operates only within its normal hydraulic performance envelope, eliminating any risk of sustained low-flow recirculation, cavitation, or thermal buildup that could otherwise arise from continuous operation at flows far below the pump's best efficiency point (BEP of 4,600 GPM / 290 L/s).

To maintain balanced utilization and system reliability, a weekly alternation strategy is implemented, with Pump P1 designated as lead unit from week 1 and Pump P2 from week 2, while the non-duty pump remains on standby. This combined float-controlled cycling and scheduled alternation prevents sustained low-flow operation, maintains both pumps in an exercised and ready condition, and ensures stable hydraulic performance.

Based on these operating controls, along with the confirmed NPSHa margin of **22.42 ft against NPSHr of 7.30 ft,** auxiliary pumping is not required for normal ADWF operation. System performance under inflows below 40 L/s will be monitored during operation to confirm stable cycling behavior, with further evaluation undertaken only if atypical conditions such as cavitation or instability are observed, consistent with AECOM recommendations.

1.2.4 EQUIPMENT LIST

NCS recommends the following models for the bypass system:

Primary System – MH# 1

Bypass Pipe	Suction/Discharge Line	Pump
Suction Isolation	Suction - (3) 12" Victaulic Suction Hose (20 ft) (1) 12" x 10" Reducer Discharge - (3) 8" x 12" Expander (discharge flange) (1) 12" DR17 HDPE Pipe (66 ft) (4) 12" DR17 HDPE 90° Elbow (2) 12" DR17 HDPE 45° Elbow (6) 12" BU Ring/Flange Kit (3) 12" Check Valve (3) 12" Gate Valve (3) 12" DR17 HDPE Wye/Tee (1) 14" Tee (tie-in) (2) 14" x 12" Reducer (1) 14" Flange Valve (client-provided)	- (2) Primary PIONEER PP108S17 10x8" Diesel Pumps - (1) Standby PIONEER PP108S17 10x8" Diesel Pump

1.2.5 PROJECT LAYOUT OVERVIEW

Figure 1.2.5.1 – Work area to be bypassed

2.0 SYSTEM OPERATION

For this bypass operation, there is one suction point in the system to consider:

Existing Comox Pump Station – Design Peak Flow Rate: 340 L/s (5,388 GPM).

- Two primary pumps handle Scenario A **(340 L/s / 5,388 GPM @ 105.43 ft TDH, governing)** and
- Scenario B **(218 L/s / 3,454 GPM @ 115.93 ft TDH).**
- One pump handle Scenario C **(45 L/s / 713 GPM @ 74.93 ft TDH).**
- Forcemain backpressure per AECOM: 22.45 m (73.6 ft) at Sc. A; 25.64 m (84.1 ft) at Sc. B; 13.15 m (43.1 ft) at Sc. C.
- 66 ft discharge length (Force main tie in) – 2x 12" DR17 HDPE discharge pipes.

2.1 SYSTEM DESIGN

Suction Manhole – 1800 mm

P1 (Primary 1) and P2 (Primary 2): PIONEER PP108S17 10x8" independent suction lines, individual discharge valve. S1 (Standby): PIONEER PP108S17 10x8" cross-connected independent suction lines, can replace either P1 or P2. P1 and P2 share two 12" HDPE discharge headers. S1 is always held on standby with automatic level-switch activation and manual override available to NCS technicians. The two primary pumps will operate with an alternating start/stop control to handle low flow conditions.

The three (3) pumps will be designated as two Primary and one Standby. Each of the primary pumps and standby pump will have individual suction with all three pumps sharing two discharge connections. The discharge from each pump will be valved and tied into the dedicated 12" HDPE discharge lines (two lines for the two primary pumps). The discharge lines will run approximately 66 ft to the permanent outfall discharge point.

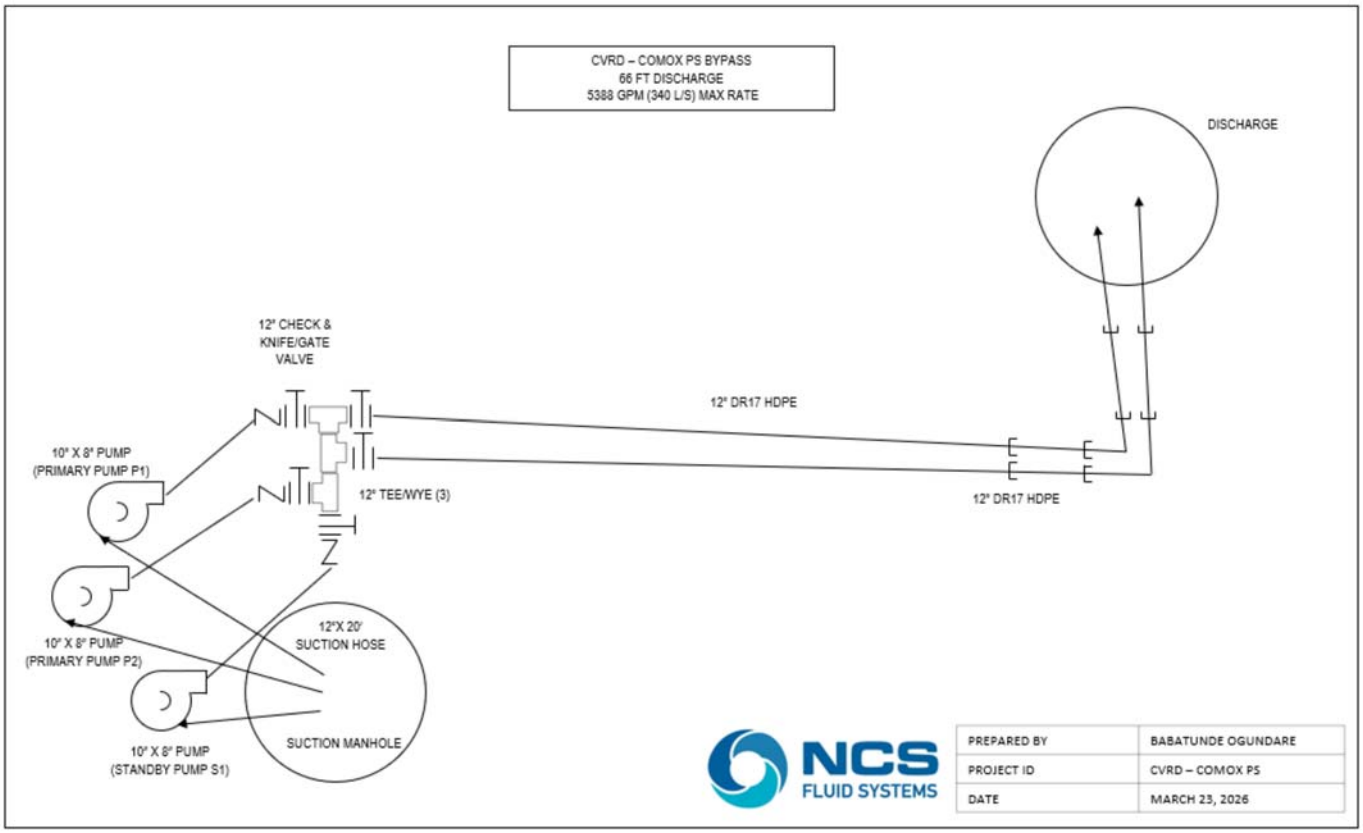


Figure 2.1.1 - System P&ID

2.2 BYPASS SYSTEM TO DISCHARGE ENGINEERING CALCULATIONS

2.2.1 HYDRAULIC SUMMARY – DUTY POINTS (ALL SCENARIOS)

Peak Flow (GPM)	Pump	Flow Per Pump (GPM)	Discharge Pipe Diameter (in.)	Static Suction Lift (ft.)	Discharge Head (Forcemain Tie-In) ft	Friction Loss per 100ft	Total Dynamic Head (ft.)
5388 GPM	PRIMARY 1 PIONEER PP108S17 10x8"	2694 GPM/ PUMP 1727 GPM/ PUMP	12”	8.92 ft	66 ft	2.21 ft, 3.15 ft	105.43 ft (Sc. A governing) 115.93 ft (Sc. B)
	PRIMARY 2 PIONEER PP108S17 10x8"						
	STANDBY 1 PIONEER PP108S17 10x8"						

Figure 2.2.1 - System Summary Table 1

**Static Suction Lift = 2.72 m (8.92 ft): AECOM suction water level at Comox PS (-1.81 m) + 3 ft (0.91 m assumed) suction lift to impeller.*

2.2.2 TOTAL DYNAMIC HEAD CALCULATIONS - P1, P2, S1 - PIONEER PP108S17 10X8"

The Total Dynamic Head is calculated and summarized above for each stage using the provided peak flow rates, measured discharge piping, provided elevations and assumption for piping coefficients. The corresponding manhole depths used to calculate suction lifts were obtained through communications with Maple Reinders Constructors Ltd.

Note: Imperial units (feet & US GPM) are used in calculations.

Static Lift and TDH Calculations are based on the following Hazen-Williams Equation:

$$f\,(ft\ of\ loss\ per\ 100ft) = 0.2083 \times \left(\frac{100}{c}\right)^{1.852} \text{ x } \frac{q^{1.852}}{d^{4.8655}}$$

$where$: $c =$ $pipe\ roughness\ coefficient$ (110 as per Aecom)
$q =$ $flow\ rate\ (gpm)$
$d =$ $inner$ pipe diameter $(inches)$

12” SUCTION HOSE @ 2694 GPM

$$f\,(ft\ of\ loss\ per\ 100ft) = 0.2083 \times \text{ x } \left(\frac{100}{110}\right)^{1.852} \text{ x } \frac{2694^{1.852}}{12^{4.8655}}$$

$$= 2.21\ \text{ft}$$

12” HDPE DISCHARGE @ 2694 GPM

$$f\ (ft\ of\ loss\ per\ 100ft) = 0.2083 \times \text{x} \left(\frac{100}{110}\right)^{1.852} \text{x} \frac{2694^{1.852}}{11.16^{4.8655}}$$

$$= 3.15\ \text{ft}$$

12" Okay as more conservative

12” Suction Side @ 2694 GPM		12” Discharge Side @ 2694 GPM		
(1) Length	= 20.0 ft	Length		= 66.0 ft
(1) 12" x 10" Reducer	= 70.0ft	(2) 12” Gate Valve	= 7.96 x 2	= 15.92 ft
		(1) 12” 45 Degree	= 14.9 x 1	= 14.9 ft
		(1) 12” Wye/Tee (Branch)	= 59.7 x 1	= 59.7 ft
		(2) 12” 90 Degree	= 29.8 x 2	= 59.6 ft
		(1) 12” Check Valve	= 120.0 x 1	= 120.0 ft
		(1) 8" x 12" Expander	= 128.0 x 1	= 128.0 ft
		(1) 14” Wye/Tee (Branch)	= 65.6 x 1	= 65.6 ft
		(1) 14” Flange Valve	= 38.3 x 1	= 38.3 ft
		(1) 14" x 12" Reducer	= 96.0 x 1	= 96.0 ft
Total	= 90.0ft		Total	= 664.02 ft

One Through

Friction Loss Calculator

Friction Loss: 12” Suction

$$= \frac{Total\ Suction\ Friction\ Loss\ x\ Friction\ Loss\ per\ 100ft\ at\ 2694\ GPM}{100} = \frac{90.0\ X\ 2.21}{100} = 2.0\ \text{ft}$$

