



FIELD HYDROSTATIC TEST REPORT (C-7.a)

Project Greeley Crescent / Bost Lateral AFE/Work Order No. 5000145  
 Pipeline 4" 18" Produced Water Pipeline (Name) Bost Lateral (Location)

Testing Contractor Wood (Name) (Contract No.)

2900 F St, Greeley, Co. 80631 (Address) (Phone No.)

Construction Contractor Wood (Name) (Contract No.)

2900 F St, Greeley, Co. 80631 (Address) (Phone No.)

Pipe O.D. 8" Wall thickness 0.746 Grade 4710 MFG'R: Flexsteel

Test Fluid Fresh Water (Type) (Source) (Temperature)

Additive N/A (Type) N/A (Quantity)

Section Tested No. 0100 From: 0+00 To: 44+05 Volume: 247 BBL

Pump Location: 0+00 (kickoff) Pump No. Gal./Stroke

Deadweight Tester Location: MFG'R: MidWestern S/N

Time	Pressure PSIG	Ambient Temp.
12:00 AM	1012	37.9
12:30 AM	1011	37.5
1:00 AM	1010	37.2
1:30 AM	1009	37.2
2:00 AM	1008	37.1
2:30 AM	1007	35.3
3:00 AM	1006	35.2
3:30 AM	1005	34.7
4:00 AM	1004	33.4
4:30 AM	1003	31.5
5:00 AM	1002	30.5

Time	Pressure PSIG	Ambient Temp.
5:30 AM	1001	29.7
6:00 AM	1000	29.8
6:30 AM	1000	30.7
7:00 AM	999	30.7
7:30 AM	998	31.4
8:00 AM	997	34.1
8:15 AM	997	34.7
10:23	4	47.8

Time	Pressure PSIG	Ambient Temp.

Strokes per 10 PSIG: First 100 PSIG N/A Last 100 PSIG N/A  
 Test Started 12:00 (Time) AM/PM 3/19/19 (Date) Test Ended 8:15 (Time) AM/PM 3/19/19 (Date)

Section Accepted: Yes Section Leaking: N/A Section Ruptured: N/A

Location and Type of Failure: None  
 Remarks: After the test was complete, The test Pressure was Dropped at 10 Psi per min.