Friction Loss: 12” Discharge

$$= \frac{Total\ Suction\ Friction\ Loss\ x\ Friction\ Loss\ per\ 100ft\ at\ 2694\ GPM}{100} = \frac{664.02\ X\ 3.15}{100} = 20.91\ \text{ft}$$

Suction Lift: Static Head (System Backpressure) = 8.92 ft

= 73.6 ft

TDH = 105.43 ft (Sc. A, governing)

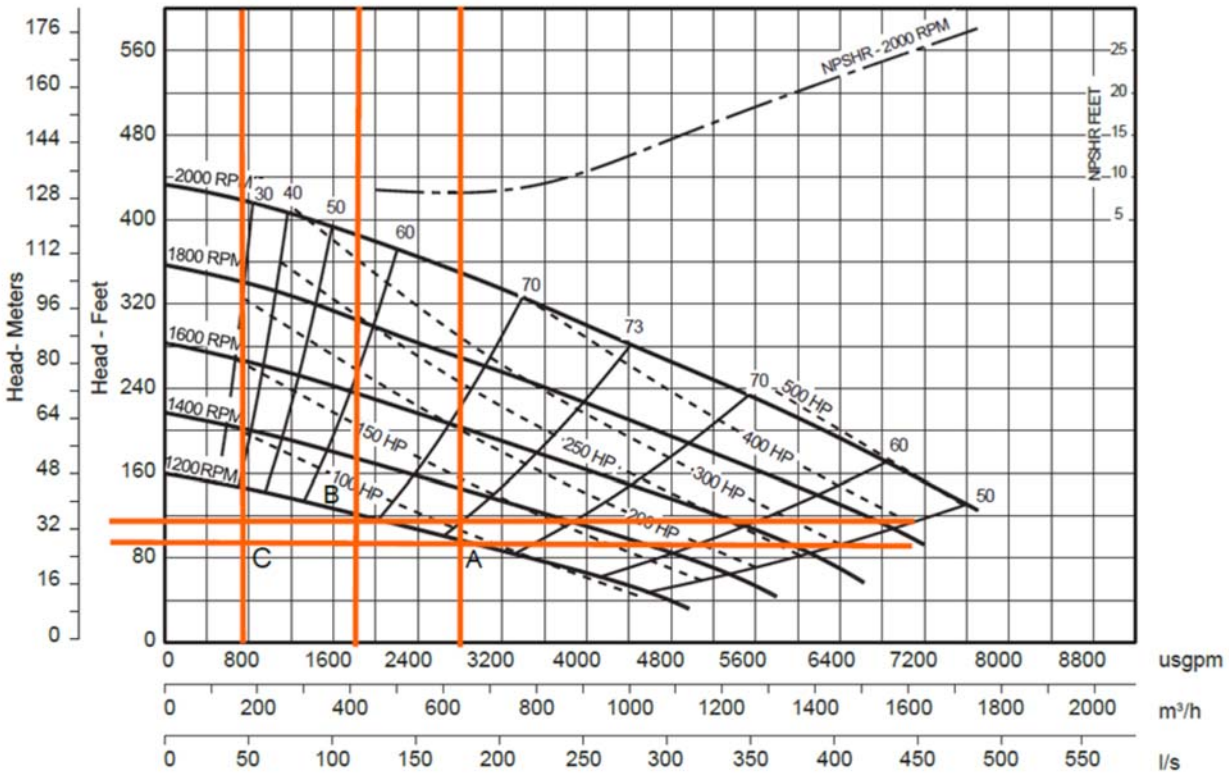
The governing TDH for pump selection is Scenario A (105.43 ft / 32.14 m). All three scenarios fall well within the PIONEER PP108S17 operating envelope.

2694 GPM @ 105.43 ft (Sc. A, governing) / 115.93 ft (Sc. B)/74.93 ft (Sc. C).

FIGURE 2.2.2.1 - SYSTEM CURVE P1, P2, S1 - PIONEER PP108S17 10X8"

Figure 2 displays the system curve for the primary pump, two (2) PIONEER PP108S17 10X8" pumps. These pumps will meet required peak flow of 5,388 GPM @ 2694GPM @ 105.43 ft (Sc. A, governing) / 1727 GPM @ 115.93 ft (Sc. B,) TDH per pump.

Multi-Speed performance Curve



PIONEER PUMP — PERFORMANCE THROUGH INNOVATION	Model	PP108S17	DWG No. 12807HQ
	Size	10" x 8" / 255 mm x 205 mm	Revision 000
	Impeller Diameter	17.5" / 445 mm	Drawn By
	Solids Handling Size	3.5" / 90 mm	Date 29 Aug 2013

Figure 2.2.2.1 – System Curve - System Curve PRIMARY and STANDBY Pumps P1, P2, S1 - 5388 GPM @ 105.43 ft (Sc. A, governing) / 115.93 ft (Sc. B) TDH

2.2.2.2 NPSHA CALCULATIONS

Atmospheric Pressure	Suction Lift	Suction Friction Loss	Vapor Pressure (10°C)
33.96 ft	8.92 ft	2.21 ft	0.41 ft

NPSHa Calculator

33.96 ft - 8.92 ft - 2.21 ft - 0.41 ft

NPSHa = 22.42 ft

NPSHa > NPSHr

22.42 ft > *7.30 ft* (PIONEER PP108S17 10x8")

** Exceeds 3 ft differential*

2.2.2.3 PUMP SELECTION AND SPECIFICATIONS

2.2.2.3.1 PARAMETERS

With a governing duty point of 2,694 GPM (170 L/s) per pump @ 105.43 ft (32.14 m) TDH (Scenario A).NCS has selected the PIONEER PP108S17 10x8" as the Primary (P1, P2) as well as Standby (S1). The pump provides substantial margin above all revised duty points.

The PIONEER PP108S17 10x8" diesel-driven high-head pump remains the selected unit. Specifications:

Max Flow: 6500 US GPM [1476.31 m3/h]
Max Head: 450 ft
Solids Handling: 3.5”
Driver: Diesel Engine

2.2.2.3.2 FUEL CONSUMPTION

The fuel consumption below is calculated utilizing 50% efficiency for the selected BBA.

$$fuel\ consumption\ (gph) = flow\ x\ \frac{TDH}{efficiency\ x\ 3960}\ x\ 0.055$$

$$fuel\ consumption\ (gph) = 2694\ GPM\ x\ \frac{105.43}{50\%\ x\ 3960}\ x\ 0.055$$

$$= \mathbf{7.90\ gph}$$

3.0 OPERATING PROCEDURE

1. Primary pumps using diaphragm priming system will operate to expedite air evacuation of the suction piping.

2. Once primed, primary pumps will always operate. If lower than anticipated flows are encountered, the primary pump will be controlled manually by the operator to try to ensure there is no loss of prime.

3. The standby pump will be operated by level switches and can be manually started by NCS monitoring technicians in the event of a pump failure.

4.0 SYSTEM TEST COMPLETION

The testing procedure below will be conducted on both systems prior to full-service operation.

1. A preliminary job walk will be conducted down the length of lines to assess possible hazards.

2. It is recommended that client provide clean water for testing of hoses used in bypass system. NCS will support the freshwater test.

3. Test will be completed for any leaks in discharge piping. A tank is suggested to get efficient water in line. If not permitted, NCS will run off a fire hydrant. If a fire hydrant will be the source of clean water, it is considered Maple Reinders Constructors Ltd.'s responsibility to obtain all permits and affiliated equipment. Once freshwater test is passed, NCS will move to a live sewage test.

4. Prior to live sewage test, the pipe plug will be inflated to initiate blockage in the line. An NCS technician will ensure the plug's hose and chain is properly secured to stop the plug from travelling downstream. The technician will also ensure this is not a tripping hazard for personnel.

5. For the duration of the sewage test, a technician will monitor the suction manhole sewage level while another technician walks the length of the discharge line. All pumps will run for the sewage test.

6. The sewage test will commence as follows:

    a. Primary pump will be turned on manually allowing engine to come to speed.

    b. As the discharge line is walked by a technician, a visual inspection will occur for any leaks in pipe, hoses, fittings, and all connection points.

    c. A technician will be staged at the primary pump, monitoring rpm and ready to turn the standby pump on if required. Another technician will be at the upstream manhole, monitoring flow, the pipe plug pressure and ready to deflate if required.

7. The primary pump will be shut down manually.

8. Steps a through c will then be completed on the each primary and stand-by pump.

9. The system is ready.

5.0 SYSTEM OPERATIONS

The system will be monitored and operated 24 hours per day, 7 days per week, by NCS Fluid Handling trained Technicians. There will be two (2) pump technicians on day shift and two (2) pump technicians on night shift for the pump systems. As part of NCS standard operation procedure, technicians will record system data on a Sewer Bypass Monitoring Checklist at minimum increments of one (1) hour. The Checklist will be sent to Maple Reinders Constructors Ltd weekly. All suction and discharge manholes will be monitored continuously. The day shift and night shift will have a shift changeover meeting to review the system operation and discuss any system requirements such as fueling, maintenance, etc.

Maple Reinders Constructors Ltd may decide to take over the daytime monitoring of the system.

6.0 NOISE CONTROL

NCS will collaborate with Maple Reinders Constructors Ltd. to minimize the sound produced by the pumping equipment. The PIONEER PP108S17 10x8" will be fully supported with Eco Barriers to bring down the sound impact generated to the bare minimum within Vancouver Island's allowable nighttime noise limits.

7.0 TRAFFIC CONTROL

As per Maple Reinders Constructors Ltd.

8.0 SUBCONTRACTORS

NCS does not intend to utilize any subcontractors on the project and will self-perform the scope of bypass work.

9.0 HEALTH, SAFETY & ENVIRONMENT

A site-specific Job Hazard Analysis, specific to the bypass procedure, will be completed at the start of each shift. The site-specific assessment will comply with all local, provincial, and federal safety regulations and will consider any factors that would contribute to changing conditions on the jobsite. The daily analysis addresses specific hazards identified with all procedures related to the installation, commissioning, operation & dismantling of the temporary bypass system.

9.1 SITE SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

As a dedicated fluid management contractor, the team at NCS has identified the appropriate levels of personal protective equipment required for employees during their specific scopes of work. These include, but are not limited to, coveralls or an applicable safety vest with reflective stripes, hard hat, safety glasses, gloves & steel toed boots.

9.2 EMERGENCY RESPONSE

1. In the event flows are abnormally high, an NCS employee will turn on the standby pumps and bring the engine speed to rpms of the primary pump in the system. Maple Reinders Constructors Ltd foreman will be contacted so Maple Reinders's emergency response plan can also be initialized and can clear the work area for possible breach. An NCS employee will call NCS emergency contacts. Pumps will run at their highest efficiency to handle flows. If all running pumps are still unable to maintain the flow, NCS will deflate the pipe plug. ***Please note, if the pipe plug is deflated, the pumps must remain running to maintain as much flow as possible running through the bypass system to lessen the force on the pipe plug.**

2. To ensure there is no accidental spillage, all pumps will have individual spill containment. An NCS fluid technician will periodically check and tighten fittings, so leaking does not occur throughout the shift. Pumps will all have isolation gate valves from suction manifold to discharge manifold in order to isolate the pumps and 12" pipe.