Weather: Partly Cloudy / overcast

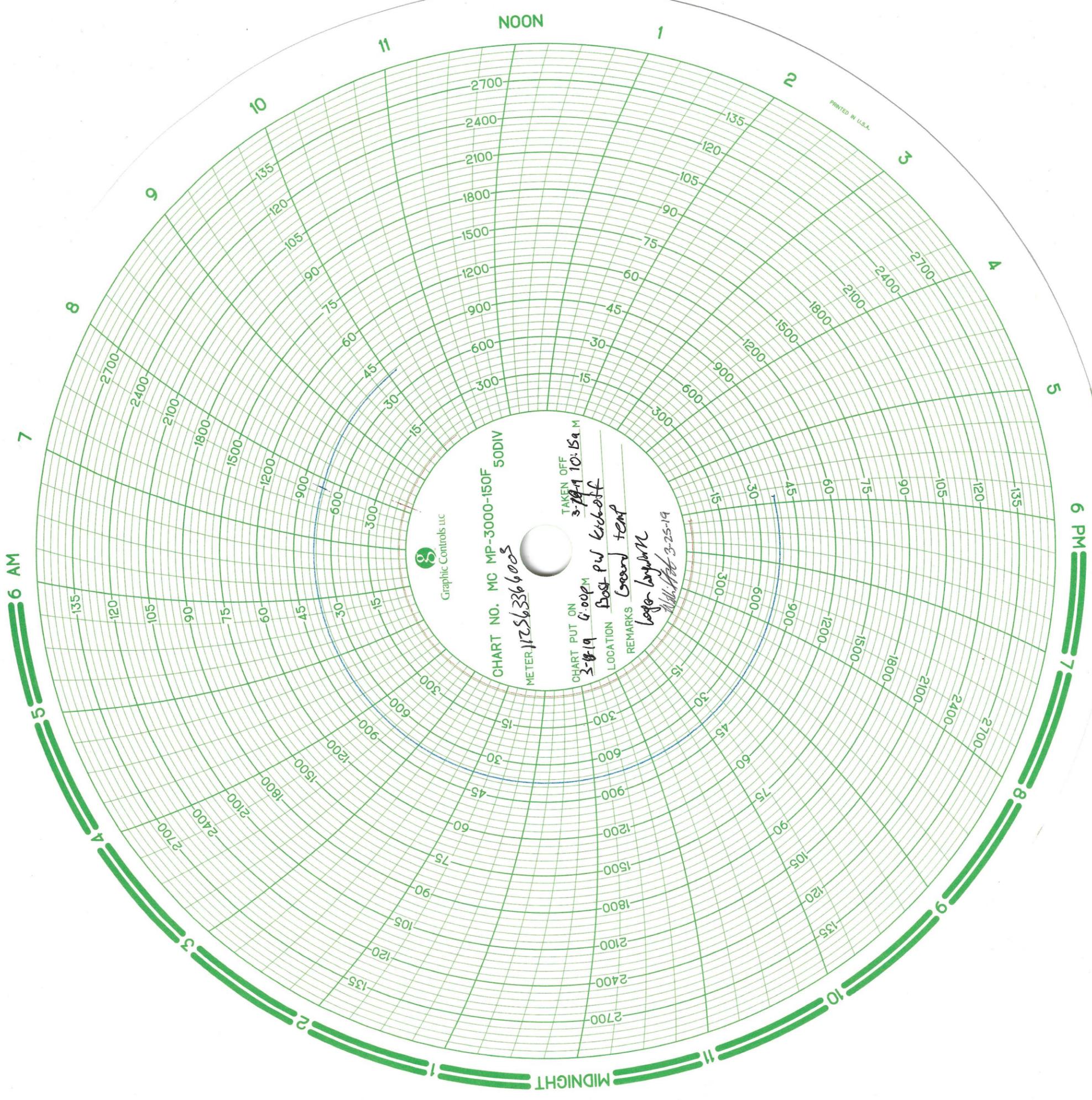
Testing Contractor's Representative Loren Langworth (Name) Test (Title) [Signature] (Signature) 3-17-19 (Date)

Constr. Contractor's Representative Tyler Work (Name) Project Manager (Title) [Signature] (Signature) 3/22/19 (Date)

Company Representative William Hartline (Name) Inspector (Title) [Signature] (Signature) 3/19/19 (Date)

Construction Superintendent Tyler Work (Name) Project Manager (Title) [Signature] (Signature) 3/22/19 (Date)





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Graphic Controls LLC

CHART NO. MC MP-3000-150F 50DIV

METER 1256336600

CHART PUT ON 3-19-19 6:00PM

LOCATION Post PW Kickoff

REMARKS Ground Temp

logo logon M  
Mili. Feb 3-25-19

TAKEN OFF 3-19-19 10:15a M



NOON

PRINTED IN U.S.A.

6 AM

6 PM

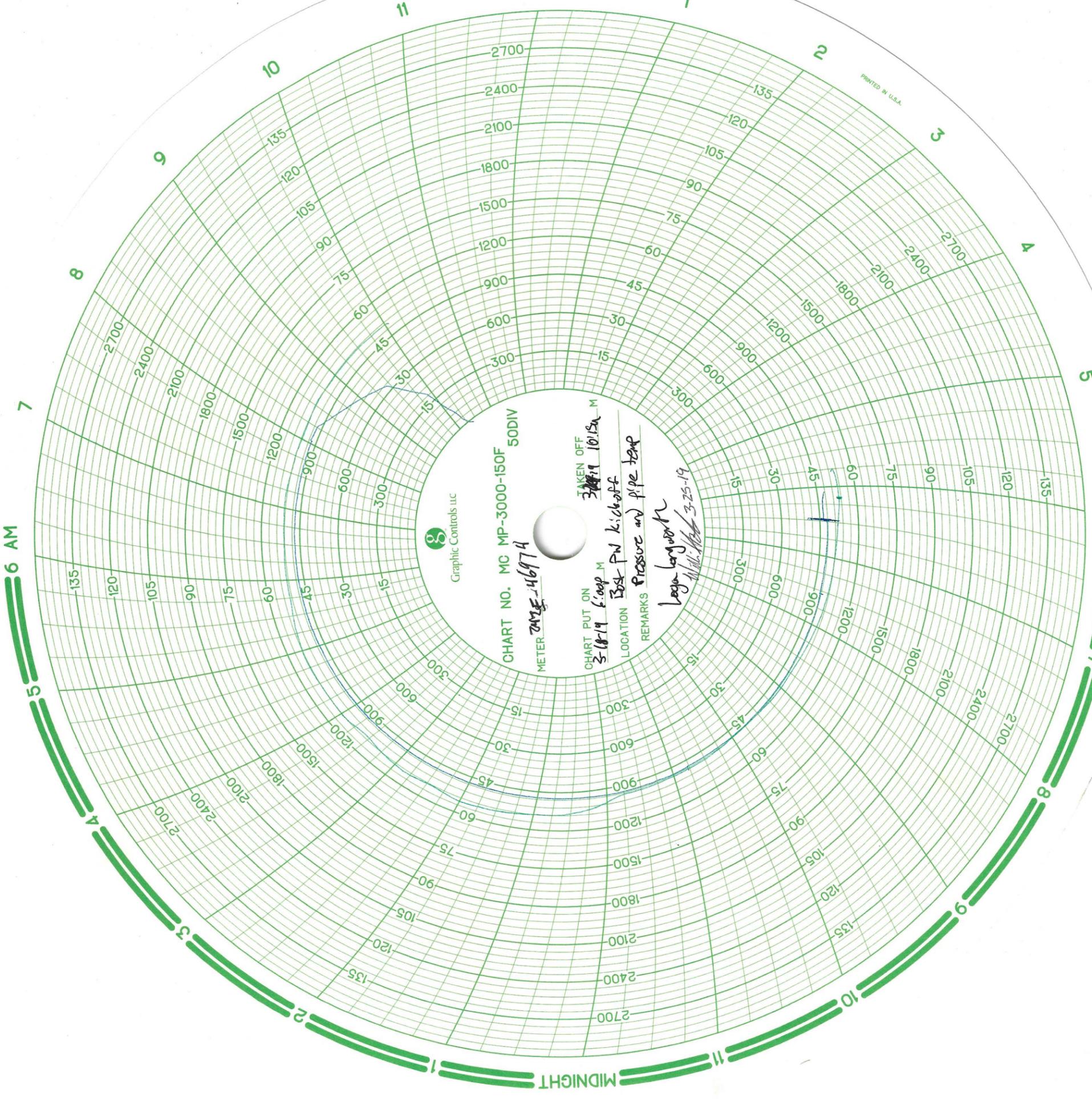


CHART NO. MC MP-3000-150F 50DIV  
 METER 46974

CHART PUT ON 3-18-19 6:00p M  
 TAKEN OFF 3-25-19 10:15a M

LOCATION Best PN k: cleoff

REMARKS Pressure and pipe temp  
loga long work  
Mill: 1000 3-25-19



Project Name / No.: <u>Best Produced water</u>		P&ID No. _____	
Test Package #: _____		_____	
System: <u>8" Produced water</u>			
Applicable Code: _____		Design Pressure: <u>740</u> PSIG	
<input checked="" type="checkbox"/> Above Ground Piping	<input checked="" type="checkbox"/> Below Ground Piping	<input type="checkbox"/> Vessel/Other _____	
Test Type: <input checked="" type="checkbox"/> Hydrostatic	<input type="checkbox"/> Pneumatic:	<input type="checkbox"/> Leak	<input type="checkbox"/> Service <input type="checkbox"/> Other _____
Test Medium: <u>Water</u>	Required Pressure: <u>1000</u> PSIG	Actual Pressure: <u>1012</u> PSIG	
Required Test Pressure Hold Time: <u>4</u> Hours <u>0</u> Minutes			
Ambient Temperature: <u>38</u> °F	Average Temperature: <u>30</u> °F		