3. Although unlikely, if a leak or spill occurs during any stage of the project, NCS' trained fluid technicians will take immediate action to contain the release and regain control. An Emergency Spill Response Plan has been developed in accordance with NCS best practices. NCS personnel will immediately notify the project manager and client representative, to determine next steps. The on-site supervisor will be accountable to follow the response steps as outlined within the Emergency Spill Response Plan and NCS' HSE manual. The project manager will work with the HSE manager, client representatives and others to respond to the situation. Emergency spill response kits (containing absorbent pad and socks) will be placed on site by each pump to ensure quick & readily available access to spill containment resources. Additionally, each diesel driven pump will be placed inside of a containment berm to help mitigate any spill infiltrating the nearby ground or environment.

4. NCS recommends a vacuum truck service on notice with site details and contacts. Vacuum truck services are, but not limited to, Emergency spill response, pipe draining, flushing lines, draining lines, emptying containments, and assistance in high flows.

5. NCS site rigged trucks used for monitoring will be outfitted with basic hand tools including, but not limited to, electric impact, wrenches, sockets, and a screwdriver set.

6. If the Maple Reinders Constructors Ltd 's Site Supervisor/Project Manager deems the bypass system needing to be removed in an emergency, the onsite NCS Fluid Technician will contact NCS emergency contacts. The NCS Fluid Technician will shut down all equipment and pull pipe plugs. The pump system will not be shut down until pipe plugs can be pulled out of the manholes. Equipment will be required for the removal of pipe plugs and will be supplied Maple Reinders Constructors Ltd. If proper equipment or an operator is not available, then NCS emergency contact will get an emergency crane truck to assist will the emergency removal of equipment. NCS emergency contact will coordinate all information with Maple Reinders Constructors Ltd's emergency contacts or Project Manager, as well as dispatching more technicians if required.

7.

10.0 ASSUMPTIONS

1. Assumptions have been made that flows provided by Maple Reinders Constructors Ltd are accurate but have the potential to vary.
2. Float set levels are to be provided by others, based on the maximum surcharge level of the manhole.
3. Discharge distances are taken from those provided by Maple Reinders Constructors Ltd in the drawings provided, and pre-estimate questions.
4. Suction lift values are taken from those provided by Maple Reinders Constructors Ltd in the drawings provided and confirmed during bypass plan creation and pre-estimate questions.

NCS Fluid Systems does not provide recommendations for construction methodologies. It is the contractor's responsibility to:

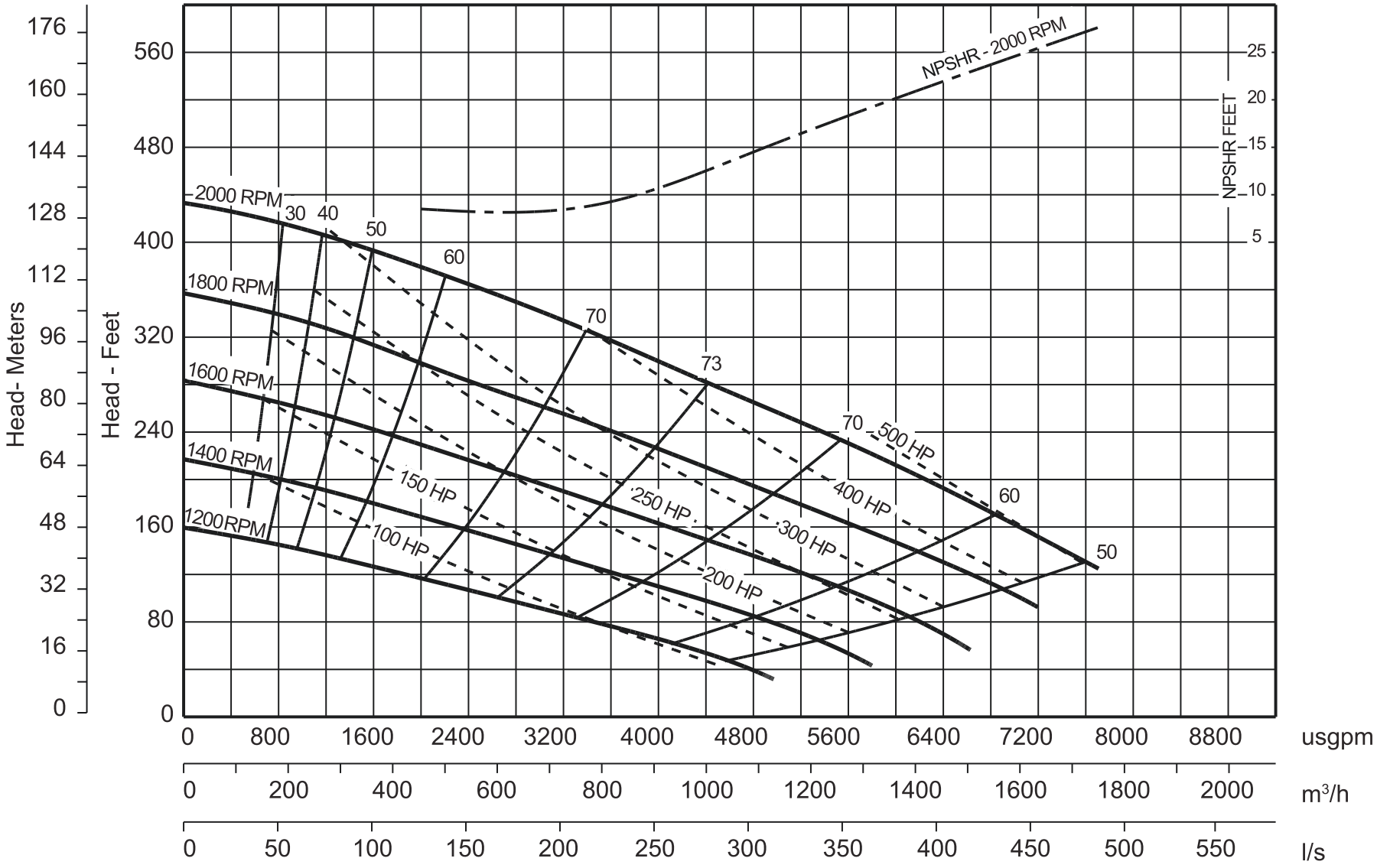
- Review project requirements in relation to their construction plan & proposed bypass/dewatering/ diversion plan during the estimating phase.
- Provide all necessary information and Construction Methodologies to NCS Fluid Systems prior to any NCS plan creation.
- Thoroughly review the submitted bypass and dewatering plan in accordance with Construction Methodologies prior to mobilization
- NCS Fluid Systems will perform all plug installations and removals from the surface and will not undertake confined space entry. The client is responsible for providing safe and unobstructed access to all areas requiring plug placement.
- If surface installation/removal is not feasible due to flow conditions or other reasons, the contractor is responsible for providing confined space entry or alternative access.
- Access to the designed suction point or manhole during bypass operation or when plugs are inflated is generally not recommended and may be impractical. NCS Fluid Systems is not responsible for construction methodologies or providing confined space access.

14.0 CONTACT LIST

Adam MacDonald
Director of Operations
amacdonald@ncsfluidsystems.ca
236.464.3744

NCS 24-Hour Emergency Line
1-888-618-7867

Duane Burkard
Chief Operating Officer
dburkard@ncsfluidsystems.ca
403.990.8676



PIONEER PUMP
PERFORMANCE THROUGH INNOVATION™

Model	PP108S17	
Size	10” x 8”	255 mm x 205 mm
Impeller Diameter	17.5”	445 mm
Solids Handling Size	3.5”	90 mm

DWG No. 12807HQ
Revision 000
Drawn By
Date 29 Aug 2013

WATER SUCTION HOSE

G341E

G341E... EPDM SUCTION HOSE

Our EPDM hose is designed for improved weathering and chemical resistance. It is often used for glycol supply lines on portable heating units in our 2" size and for dewatering applications in our larger sizes.

Tube: Smooth, black EPDM rubber.

Reinforcement: Heavy wire helix embedded between layers of synthetic textile cords.

Cover: Black, wrapped finish, weather and abrasion resistant EPDM rubber with white stripe.

Temperature Range: -30°C (-22°F) to 80°C (176°F)

I.D.	Part Number	O.D.	Working Pressure	Vacuum Rating	Bend Radius	Weight per foot	PRICE PER FOOT Cut	Std Length	Standard Length
2"	G341E-200	2.44"	150 psi	29" Hg	11"	1.02 lb	$9.40	$8.10	100 ft
3	G341E-300	3.43	150	29	13	1.47	15.50	12.70	100
4	G341E-400	4.49	150	29	17	2.19	21.30	17.60	100
6	G341E-600	6.66	150	28	35	4.68	44.50	35.60	100
8	G341E-800	8.73	150	28	43	7.28	64.00	51.20	20 or 40
10	G341E-1000	10.91	150	23	59	11.06	98.30	78.60	20 or 40

G341C

G341C... CORRUGATED EPDM SUCTION HOSE

For large bore dewatering and other applications where full vacuum is required, Green Line offers our G341C water suction hose in sizes 8" through 12". The EPDM tube and cover construction allows greater resistance to UV exposure as well as some chemicals while the corrugated cover is ideal for rugged and demanding applications.

Tube: Smooth, black EPDM rubber.

Reinforcement: Heavy dual wire helix embedded between layers of synthetic textile cords.

Cover: Black, corrugated, abrasion, ozone, and weather resistant EPDM rubber.

Temperature Range: -35°C (-31°F) to 100°C (212°F).

I.D.	Part Number	O.D.	Working Pressure	Vacuum Rating	Bend Radius	Weight per foot	PRICE PER FOOT Cut	Std Length	Standard Length
8"	G341C-800	8.82"	150 psi	29" Hg	32"	8.20 lb	$69.20	$55.30	10,20 or 40
10	G341C-1000	10.91	150	29	40	11.54		82.40	10,20 or 40
12	G341C-1200	13.15	150	29	60	16.57		133.70	10,20 or 40

Lansas® PRODUCTS

Manufactured by Vanderlans & Sons, Inc.

"WE JUST MADE THE BEST TEST PLUGS BETTER"™

4 years ago, we began evaluating our entire product line. We looked at all designs from top to bottom and we analyzed every step of the manufacturing process. In doing so, new ideas were developed and new automation was put in place. We found new materials and worked with our chemists to modify existing formulas. Through this process 3 patents have been applied for and the LANSAS 5-Line™ was born. The 5-Line™ currently consists of testing equipment and several plug designs. As a standard, all 5-Line™ items will be equipped with the LANSAS RP2® Rupture Protection device. The LANSAS RP2® virtually eliminates catastrophic bursting of Pipe Plugs from over-inflation due to user error, misuse, faulty gauges or regulators. This relief valve is designed to open and reset repeatedly. Your 5-Line™ plug will always remain in service unlike valves by other manufacturers with one time use breakable discs.The 5-Line™ derives its name from the 5 YEAR WARRANTY that all 5-Line™ items have as a standard.

Lansas® PRODUCTS
Manufactured by Vanderlans & Sons, Inc.