Test Start Time: <u>12:00 am</u>	Test Finish Time: <u>8:15 am</u>	Actual Test Hold Time: <u>9</u> Hour <u>15</u> Min.	
Allowable Leakage/Pressure Drop: <u>75 PSI</u>	Actual Leakage/Pressure Drop: <u>15 PSI</u>		
Test Acceptable: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			
If Test Not Acceptable; State Why: _____			
<b>CALIBRATION DATA</b>			
Chart Recorder ID: <u>242E-46974</u>	Calibration Date: <u>2-13-19</u>	Static Range: <u>0-3000</u>	
Chart Recorder ID: <u>112563366003</u>	Calibration Date: <u>3-4-19</u>	Static Range: <u>0-3000</u>	
Pressure Gauge ID: <u>576537</u>	Calibration Date: <u>2-18-19</u>	Gauge Range: <u>0-10600</u>	
Pressure Gauge ID: _____	Calibration Date: _____	Gauge Range: _____	
Deadweight ID: _____	Calibration Date: _____	Weight Range: _____	
Lines Included: _____			
Mainline from receiver to launcher and launcher to _____			
LACT			
<b>TEST ACCEPTANCE</b>			
Test Performed By: <u>Logan Bergman</u>	Date: <u>3-18-19</u>		
Wood Superintendent: _____	Date: _____		
Client Representative: <u>William Hartline</u>	Date: <u>3-25-19</u>		
Other: _____	Date: _____		