5® Line

New

5-LINE MULTI-SIZE FRONT & BACK PLUGS

The new 5-Line™ Multi-Size Front and Back Plugs are *better* in a number of ways. The most noticeable difference is in the very unique new design featuring the LANSAS proprietary "Flat-Rib"™ design which holds 60% more back pressure than standard O-ring ribbed plugs. We are using our improved reformulated rubber and laying the fabric in a way that the plugs can get the widest range of use on the market today. As with all other LANSAS products included in the 5-Line™ group, our 5-Line™ Multi-Size Front and Back plugs are equipped with the LANSAS RP2 Rupture Protection. We trust in this design enough to back it with the 5-Line™ 5 YEAR WARRANTY. If you are looking for the most Return on Investment look no further than the LANSAS 5-Line™ where once again it shows LANSAS is BETTER BY DESIGN™ since 1955.

Custom Designs Are Always™ Available

DOMEHEAD™ FRONT & BACK PLUGS

Patent # 5,785,090 Patent # 5,379,802 Patent # 4,079,755

THE LANSAS DOMEHEAD™ is the most durable multi-size pipe plug available. The unique design of this plug is covered under two U.S. patents. The first patent relates to the 2-ply of cross biased tire cord reinforcement (more on larger sizes). This design allows for controlled expansion of the plug. As this plug inflates it gets larger in diameter and shorter in length. By changing the shape of the plug rather than stretching the rubber we are able to make contact in the pipe at a lower pressure. This gives us higher contact pressure per square inch at an overall lower inflation pressure. Contact area and pressure are everything.
The second patent covers our superior end design. The ends are reinforced with a steel "spider™" ring wrapped in fabric. The fabric extends from the spider™ into the body of the plug. This advanced design transfers the stress of the inflation through the fabric to the steel spider™ ring leaving the bond at the base plate at a more relaxed state.

RUPTURE PROTECTED DOMEHEAD™ PLUGS

LANSAS RUPTURE PROTECTED PLUGS have a built in air relief valve that will prevent the plug from being over inflated due to faulty gauges or operator error. Once the valves cracking pressure is reached the Lansas RP™ Valve will open relieving the excess pressure. The RP™ Valve will reset at, or just below the required inflation pressure for the plug.

RP™ RUPTURE PROTECTED PLUG

Features:

- Eliminate operator error
- No broken discs to be replaced
- Plug stays in service
- Valve is recessed to prevent damage
- RP™ valves now available on most Multi Size Plugs manufactured by Lansas Products
- Don't be sold by cheap imitations of the original
- Another original design by Lansas Products

LANSAS Newly Redesigned Protective Sleeves

The LANSAS Protective Sleeve now has large D-Rings in place of the typical loops you see on other manufacturer's sleeves. This simple design improvement is superior in strength and makes it much easier to restrain the sleeve using the LANSAS SMART-SECURE™ Protective Sleeve Cable Restraint System.
These D-Rings are tied into the sleeve with 2-Ply's of biased cord fabric for added strength to ensure years of reliable service.
LANSAS Protective Sleeves help protect the plug while in the pipeline saving it from damage from debris, degraded pipe, barnacles, and more while in the pipeline. Additionally, it protects the Pipe Plug, your real investment, while on harsh job sites when stored improperly or simply from being moved from spot to spot during normal use.
LANSAS Protective Sleeves often times can be repaired at the LANSAS Factory Warehouses where repairs are completed.

IMPROVED

Lansas® PRODUCTS

Manufactured by Vanderlans & Sons, Inc.

ITEM 1 IN PRICE LIST

5 LINE MULTI-SIZE PLUGS

MULTI-SIZE BACK PLUG

PART NUMBER	RANGE OF USE		REQUIRED INFLATION PRESSURE	MAXIMUM BACK/TEST PRESSURE	BYPASS SIZE	PRODUCT DIMENSIONS		
	MINIMUM PIPE DIAMETER	MAXIMUM PIPE DIAMETER				LENGTH	DEFLATED DIAMETER	WEIGHT
550-816	7.4"	16.25"	30 psi	15 psi	N/A	32.0"	7.3"	14 lbs.
550-1018	9.1"	18.25"	30 psi	15 psi	N/A	35.0"	9.0"	21 lbs.
550-1224	10.6"	24.25"	30 psi	15 psi	N/A	41.5"	10.5"	30 lbs.

MULTI-SIZE FRONT PLUG

551-1018	9.1"	18.25"	30 psi	15 psi	3/4" + 1/4"	35.0"	9.0"	26 lbs.
551-1224	10.6"	24.25"	30 psi	15 psi	3/4" + 1/4"	41.5"	10.5"	37 lbs.

ITEM 2 & 4 IN PRICE LIST

MULTI-SIZE DOMEHEAD™ BACK PLUG

PART NUMBER	RANGE OF USE		REQUIRED INFLATION PRESSURE	MAXIMUM BACK/TEST PRESSURE	PRODUCT DIMENSIONS		
	MINIMUM PIPE DIAMETER	MAXIMUM PIPE DIAMETER			LENGTH	DEFLATED DIAMETER	WEIGHT
050-46	3.5"	6.25"	30 psi	15 psi	9.5"	3.5"	1 lbs.
050-610	5.3"	10.25"	30 psi	15 psi	19.7"	5.0"	4 lbs.
050-812	7.3"	12.25"	25 psi	15 psi	20.0"	7.0"	8 lbs.
050-1016	9.5"	16.25"	25 psi	15 psi	30.0"	9.30"	19 lbs.
050-1218	11.5"	18.25"	25 psi	15 psi	30.0"	11.0"	29 lbs.
050-1224	11.5"	24.25"	25 psi	15 psi	41.0"	11.0"	33 lbs.
050-1530	14.0"	30.25"	20 psi	8 psi	55.0"	13.0"	48 lbs.
050-1530RP	14.0"	30.25"	20 psi	8 psi	55.0"	13.0"	50 lbs.
050-2036	19.0"	36.25"	20 psi	8 psi	64.0"	18.5"	71 lbs.
050-2036RP	19.0"	36.25"	20 psi	8 psi	64.0"	18.5"	73 lbs
050-2448	22.0"	48.25"	15 psi	8 psi	84.0"	21.5"	102 lbs.
050-2448RP	22.0"	48.25"	15 psi	8 psi	84.0"	21.5"	104 lbs.
050-3660	34.5"	60.25"	10 psi	6 psi	84.0"	29.5"	187 lbs.
050-3660RP	34.5"	60.25"	10 psi	6 psi	84.0"	29.5"	189 lbs.
050-4278	37.0"	78.25"	10 psi	6 psi	101.0"	37.0"	314 lbs.
050-4278RP	37.0"	78.25"	10 psi	6 psi	101.0"	37.0"	316 lbs.
050-4872	46.0"	72.25"	10 psi	6 psi	84.0"	43.5"	331 lbs.
050-4872RP	46.0"	72.25"	10 psi	6 psi	84.0"	43.5"	333 lbs.
050-5496	53.0"	96.25"	10 psi	6 psi	114.0"	51.0"	496 lbs.
050-5496RP	53.0"	96.25"	10 psi	6 psi	114.0"	51.0"	498 lbs.
050-6096	58.0"	96.25"	10 psi	6 psi	110.0"	56.0"	515 lbs.
050-6096RP	58.0"	96.25"	10 psi	6 psi	110.0"	56.0"	517 lbs.

ITEM 3 & 4 IN PRICE LIST

MULTI-SIZE DOMEHEAD™ FRONT

PART NUMBER	RANGE OF USE		REQUIRED INFLATION PRESSURE	MAXIMUM BACK/TEST PRESSURE	BY-PASS SIZES	PRODUCT DIMENSIONS		
	MINIMUM PIPE DIAMETER	MAXIMUM PIPE DIAMETER				LENGTH	DEFLATED DIAMETER	WEIGHT
051-46	3.5"	6.25"	30 psi	15 psi	1/4" + 1/4"	9.5"	3.5"	2 lbs.
051-610	5.3"	10.25"	30 psi	15 psi	1/2" + 1/4"	18.0"	5.0"	7 lbs.
051-812	7.3"	12.25"	25 psi	15 psi	3/4" + 1/4"	20.0"	7.0"	10 lbs.
051-1016	9.5"	16.25"	25 psi	15 psi	3/4" + 1/4"	27.5"	9.30"	20 lbs.
051-1218	11.5"	18.25"	25 psi	15 psi	3/4" + 1/4"	28.5"	11.0"	30 lbs.
051-1224	11.5"	24.25"	25 psi	15 psi	3/4" + 1/4"	41.0"	11.0"	35 lbs.
051-1530	14.0"	30.25"	20 psi	8 psi	3/4" + 1/4"	55.0"	13.0"	50 lbs.
051-1530RP	14.0"	30.25"	20 psi	8 psi	3/4" + 1/4"	55.0"	13.0"	52 lbs.
051-2036	19.0"	36.25"	20 psi	8 psi	3/4" + 1/4"	64.0"	18.5"	73 lbs.
051-2036RP	19.0"	36.25"	20 psi	8 psi	3/4" + 1/4"	64.0"	18.5"	75 lbs.
051-2448	22.0"	48.25"	15 psi	8 psi	3/4" + 1/4"	84.0"	21.5"	105 lbs.
051-2448RP	22.0"	48.25"	15 psi	8 psi	3/4" + 1/4"	84.0"	21.5"	107 lbs.
051-3660	34.5"	60.25"	10 psi	6 psi	3/4" + 1/4"	84.0"	29.5"	190 lbs.
051-3660RP	34.5"	60.25"	10 psi	6 psi	3/4" + 1/4"	84.0"	29.5"	192 lbs.
051-4278	37.0"	78.25"	10 psi	6 psi	3/4" + 1/4"	101.0"	37.0"	318 lbs.
051-4278RP	37.0"	78.25"	10 psi	6 psi	3/4" + 1/4"	101.0"	37.0"	320 lbs.
051-4872	46.0"	72.25"	10 psi	6 psi	3/4" + 1/4"	84.0"	43.5"	335 lbs.
051-4872RP	46.0"	72.25"	10 psi	6 psi	3/4" + 1/4"	84.0"	43.5"	337 lbs.
051-5496	53.0"	96.25"	10 psi	6 psi	3/4" + 1/4"	114.0"	51.0"	501 lbs.
051-5496RP	53.0"	96.25"	10 psi	6 psi	3/4" + 1/4"	114.0"	51.0"	503 lbs.
051-6096	58.0"	96.25"	10 psi	6 psi	3/4" + 1/4"	110.0"	56.0"	520 lbs.
051-6096RP	58.0"	96.25"	10 psi	6 psi	3/4" + 1/4"	110.0"	56.0"	522 lbs.

NOTE: 10" x 16" PLUGS AND LARGER HAVE 2 INFLATION PORTS. (1) STANDARD 1/4" (F) NPT AND (1) SECONDARY 1/2" (F) NPT.