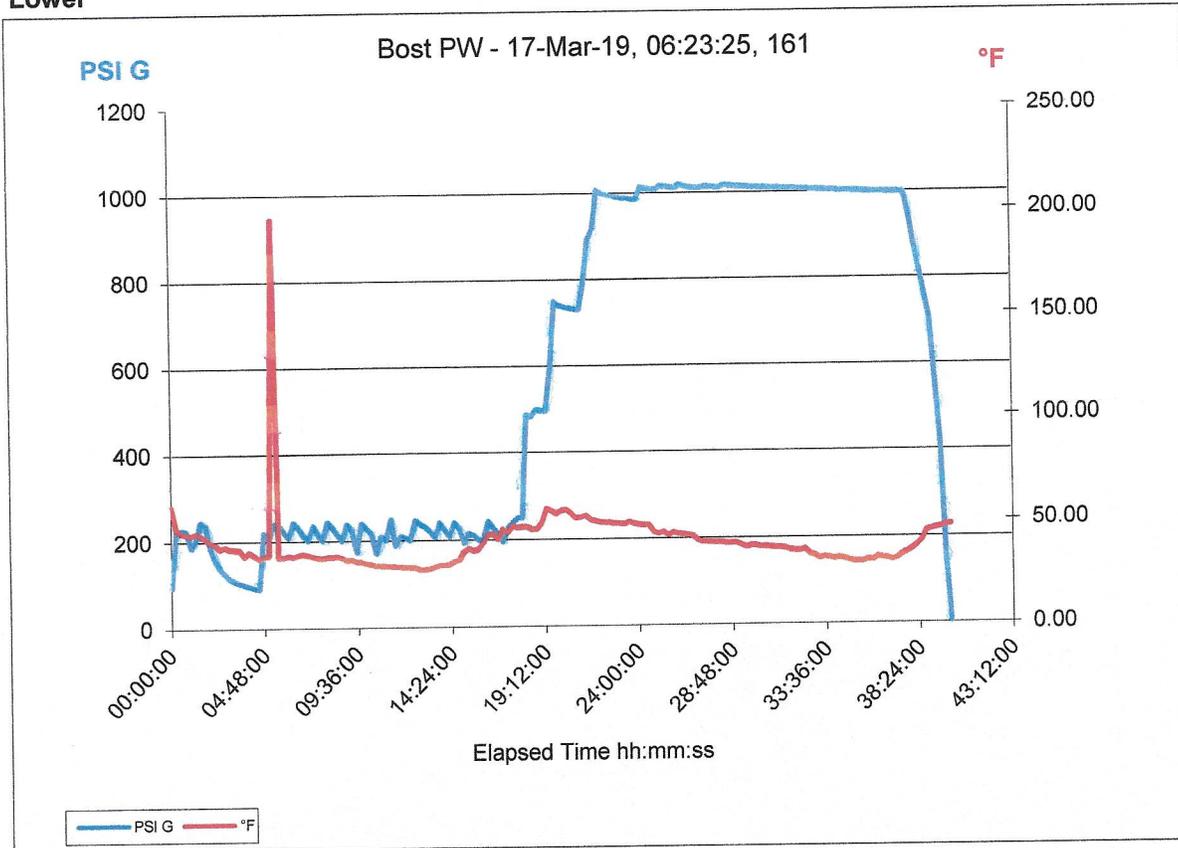


# Data Collection Report

	Chassis	Left Scale	Right Scale
Serial Number	683559	576537	687923
Datatype		Lower	Upper
Units		PSI G	°F

Lower

Upper



	Chassis	Lower Module	Upper Module	BARO Module	Left Scale	Right Scale
Serial Number	683559	576537	687923		576537	687923
Model	NV	10KPSI	RTD100			
Message Store						
Userspan		1.00000	1.00000			
Offset						
Datatype					Lower	Upper
Units		PSI G	°F		PSI G	°F
Tare						
Average						
User Factor						
User Offset						
User Resolution						
Firmware Version	R080016	R090009	R100006			
Calibration Due		18-Feb-20	19-Feb-20			
Run Index	12					
Run Start Time			17-Mar-19/18:23:25			
Run Duration			1 day 16 hours			
Run Tag			Bost PW			
Logging Interval	900.0					

Data Points				
Point #	Time	Left - PSI G	Right - °F	
1	00:00:00.0	96	58.92	
2	00:15:00.0	227	47.33	
3	00:30:00.0	228	46.06	
4	00:45:00.0	226	45.30	
5	01:00:00.0	188	44.79	
6	01:15:00.0	203	45.62	
7	01:30:00.0	246	44.96	
8	01:45:00.0	239	43.11	
9	02:00:00.0	185	41.27	
10	02:15:00.0	156	40.51	

11	02:30:00.0
12	02:45:00.0
13	03:00:00.0
14	03:15:00.0
15	03:30:00.0
16	03:45:00.0
17	04:00:00.0
18	04:15:00.0
19	04:30:00.0
20	04:45:00.0
21	05:00:00.0
22	05:15:00.0
23	05:30:00.0
24	05:45:00.0
25	06:00:00.0
26	06:15:00.0
27	06:30:00.0
28	06:45:00.0
29	07:00:00.0
30	07:15:00.0
31	07:30:00.0
32	07:45:00.0
33	08:00:00.0
34	08:15:00.0
35	08:30:00.0
36	08:45:00.0
37	09:00:00.0
38	09:15:00.0
39	09:30:00.0
40	09:45:00.0
41	10:00:00.0
42	10:15:00.0
43	10:30:00.0
44	10:45:00.0
45	11:00:00.0
46	11:15:00.0
47	11:30:00.0

138	189
105	250
110	201
116	210
126	172
138	218
101	229
98	241
94	175
91	226
220	240
205	201
241	216
205	232
220	245
91	201
94	216
98	236
101	202
105	214
110	231
116	244
126	208
138	222
101	239
98	241
94	205
91	220
220	91
205	94
241	98
205	101
220	105
241	110
205	116
220	126
241	138