ITEM 2 & 4 IN PRICE LIST

PROTECTIVE SLEEVES

PART NUMBER	FITS PLUGS WITH NOTED PART NUMBERS	WEIGHT
069-610	050-610, 051-610	2.5 lbs.
069-610FT	093-610	2.5 lbs.
069-812	050-812, 051-812	3 lbs.
069-812FT	092-812, 094-812, 096-812	3 lbs.
059-816	550-816	5 lbs.
069-1016	050-1016, 051-1016	6 lbs.
069-1016FT	094-1016, 096-1016, 098-1016	6 lbs.
059-1018	550-1018, 551-1018	8 lbs.
069-1218	050-1218, 051-1218	10 lbs.
069-1218FT	094-1218, 096-1218, 098-1218	10 lbs.
059-1224	550-1224, 551-1224	15 lbs.
069-1224	050-1224, 051-1224	14 lbs.
069-1224FT	094-1224, 096-1224, 098-1224	14 lbs.
069-1530	050-1530, 051-1530, 094-1530S	21 lbs.
069-1530FT	094-1530H, 096-1530, 098-1530	21 lbs.
069-2036	050-2036, 051-2036, 094-2036S	28 lbs.
069-2036FT	094-2036H, 096-2036, 098-2036	28 lbs.
069-2448	050-2448, 051-2448, 094-2448, 096-2448, 098-2448	53 lbs.
069-3660	050-3660, 051-3660, 094-3660, 096-3660, 098-3660	78 lbs.
069-4278	050-4278, 051-4278, 094-4278, 096-4278, 098-4278	93 lbs.
069-4872	050-4872, 051-4872, 094-4872, 096-4872, 098-4872	89 lbs.
069-5496	050-5496, 051-5496, 094-5496, 096-5496, 098-5496	160 lbs.
069-6096	050-6096, 051-6096, 094-6096, 096-6096, 098-6096	166 lbs.

Custom sleeves always available

CAST BODY WEDGE GATE VALVES

FIG. 20-150, STAINLESS STEEL - CLASS 150

Design Features

- Locking handwheel nut.
- Provision for lockout lanyard.
- TFE impregnated packing for temperature to 450ºF/232ºC and PH 2-12.
- Precision machined flexible wedge gate and seat for light shut-off.
- Fully guided gate to ensure alignment.
- Outside screw and yoke, non-rising handwheel, rising stem.
- Two piece yoke and bonnet assembly.
- Flanges match ASME B 16.5-150 Lbs standard. Serrated gasket faces.
- Face to face ASME B16.10

Designed to ASME B16.34 & API 603 tested to API 598

FLOW CONTROL COMPONENTS

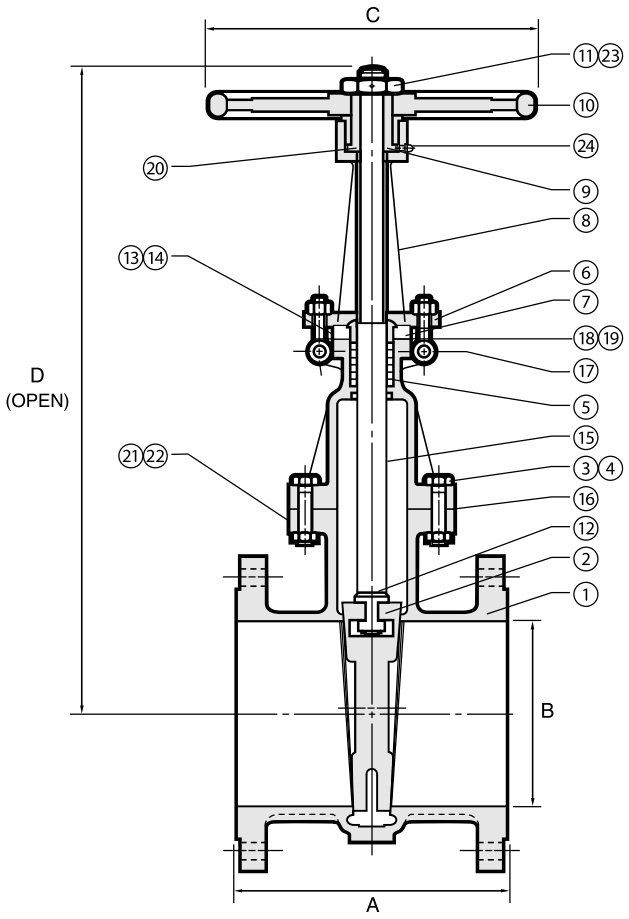
M. A. Stewart & Sons Ltd.
VALVES AND FITTINGS

Designed to handle corrosive fluids in the process industries

STAINLESS STEEL WEDGE GATE VALVES

FIG. 20-150, STAINLESS STEEL - CLASS 150

FIG 20B-150-CF8M (316)
FIG 20L-150-CG8M (317)



Item	Description	Fig. 20B	Fig. 20L
1	Body	ASTM A351 Gr.CF8M	ASTM A351 Gr.CG8M
2	Disc	ASTM A351 Gr.CF8M	ASTM A351 Gr.CG8M
3	Nut	AISI 304	AISI 304
4	Bonnet-Bolt	AISI 304	AISI 304
5	Packing	TFE Impregnated	TFE Impregnated
6	Gland Flange	ASTM A351 Gr.CF8M	ASTM A351 Gr.CG8M
7	Gland	ASTM A479 Gr.316	ASTM A479 Gr.317L
8	Yoke	ASTM A351 Gr.CF8	ASTM A351 Gr.CF8
9	Stem Sleeve	SAE 660 (Bronze)	SAE 660 (Bronze)
10	Handwheel	ASTM A536 Gr.60-42-10	
11	Handwheel Nut	MS Plated Steel	
12	Stem	ASTM A479 Gr.316	ASTM A479 Gr.317L
13	Yoke Bolt	AISI 304	AISI 304
14	Nut	AISI 304	AISI 304
15	Bonnet	ASTM A351 Gr.CF8M	ASTM A351 Gr.CG8M
16	Gasket	P.T.F.E.	P.T.F.E.
17	Gland Bolt Pin	AISI 304	AISI 304
18	Gland Bolt	AISI 304	AISI 304
19	Gland Bolt Nut	AISI 304 Nylock	AISI 304 Nylock
20	Sleeve Retainer	AISI 304	AISI 304
21	Nameplate	ASTM A240 Gr.304	ASTM A240 Gr.304
22	Rivets	Aluminium	Aluminium
23	Lock Screw	SS-Commercial Grade	SS SS-Commercial Grade
24	Grease Nipple	Cadmium Plated Steel	Cadmium Plated Steel

DIMENSIONS - INCHES													
Size	2	2.5	3	4	6	8	10	12	14	16	18	20	24
A	7	7.5	8	9	10.2	11.5	13	14	15	16	17	18	20
B	2	2.5	3	4	6	8	10	12	13.2	16	18	20	24
C	7	7	8	9	12	14	16	18	18	20	20	20	20
D	13.3	15.1	18.1	20.5	28	36.4	44.3	51.7	60	66.5	73.75	80.75	94
Wt. lb.	44	50	55	80	130	220	348	480	600	830	900	1150	1520

DIMENSIONS - MILLIMETERS													
Size	50	65	80	100	150	200	250	300	350	400	450	500	600
A	178	190	203	229	260.7	292	330	356	381	406	432	457	508
B	51	63.5	78	102	152	203	254	305	336.5	400	450	500	600
C	178	178	203	229	305	356	406	457	457	508	508	508	508
D	338	386	461	520	714	925	1126	1314	1525	1689	1873	2051	2388
Wt. Kg.	20	23	25	36	59	100	158	218	276	373	410	523	690

- Handwheel actuator standard.
- Chainwheel, bevel gear, electric, hydraulic or pneumatic actuators are available.
- Also available in larger sizes, or in special alloys like CN7m (Alloy 20), Duplex SS, Hastelloy are available on request.

M. A. Stewart & Sons Ltd.
VALVES AND FITTINGS

SURREY, BC
P: 604.594.8431
F: 604.594.4335
surrey@mastewart.com

EDMONTON, AB
P: 780.436.9051
F: 780.435.0463
edmonton@mastewart.com

AJAX, ON
P: 905.683.7303
F: 905.683.9108
ajax@mastewart.com

MONTREAL, QC
P: 514.421.6311
F: 514.421.6323
montreal@mastewart.com

2/16/11-20-150.4

Sewer Bypass Monitoring Checklist

Client : _____ Site Address: _____

Pump Tech: _____ Foreman: _____

Date: _____ Emergency Contact No.: _____

Time	Suction Gauge (Hg)	Discharge Gauge (PSI)	Pump Seal (Oil)	Any Pipe / Joint Leak	Engine RPM	Fuel Tank (% Full)	Engine Temp	Sewer Plug Pressure	Surcharge Level	H2S Gas Monitor	Back up Pump Test

Any Unusual Observation:

_____

_____

_____

_____

_____ _____

Pump Tech (Sign) Forman (Sign)

Appendix B – Victaulic 905 Coupling

Victaulic® Coupling for Plain End Polyethylene Pipe
Style 905

19.07




1.0 PRODUCT DESCRIPTION

Available Sizes

- 2 – 14" IPS pipe size
- 63 – 355 mm ISO pipe sizes

Pipe Material

- HDPE pipe conforming to ASTM D3035 and ASTM F714 or ISO 4427-2 (SDR 7 – 26)
- PE-RT pipe conforming to ASTM D3350, cell class PE445574C, ASTM F2619, and ASTM F714 (SDR 7 – 26)
- See publication 36.01 for information on cross-linked polyethylene (PE-Xa) pipe.
- Contact Victaulic for other pipe materials

Maximum Working Pressure

- Meets or exceeds the pressure rating of the HDPE or PE-RT pipe

Operating Temperature

- Dependent upon pipe manufacturer rating and gasket selection
- Reference section 3.0 for gasket performance options
- Consult pipe manufacturer for pipe material performance limitations

Function

- Joins plain end polyethylene pipe
- Utilizes patented Installation-Ready™ technology to eliminate loose parts

Pipe Preparation

- For use on plain end HDPE or PE-RT pipe

NOTE

- All references to HDPE within this document are inclusive of PE-RT

2.0 CERTIFICATION/LISTINGS

FM APPROVED
CLASSIFIED c UL us WATER QUALITY ANSI/NSF 61 & 372
WaterMark
CNBOP-PIB

NOTE

- See Publication 10.01: Victaulic Fire Protection Approval Reference Guide for details.
- See Publication 02.06: Victaulic Approvals for Potable Water Products – ANSI/NSF 61 and ANSI/NSF 372 if applicable.
- WaterMark™ certification only applies to fusion bonded epoxy-coated couplings with Grade “E” EPDM gaskets. Contact Victaulic for further details.

ALWAYS REFER TO ANY NOTIFICATIONS AT THE END OF THIS DOCUMENT REGARDING PRODUCT INSTALLATION, MAINTENANCE OR SUPPORT.

3.0 SPECIFICATIONS – MATERIAL

Housing: Ductile iron conforming to ASTM A536, Grade 65-45-12.

Housing Coating: (specify choice)

- ☐ Orange coating for IPS sizes
- ☐ Black coating for ISO sizes and 5" IPS
- ☐ Liquid bonded epoxy
- ☐ Fusion bonded epoxy, galvanized and other coatings are available. Contact Victaulic for details.

Retaining Ring: Type 316 stainless steel.

Coupling Gasket: (specify choice[1])

☐ **Grade "T" Nitrile (Standard or Flush-Seal™)**

Nitrile (Orange color code). Temperature range –20°F to +180°F/–29°C to +82°C. May be specified for oil related services, including air with oil vapor, this gasket may be specified for temperatures rated up to +180°F/+82°C. For water related services, this gasket may be specified for temperatures rated up to +150°F/+66°C. For oil free, dry air services, this gasket may be specified for temperatures rated up to +140°F/+60°C. NOT COMPATIBLE FOR USE WITH HOT WATER SERVICES OR STEAM SERVICES.

☐ **Grade "E" EPDM (Standard or Flush-Seal™)**

EPDM (Green color code). Temperature range –30°F to +230°F/–34°C to +110°C. May be specified for hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. UL Classified in accordance with NSF/ANSI/CAN 61 for cold +73°F/+23°C potable water service and NSF/ANSI/CAN 372. NOT COMPATIBLE FOR USE WITH PETROLEUM SERVICES OR STEAM SERVICES.

☐ **Grade "EF" EPDM**

EPDM (Green "X" color code). Temperature range –30°F to +230°F/–34°C to +110°C. May be specified for hot and cold water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. Also meets hot and cold potable water requirements per DVGW, KTW, ÖVGW, SVGW, and French ACS (Crecep), approved for W534, approved for EN681-1 Type WA cold potable, and Type WB hot potable water service. NOT COMPATIBLE FOR USE WITH PETROLEUM SERVICES OR STEAM SERVICES.

☐ **Grade "O" Fluoroelastomer**

Fluoroelastomer (Blue stripe color code). Temperature range +20°F to +300°F/-7°C to +149°C. May be specified for many oxidizing acids, petroleum oils, halogenated hydrocarbons, lubricants, hydraulic fluids, organic liquids and air with hydrocarbons. NOT COMPATIBLE FOR USE WITH HOT WATER SERVICES OR STEAM SERVICES.

[1] Services listed are General Service Guidelines only. It should be noted that there are services for which these gaskets are not compatible. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service guidelines and for a listing of services which are not compatible.

NOTE

- The maximum temperature ratings shown exceed the temperature ratings for HDPE pipe. Consult individual pipe manufacturers for specific temperature limits.

Hardware:

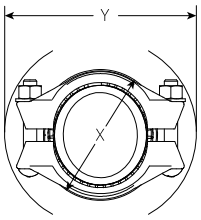
Bolts/Nuts: (specify choice[2])

- ☐ Carbon steel oval neck track bolts meeting the mechanical property requirements of ASTM A449 (imperial) and ISO 898-1 Class 9.8 (M10-M16) Class 8.8 (M20 and greater). Carbon steel hex nuts meeting the mechanical property requirements of ASTM A563 Grade B (imperial - heavy hex nuts) and ASTM A563M Class 9 (metric - hex nuts). Track bolts and hex nuts are zinc electroplated per ASTM B633 ZN/FE5, finish Type III (imperial) or Type II (metric), with blue (imperial) or black (metric) fluoropolymer top coat. Hardened steel washers conforming to ASTM F436 Type 3 (weathering steel).
- ☐ 2 – 4", 63 – 110 mm: Stainless steel oval neck track bolts meeting the mechanical property requirements of ASTM F593, Group 2 (316 stainless steel), condition CW. Stainless steel heavy hex nuts meeting the mechanical property requirements of ASTM F594, Group 2 (316 stainless steel), condition CW, with galling reducing coating. Stainless steel washers conforming to ASME B18.21.1 and ASTM A666, Type 316, Annealed.
- ☐ 5 – 14", 125 – 355 mm: Stainless steel oval neck track bolts meeting the mechanical property requirements of ASTM A193, Class 2 (316 stainless steel), Grade B8M. Stainless steel heavy hex nuts meeting the mechanical property requirements of ASTM A194 Grade 8M Heavy Hex, with galling reducing coating. Stainless steel washers conforming to ASME B18.21.1 and ASTM A666, Type 316, Annealed.

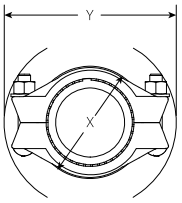
[2] Stainless steel bolts/nuts available in imperial size only

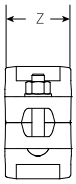
4.0 DIMENSIONS

Style 905 – IPS Standard

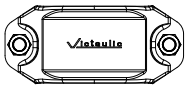


Style 905 Pre-Assembled (Installation-Ready Condition)





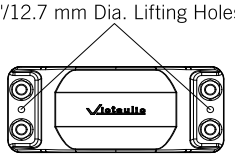
Style 905 Joint Assembled



2 – 6" IPS

8" IPS

½"/12.7 mm Dia. Lifting Holes[3]



10 – 14" IPS

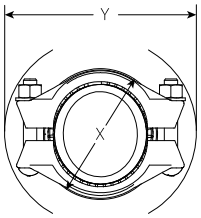
Size		Pipe End Separation[4]	Bolt/Nut		Dimensions					Weight
					Pre-assembled (Installation-Ready™ Condition)		Joint Assembled			
Nominal inches	Actual Outside Diameter inches mm	Allowable inches mm	Qty.	Size inches	X inches mm	Y inches mm	X inches mm	Y inches mm	Z inches mm	Approx. (Each) lb kg
2	2.375 60.3	0.25 6.4	2	½ x 3 ¼	3.88 99	6.38 162	3.50 89	6.63 168	4.13 105	5.5 2.5
3	3.500 88.9	0.25 6.4	2	⅝ x 3 ½	5.13 130	8.13 207	4.63 118	8.13 207	4.13 105	8.5 3.9
4	4.500 114.3	0.25 6.4	2	⅝ x 4 ¼	6.50 165	9.25 235	6.00 152	9.38 238	4.75 121	13.1 5.9
5	5.563 141.3	0.25 6.4	2	¾ x 4 ¼	7.63 194	10.88 276	6.88 175	11.25 286	4.88 124	18.7 8.5
6	6.625 168.3	0.25 6.4	2	¾ x 5	8.88 226	12.13 308	8.13 207	12.63 321	4.75 121	19.4 8.8
8	8.625 219.1	0.40 10.2	4	¾ x 6 ¼	11.00 279	14.50 368	10.00 254	14.88 378	5.00 127	28.0 12.7
10	10.750 273.0	0.40 10.2	4	⅞ x 6 ½	13.73 349	17.75 451	12.73 323	18.25 464	7.09 180	73.5 33.3
12	12.750 323.9	0.40 10.2	4	⅞ x 6 ½	15.83 402	19.63 499	14.83 377	20.07 510	7.11 181	86.5 39.2
14	14.000 355.6	0.40 10.2	4	1 ⅛ x 7	17.67 449	21.38 543	16.42 417	21.89 556	8.42 214	112.6 51.1

[3] Unthreaded through holes for appropriately sized lifting eyes or hooks.

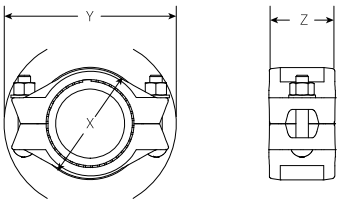
[4] Style 905 couplings when sufficiently pressurized will allow pipe ends to separate to maximum value shown.

4.1 DIMENSIONS

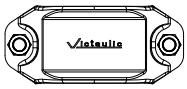
Style 905 – ISO Standard



Style 905 Pre-Assembled (Installation-Ready Condition)



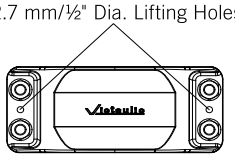
Style 905 Joint Assembled



63 – 160 mm ISO

180 – 225 mm ISO

12.7 mm/½" Dia. Lifting Holes[5]



250 – 355 mm ISO

Size	Pipe End Separation[7]	Bolt/Nut		Dimensions					Weight
				Pre-assembled (Installation-Ready™ Condition)		Joint Assembled			
Nominal mm	Allowable mm inches	Qty.	Size[6] mm inches	X mm inches	Y mm inches	X mm inches	Y mm inches	Z mm inches	Approx. (Each) kg lb
63	6.4 0.25	2	M12 x 83 ½ x 3 ¼	99 3.88	152 6.00	89 3.50	168 6.63	105 4.13	2.5 5.5
75	6.4 0.25	2	M16 x 83 ⅝ x 3 ¼	114 4.50	184 7.25	102 4.00	194 7.63	105 4.13	3.7 8.1
90	6.4 0.25	2	M16 x 102 ⅝ x 4	130 5.13	195 7.68	118 4.63	210 8.25	105 4.13	3.9 8.5
110	6.4 0.25	2	M16 x 102 ⅝ x 4	159 6.25	219 8.63	146 5.75	232 9.13	121 4.75	5.9 13.0
125	6.4 0.25	2	M20 x 108 ¾ x 4 ¼	175 6.88	264 10.38	159 6.25	273 10.75	124 4.88	7.8 17.3
140	6.4 0.25	2	M20 x 108 ¾ x 4 ¼	194 7.63	276 10.88	175 6.88	286 11.25	124 4.88	8.5 18.7
160	6.4 0.25	2	M20 x 127 ¾ x 5	210 8.25	292 11.50	194 7.63	305 12.00	121 4.75	8.8 19.3
180	10.2 0.40	4	M20 x 159 ¾ x 6 ¼	248 9.75	337 13.25	219 8.63	353 13.88	127 5.00	11.5 25.4
200	10.2 0.40	4	M20 x 159 ¾ x 6 ¼	267 10.50	353 13.88	238 9.38	368 14.50	127 5.00	12.2 26.8
225	10.2 0.40	4	M20 x 159 ¾ x 6 ¼	295 11.63	373 14.68	267 10.50	387 15.25	127 5.00	13.0 28.7
250	10.2 0.40	4	M22 x 165 ⅞ x 6 ½	326 12.84	427 16.83	301 11.84	441 17.35	180 7.09	30.9 68.1
280	10.2 0.40	4	M22 x 165 ⅞ x 6 ½	359 14.14	458 18.03	334 13.14	470 18.50	180 7.09	35.4 78.0
315	10.2 0.40	4	M22 x 165 ⅞ x 6 ½	394 15.50	489 19.25	368 14.50	500 19.69	180 7.09	38.1 83.9
355	10.2 0.40	4	M27 x 178 1 ⅛ x 7	449 17.67	543 21.38	417 16.42	556 21.89	214 8.42	51.1 112.6

[5] Unthreaded through holes for appropriately sized lifting eyes or hooks.
[6] Metric bolts/nuts standard, with the exception of North America, South America, and Australian configurations, where imperial sizes are standard.
[7] Style 905 couplings when sufficiently pressurized will allow pipe ends to separate to maximum value shown.

5.0 PERFORMANCE

Style 905 – IPS Standard

Pressure Rating: joints made with Style 905 Couplings meet the pressure rating of the HDPE pipe.