38.31	29.14
39.02	29.40
38.12	29.52
37.96	29.60
37.70	29.57
34.74	30.40
36.61	30.83
35.11	31.59
33.39	31.84
34.58	32.81
35.16	32.52
35.16	33.69
35.16	34.47
35.16	34.07
35.16	34.01
35.16	33.59
35.16	33.98
35.16	33.98
35.16	34.43
35.16	34.43
35.16	35.19
35.16	35.19
35.16	35.51
35.16	35.10
35.16	34.23
35.16	34.80
35.16	34.01
35.16	34.08
35.16	196.84
35.16	34.08
35.16	34.01
35.16	34.80
35.16	34.23
35.16	35.10
35.16	35.51
35.16	35.19
35.16	34.43
35.16	33.98
35.16	33.98
35.16	33.59
35.16	33.59
35.16	34.01
35.16	34.07
35.16	34.47
35.16	33.69
35.16	32.52
35.16	32.81
35.16	31.84
35.16	31.59
35.16	30.83
35.16	30.40
35.16	29.57
35.16	29.60
35.16	29.52
35.16	29.40
35.16	29.14

48	11:45:00.0	211	29.00
49	12:00:00.0	207	28.69
50	12:15:00.0	201	28.68
51	12:30:00.0	248	28.56
52	12:45:00.0	238	27.53
53	13:00:00.0	232	27.65
54	13:15:00.0	222	27.96
55	13:30:00.0	207	28.95
56	13:45:00.0	242	29.70
57	14:00:00.0	224	29.69
58	14:15:00.0	209	30.06
59	14:30:00.0	242	31.42
60	14:45:00.0	228	32.22
61	15:00:00.0	194	35.97
62	15:15:00.0	217	37.68
63	15:30:00.0	211	36.71
64	15:45:00.0	200	37.26
65	16:00:00.0	202	40.47
66	16:15:00.0	244	44.07
67	16:30:00.0	228	44.70
68	16:45:00.0	215	41.95
69	17:00:00.0	196	46.95
70	17:15:00.0	228	45.23
71	17:30:00.0	240	48.56
72	17:45:00.0	251	47.67
73	18:00:00.0	251	47.95
74	18:15:00.0	487	47.97
75	18:30:00.0	483	46.71
76	18:45:00.0	498	46.84
77	19:00:00.0	496	49.73
78	19:15:00.0	495	56.70
79	19:30:00.0	594	55.52
80	19:45:00.0	750	54.23
81	20:00:00.0	742	55.78
82	20:15:00.0	738	56.08
83	20:30:00.0	736	54.28
84	20:45:00.0	734	52.13

85	21:00:00.0	732	52.37
86	21:15:00.0	793	53.08
87	21:30:00.0	893	51.08
88	21:45:00.0	917	50.61
89	22:00:00.0	1006	49.99
90	22:15:00.0	1000	49.66
91	22:30:00.0	996	49.66
92	22:45:00.0	994	49.14
93	23:00:00.0	991	49.11
94	23:15:00.0	989	48.92
95	23:30:00.0	988	49.90
96	23:45:00.0	986	49.04
97	24:00:00.0	985	48.62
98	24:15:00.0	1013	48.23
99	24:30:00.0	1010	48.19
100	24:45:00.0	1008	44.96
101	25:00:00.0	1007	44.06
102	25:15:00.0	1015	44.83
103	25:30:00.0	1014	43.25
104	25:45:00.0	1013	44.78
105	26:00:00.0	1011	43.94
106	26:15:00.0	1018	43.73
107	26:30:00.0	1014	43.32
108	26:45:00.0	1012	42.70
109	27:00:00.0	1011	40.84
110	27:15:00.0	1011	39.79
111	27:30:00.0	1013	39.80
112	27:45:00.0	1013	39.65
113	28:00:00.0	1012	39.48
114	28:15:00.0	1011	39.51
115	28:30:00.0	1016	39.04
116	28:45:00.0	1015	39.26
117	29:00:00.0	1014	39.22
118	29:15:00.0	1013	38.15
119	29:30:00.0	1013	37.32
120	29:45:00.0	1012	37.84
121	30:00:00.0	1011	37.86