IPS Size		PE4710 HDPE Pipe DR[8]													
		7		9		11		13.5		17		21		26	
Nominal Size	Actual O.D.	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load	Max. Joint Work. Press.	Max. Permiss. End Load
inches	inches mm	psi kPa	lb N	psi kPa	lb N	psi kPa	lb N	psi kPa	lb N	psi kPa	lb N	psi kPa	lb N	psi kPa	lb N
2	2.375 60.3	333 2295	1475 6560	250 1725	1110 4940	200 1380	885 3935	160 1100	710 3160	125 860	555 2470	100 690	445 1980	–	–
3	3.500 88.9	333 2295	3205 14255	250 1725	2405 10700	200 1380	1925 8565	160 1100	1540 6850	125 860	1205 5360	100 690	960 4270	–	–
4	4.5 114.3	333 2295	5295 23555	250 1725	3975 17680	200 1380	3180 14145	160 1100	2545 11320	125 860	1990 8850	100 690	1590 7075	–	–
5	5.563 141.3	333 2295	8095 36010	250 1725	6075 27025	200 1380	4860 21620	160 1100	3890 17305	125 860	3040 13525	100 690	2430 10810	–	–
6	6.625 168.3	333 2295	11480 51065	250 1725	8620 38345	200 1380	6895 30670	160 1100	5515 24530	125 860	4310 19170	100 690	3445 15325	80 550	2760 12275
8	8.625 219.1	333 2295	19455 86540	250 1725	14605 64965	200 1380	11685 51975	160 1100	9350 41590	125 860	7305 32495	100 690	5845 26000	80 550	4675 20795
10	10.750 273	333 2295	30225 134450	250 1725	22690 100930	200 1380	18155 80755	160 1100	14520 64590	125 860	11345 50465	100 690	9075 40370	80 550	7260 32295
12	12.750 323.9	333 2295	42515 189115	250 1725	31920 141985	200 1380	25535 113585	160 1100	20430 90875	125 860	15960 70995	100 690	12770 56805	80 550	10215 45440
14	14.000 355.6	333 2295	51260 228015	250 1725	38485 171190	200 1380	30790 136960	160 1100	24630 109560	125 860	19240 85585	100 690	15395 68480	80 550	12315 54780

[8] HDPE pipe conforming to ASTM D3035 and F714 at 73°F/23°C. Reference plastic pipe manufacturer data for derating factors at other temperatures

NOTE

- Victaulic coupling gaskets have been demonstrated to seal under full (29" of Hg/3.4 kPa [absolute]) vacuum requirements. Consult the specific HDPE pipe manufacturer for their recommended limitations regarding maximum vacuum, as well as the effects of temperature and pipe ovality.
- Contact Victaulic for other pipe materials.

5.1 PERFORMANCE

Style 905 – ISO Standard

Pressure Rating: joints made with Style 905 Couplings meet the pressure rating of the HDPE pipe.

ISO Size	**PE100 HDPE Pipe SDR[9]**													
	7.4		**9**		**11**		**13.6**		**17**		**21**		**26**	
Nominal Size mm	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb	**Max. Joint Work. Press.** Bar kPa psi	**Max. Permiss. End Load** N lb
63	25 2500 363	7875 1770	20 2000 290	6295 1415	16 1600 232	5025 1130	12.5 1250 182	3960 890	10 1000 145	3135 705	8 800 116	2515 565	–	–
75	25 2500 363	11165 2510	20 2000 290	8920 2005	16 1600 232	7140 1605	12.5 1250 182	5605 1260	10 1000 145	4450 1000	8 800 116	3560 800	–	–
90	25 2500 363	16080 3615	20 2000 290	12855 2890	16 1600 232	10275 2310	12.5 1250 182	8075 1815	10 1000 145	6430 1445	8 800 116	5140 1155	–	–
110	25 2500 363	24000 5395	20 2000 290	19170 4310	16 1600 232	15345 3450	12.5 1250 182	12030 2705	10 1000 145	9585 2155	8 800 116	7675 1725	–	–
125	25 2500 363	31005 6970	20 2000 290	24775 5570	16 1600 232	19815 4455	12.5 1250 182	15545 3495	10 1000 145	12390 2785	8 800 116	9920 2230	–	–
140	25 2500 363	38875 8740	20 2000 290	31070 6985	16 1600 232	24845 5585	12.5 1250 182	19505 4385	10 1000 145	15525 3490	8 800 116	12435 2795	–	–
160	25 2500 363	50800 11420	20 2000 290	40590 9125	16 1600 232	32470 7300	12.5 1250 182	25465 5725	10 1000 145	20285 4560	8 800 116	16235 3650	6 600 87	12165 2735
180	25 2500 363	64300 14455	20 2000 290	51355 11545	16 1600 232	41080 9235	12.5 1250 182	32225 7245	10 1000 145	25690 5775	8 800 116	20550 4620	6 600 87	15415 3465
200	25 2500 363	79335 17835	20 2000 290	63385 14250	16 1600 232	50710 11400	12.5 1250 182	39765 8940	10 1000 145	31695 7125	8 800 116	25355 5700	6 600 87	19015 4275
225	25 2500 363	100440 22580	20 2000 290	80245 18040	16 1600 232	64190 14430	12.5 1250 182	50355 11320	10 1000 145	40125 9020	8 800 116	32095 7215	6 600 87	24065 5410
250	25 2500 363	123995 27875	20 2000 290	99060 22270	16 1600 232	79245 17815	12.5 1250 182	62165 13975	10 1000 145	49530 11135	8 800 116	39610 8905	6 600 87	29715 6680
280	25 2500 363	155555 34970	20 2000 290	124260 27935	16 1600 232	99420 22350	12.5 1250 182	77975 17530	10 1000 145	62140 13970	8 800 116	49710 11175	6 600 87	37275 8380
315	25 2500 363	196855 44255	20 2000 290	157265 35355	16 1600 232	125820 28285	12.5 1250 182	98685 22185	10 1000 145	78620 17675	8 800 116	62900 14140	6 600 87	47175 10605
355	25 2500 363	249970 56195	20 2000 290	199705 44895	16 1600 232	159760 35915	12.5 1250 182	125330 28175	10 1000 145	99840 22445	8 800 116	79870 17955	6 600 87	59920 13470

9 HDPE pipe conforming to ISO 4427-2 at 68°F/20°C. Reference plastic pipe manufacturer data for derating factors at other temperatures

NOTES

- Victaulic coupling gaskets have been demonstrated to seal under full (29" of Hg/3.4 kPa [absolute]) vacuum requirements. Consult the specific HDPE pipe manufacturer for their recommended limitations regarding maximum vacuum, as well as the effects of temperature and pipe ovality.
- Contact Victaulic for other pipe materials.

5.2 PERFORMANCE

Style 905 – IPS Standard

Allowable Tensile Load (ATL): joints made with Style 905 Couplings can sustain tensile loads noted below.

IPS Size	Allowable Tensile Load[10] DR						
Nominal Size inches	**7** lb N	**9** lb N	**11** lb N	**13.5** lb N	**17** lb N	**21** lb N	**26** lb N
2	2369 10540	1911 8501	1599 7114	1327 5904	1071 4765	878 3906	–
3	5146 22890	4151 18463	3473 15449	2882 12821	2327 10349	1906 8478	–
4	8507 37839	6861 30520	5741 25539	4765 21195	3846 17108	3151 14016	–
5	12292 54678	10388 46208	8692 38664	7165 31872	5823 25902	4815 21418	–
6	18437 82013	14871 66151	12444 55353	10327 45938	8336 37081	6829 30377	5568 24768
8	31200 138784	25200 112095	21100 93857	17500 77844	14100 62720	11574 51484	9438 41982
10	48500 215738	39100 173926	32800 145901	27200 120991	21900 97416	17900 79623	14662 65220
12	68300 303814	55100 245096	46100 205062	38300 170366	30900 137449	25200 112095	20625 91745
14	72000 320270	64000 284686	55600 247320	46100 205062	37200 165473	30400 135226	24867 110614

[10] Allowable tensile loads (ATL) shown are for straight pulling of unpressurized assembled pipe sections for a maximum period of one half hour at 68°F/20°C. Consult pipe manufacturer's recommendation for ATL reduction factors at elevated temperatures.

5.3 PERFORMANCE

Style 905 – ISO Standard

Allowable Tensile Load (ATL): joints made with Style 905 Couplings can sustain tensile loads noted below.

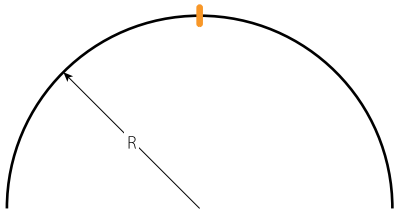
ISO Size	Allowable Tensile Load[11] SDR						
Nominal Size	**7.4**	**9**	**11**	**13.6**	**17**	**21**	**26**
mm	N lb	N lb	N lb	N lb	N lb	N lb	N lb
63	11076 2490	9360 2104	7832 1761	6456 1451	5247 1179	4297 966	–
75	15702 3530	13269 2983	11103 2496	9150 2057	7437 1672	6094 1370	–
90	22616 5084	19112 4297	15992 3595	13182 2864	10713 2408	8776 1973	–
110	33748 7587	28519 6411	23864 5365	19671 4422	15987 3594	13096 2944	–
125	43610 9804	36854 8285	30840 6933	25422 5715	20658 4644	16921 3804	–
140	54678 12292	46208 10388	38664 8692	31872 7165	25902 5823	21218 4770	–
160	71440 16061	60372 13572	50517 11357	41641 9361	33841 7608	27721 6232	22606 5082
180	90415 20326	76407 17177	63934 14373	52698 11847	42827 9628	35083 7887	28611 6432
200	111561 25080	94276 21194	78889 17735	65029 14619	52849 11881	43290 9732	35301 7936
225	141271 31759	119381 26838	99898 22458	82345 18512	66919 15044	54820 12324	44705 10050
250	173925 39100	146791 33000	122770 27600	101419 22800	82292 18500	67613 15200	54713 12300
280	218408 49100	184601 41500	154576 34750	127219 28600	103421 23250	84516 19000	68947 15500
315	276679 62200	233531 52500	195721 44000	161025 36200	130777 29400	107202 24100	87185 19600
355	351410 79000	296695 66700	248565 55880	204617 46000	166363 37400	136116 30600	110761 24900

[11] Allowable tensile loads (ATL) shown are for straight pulling of unpressurized assembled pipe sections for a maximum period of one half hour at 68°F/20°C. Consult pipe manufacturer's recommendation for ATL reduction factors at elevated temperatures.

5.4 PERFORMANCE

Style 905 – IPS Standard

Bend Radius: joints made with Style 905 Couplings can sustain a radius as recommended by the Plastic Pipe Institute (PPI) in the Handbook of PE Pipe (2nd ed, Chapter 7, Table 4).

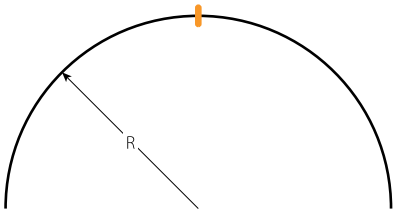


IPS Size	Minimum Recommended Bend Radius DR						
Nominal Size inches	**7** inches mm	**9** inches mm	**11** inches mm	**13.5** inches mm	**17** inches mm	**21** inches mm	**26** inches mm
2	48 1207	48 1207	59 1508	59 1508	64 1629	155 3937	–
3	70 1778	70 1778	88 2223	88 2223	95 2400	95 2400	–
4	90 2286	90 2286	113 2858	113 2858	122 3086	122 3086	–
5	111 2813	111 2813	138 3516	138 3516	149 3797	149 3797	–
6	133 3366	133 3366	166 4207	166 4207	179 4543	179 4543	225 5715
8	173 4382	173 4382	216 5477	216 5477	233 5915	233 5915	293 7442
10	215 5461	215 5461	269 6826	269 6826	290 7372	290 7372	366 9296
12	255 6477	255 6477	319 8096	319 8096	344 8744	344 8744	434 11024
14	280 7112	280 7112	350 8890	350 8890	378 9601	378 9601	476 12090

5.5 PERFORMANCE

Style 905 – ISO Standard

Bend Radius: joints made with Style 905 Couplings can sustain a bending radius as recommended by the Plastic Pipe Institute (PPI) in the Handbook of PE Pipe (2nd ed, Chapter 7, Table 4).



ISO Size	Minimum Recommended Bend Radius SDR						
Nominal Size mm	**7.4** mm inches	**9** mm inches	**11** mm inches	**13.6** mm inches	**17** mm inches	**21** mm inches	**26** mm inches
63	1266 50	1266 50	1582 62	1582 62	1709 67	4090 161	–
75	1507 59	1507 59	1884 74	1884 74	2035 80	4877 192	–
90	1809 71	1809 71	2261 89	2261 89	2442 96	2442 96	–
110	2210 87	2210 87	2762 109	2762 109	2983 117	2983 117	–
125	2512 99	2512 99	3140 124	3140 124	3391 134	3391 134	–
140	2813 111	2813 111	3516 138	3516 138	3797 149	3797 149	–
160	3215 127	3215 127	4019 158	4019 158	4340 171	4340 171	5461 215
180	3617 142	3617 142	4521 178	4521 178	4883 192	4883 192	6147 242
200	4018 158	4018 158	5022 198	5022 198	5424 214	5424 214	6833 269
225	4521 178	4521 178	5652 223	5652 223	6104 240	6104 240	7671 302
250	5000 197	5000 197	6250 246	6250 246	6750 266	6750 266	8534 336
280	5600 220	5600 220	7000 276	7000 276	7560 298	7560 298	9550 376
315	6300 248	6300 248	7875 310	7875 310	8505 335	8505 335	10744 423
355	7100 280	7100 280	8875 349	8875 349	9585 377	9585 377	12116 477

6.0 NOTIFICATIONS

⚠ WARNING

- **Read and understand all instructions before attempting to install any Victaulic products.**
- **Always verify that the piping system has been completely depressurized and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Confirm that any equipment, branch lines, or sections of piping that may have been isolated for/during testing or due to valve closures/positioning are identified, depressurized, and drained immediately prior to installation, removal, adjustment, or maintenance of any Victaulic products.**
- **Wear safety glasses, hardhat, foot protection, and hearing protection.**

Failure to follow these instructions could result in death or serious personal injury and property damage.

7.0 REFERENCE MATERIALS

I-900: HDPE Products Installation and Assembly Manual
I-905.REUSE: Victaulic Style 905 Reuse Instructions
IT-905: Style 905 Installation Tag
IT-905.FS: Style 905 with Flush-Seal™ Gasket Installation Instructions
05.01: Gasket Selection Guide
19.09: Style 908 Coupling for Double Grooved HDPE pipe
19.10: Style 907 Transition Coupling for HDPE-to-Steel
19.11: HDPE Plain End Fittings
19.12: Style 904 Flange Adapter for HDPE-to-Flanged Pipe
29.01: Terms and Conditions/Warranty
I-ENDCAP: Victaulic End Caps Installation Instructions

Appendix C – Romac Coupling

MACRO HP EXTENDED RANGE COUPLING
2 – 16 INCH

SUBMITTAL INFORMATION

NSF61/372 Certified.

USE

Provides an Extended Range Coupling for multi-purpose use from steel pipe up through class 200 asbestos cement pipe. Each end requires only one bolt to compress the gasket around the pipe. The MACRO can accommodate up to 10 degrees of deflection, 16" Macro 2 bolts per gasket, up to 8 degrees of deflection.

STANDARD

The MACRO coupling is in accordance with the requirements of AWWA Standard C219.

MATERIALS

CASTINGS
All cast components (end rings, center ring, and bolt cams) are ductile iron, meeting or exceeding the requirements of ASTM A 536, grade 65-45-12 or 60-40-18.

END RINGS
4 – 12 inch End Rings are segmented and joined with an integrated hinge. 2 and 3 inch use a type 316 stainless steel pin. The gap is spanned by the armor. 16 inch Macro end rings consist of 2 halves connected with bolts.

CENTER RING
Cast with integral handle for ease of assembly.

ARMOR
Heavy gauge 304 stainless steel.

GASKETS
Made from virgin Ethylene Propylene Diene Monomer Rubber (EPDM) compounded for water and sewer service in accordance with ASTM D2000, NSF 61 Certified. NBR - NSF 61 gaskets available upon request, 2 - 12 inch.

BOLTS AND NUTS
Type 304 stainless steel. 2 and 3 inch are 1/2-13 UNC, 4 – 16 inch are 5/8-11 UNC. All are carriage head bolts with heavy hex nuts. Fasteners provided with anti-galling protection. 316 stainless available on request.

COATINGS
Center Ring is Romacote fusion bonded epoxy, NSF 61 Certified. Center Ring can be coated to AWWA C213 upon request. End Rings are E-Coated epoxy.

12/2/2024

PRESSURE

When properly installed on a pipe that is within the outside diameter range of the Romac MACRO HP coupling, the 2 – 8 inch can be used at working pressures up to 305 psi, 10" and 12" up to 260 psi, 16" up to 260 psi for outer gasket, 200 psi for inner gasket. The LR (Low-Range) Macro can be use up to 200 psi working pressure 4"-12". The Macro can be tested up to 1.5 times working pressure.

Document # 20-1-0048

SIZES & RANGES

See Catalog.

This information is based on the best data available at the date printed above. Please check with Romac for any updates or changes.

ROMAC INDUSTRIES, INC.

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ROMAC INDUSTRIES, INC.

INSTALLATION INSTRUCTIONS

Certified to NSF/ANSI/CAN 61

Read installation instructions first before installing. Check parts to ensure that no damage has occurred during transit, the bolt guides are aligned with the axis of the pipe, and that no parts are missing. Check the diameter of the pipe and confirm you have the proper size coupling.

MACRO HP™ Sizes: 2"-16"

Two-Bolt Extended Range Couplings

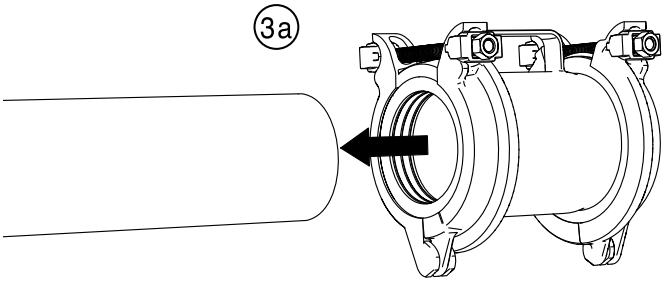
MACRO SIZES	GASKET RANGES	MACRO SIZES	GASKET RANGES
2"	INNER 2.12 - 2.55 OUTER 2.50 - 2.90	10"	INNER 10.70 - 11.30 OUTER 11.25 - 11.90
3"	INNER 3.13 - 3.63 OUTER 3.63 - 4.13	10"XL	INNER 11.00 - 11.65 OUTER 11.55 - 12.20
4"	INNER 4.40 - 5.05 OUTER 4.95 - 5.60	12"	INNER 12.70 - 13.30 OUTER 13.15 - 13.80
6"	INNER 6.60 - 7.15 OUTER 7.10 - 7.60	12"XL	INNER 13.15 - 13.80 OUTER 13.75 - 14.40
8"	INNER 8.60 - 9.20 OUTER 9.10 - 9.75	16"	INNER 17.10 - 18.19 OUTER 18.11 - 19.20

Step 1 • Clean the pipe surfaces wherever the gaskets will come in contact with the pipe, and check to see that the pipe surface is smooth (no dents, projections, gouges, etc.) where the gaskets seal against the pipe. Confirm that your pipe OD is within the range molded into the gasket. In the case the outer gasket is required, remove inner gasket.

NOTE: If inner gasket needs to be reinserted, the letter O (sizes 4"-12") or small dot (sizes 2",3" and 16") on the front face of the inner gasket must be positioned towards the outside of the coupling. In the case that both inner and outer gaskets are removed from the coupling and separated, they can be reassembled by having the small dots or the letter O on the same side of the gasket assembly.

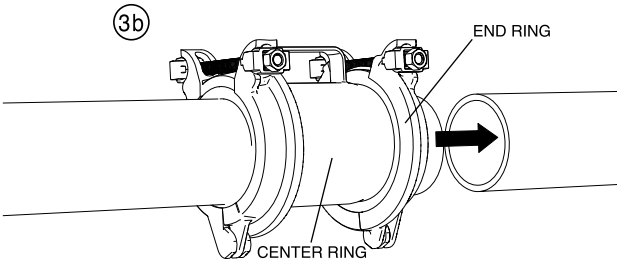
Step 2 • Lightly lubricate the pipe with thin film of suitable lubricant. Do not lubricate the gaskets.

Step 3a • With the bolts in the extended position, place the coupling onto one pipe end, bring the other pipe into position and slide coupling over the gap.



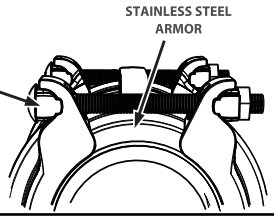
Note: Flexible Couplings do not protect against possible pullout of the pipe ends, or the coupling migrating along the pipe in unrestrained conditions.

Step 3b • Bring the other pipe into position and slide coupling over the gap. There should be a minimum of 2 inches of pipe insertion per coupling end. Confirm proper alignment between pipes and maintain the recommended gap between pipe ends (¼" - ½").



Keep stainless steel armors centered under the gap in the end rings.

Check that Bolt Guides are positioned properly before bolt tightening.



Step 5 • Tighten each bolt until the gasket contacts the pipe and the coupling is snugly held in place. This should happen at approximately 10 - 20 ft-lbs.

Step 6 • With the coupling properly located, tighten the bolts with a torque wrench to:

30 ft-lbs (2&3" size)

65 ft-lbs (4"-12", including XL sizes)

120 ft-lbs (16" size)

NOTE: For cold weather conditions (below 40 deg F), performance can be improved by warming up the coupling and gasket.

Wait 10 minutes and retighten to account for settling of the gasket.

Step 7 • Confirm proper installation by pressurizing the line and checking for leaks.

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ROMAC INDUSTRIES, INC.

INSTALLATION INSTRUCTIONS

MACRO HP™ Sizes: 2"-16"

Two-Bolt Extended Range Coupling

PRECAUTIONS

1. Check diameter of pipe to make sure the correct sized coupling and gasket range has been selected.
2. Confirm the pipe is round. The coupling may not fit or function on pipe that is too far out of round.
3. Clean pipe to remove dirt and corrosion from pipe surface. Lubrication and additional cleaning should be provided by brushing both the gasket and plain pipe end with soapy water or approved pipe lubricant per ANSI/AWWA C111/A21.11.
4. Make sure no foreign materials lodge between gasket and pipe.
5. Avoid loose fitting wrenches, or wrenches too short to achieve proper torque.
6. Keep threads free of foreign material to allow proper tightening.
7. Make sure the stainless steel armors are centered under the gap in the end rings. Check that end rings are concentric on center ring.
8. Take care to follow proper bolt tightening procedures and torque recommendations. Do not overtorque.
9. Pressure test for leaks before backfilling.
10. Backfill and compact carefully around pipe and fittings.
11. Couplings on different pipe diameters have the potential to migrate. In these instances, restraint is required.
12. Do not strike or pry on the coupling with hammers, shovels, or other equipment.
13. When reinstalling, be sure to inspect all parts for damage and apply additional lubricant to the fasteners.

COMMON INSTALLATION PROBLEMS

1. Pipe not inserted into the coupling far enough.
2. Too much pipe deflection.
3. End rings not concentric on center ring.
4. Not waiting ten minutes and retorquing to recommended torque.

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