122	30:15:00.0	1011	37.32
123	30:30:00.0	1010	37.42
124	30:45:00.0	1010	37.12
125	31:00:00.0	1009	36.80
126	31:15:00.0	1009	36.76
127	31:30:00.0	1008	36.56
128	31:45:00.0	1008	35.68
129	32:00:00.0	1007	35.50
130	32:15:00.0	1007	35.27
131	32:30:00.0	1006	36.04
132	32:45:00.0	1006	33.59
133	33:00:00.0	1005	33.04
134	33:15:00.0	1005	31.58
135	33:30:00.0	1004	32.23
136	33:45:00.0	1004	31.90
137	34:00:00.0	1003	31.27
138	34:15:00.0	1003	31.76
139	34:30:00.0	1002	31.24
140	34:45:00.0	1002	30.60
141	35:00:00.0	1002	30.00
142	35:15:00.0	1001	29.78
143	35:30:00.0	1001	29.90
144	35:45:00.0	1000	30.88
145	36:00:00.0	1000	30.56
146	36:15:00.0	999	32.11
147	36:30:00.0	999	31.56
148	36:45:00.0	999	31.24
149	37:00:00.0	998	30.56
150	37:15:00.0	998	31.26
151	37:30:00.0	998	33.19
152	37:45:00.0	997	34.20
153	38:00:00.0	945	35.62
154	38:15:00.0	878	37.24
155	38:30:00.0	818	39.75
156	38:45:00.0	762	44.39
157	39:00:00.0	709	45.27
158	39:15:00.0	558	45.81

159	39:30:00.0	416	46.25
160	39:45:00.0	155	47.15
161	40:00:00.0	4	47.55



# Calibration Certificate

7200 E. Dry Creek Rd, STE C-102, Centennial, CO 80112  
Ph. 303-804-0667 Cal.Lab@Apex-Instruments.com

**Certificate Number: 190896**

**Customer:**

Wood Group Ekholm  
Greeley, CO

**Manufacturer:** Crystal Engineering  
**Model Number:** nVision 10,000 psi  
**Serial Number:** 576537  
**Description:** Pressure Module  
**Procedure:** CI-001  
**Calibrated To:** Manufacturer's Specifications  
**Technician:** Austin Moynaux

**Calibration Date:** 2/18/2019  
**Due Date:** 2/18/2020  
**As Found:** In Tolerance  
**As Left:** As Found  
**Temperature:** 69.8 F  
**Humidity:** 18.8 %

**Tolerance Spec:**

0 to 30% of FS: +/- 0.015% of FS  
30% to 110% of FS: +/- 0.05% of Rdg

**Technician Notes:**

As Left Userspen: 1.00000

Approved Signatory:

Apex Instruments certifies that the instrument listed above meets the specifications of the manufacturer at the completion of its calibration. Standards used are traceable to the National Institute of Standards and Technology (NIST), or have been derived from accepted values, natural physical constants, or through the use of the ratio method of self-calibration techniques.

Methods used are in accordance with the procedure listed above. This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

Unless otherwise contractually specified, a binary decision rule, utilizing simple acceptance, and simple rejection criteria will be used for the determination of compliance. When compliance statements are present, they are reported without factoring in the effects of uncertainty and the limits are defined by the manufacturer's stated accuracy.

This certificate does not guarantee the continued performance of the instrument listed above. Any modifications or services performed hereafter may void this certificate.

This certificate is not to be reproduced other than in full, except with prior written approval from Apex Instruments Inc.



Description	Model Number	Serial Number	Calibration Date	Due Date	ID
Digital Multimeter, 8 1/2 Digit	3458A	2823A11060	1/4/2019	1/4/2020	APX00012
Reference Thermometer Readout / PRT	1502A / 5628-12-D	B64070 / 3526	8/29/2018	8/29/2019	APX00014
Reference Thermometer Readout / PRT	1502A / 5628-12-D	B0B641 / 3780	6/26/2018	6/26/2019	APX00015
Decade Resistor	1433-28	E1-17295164	7/27/2018	7/27/2019	APX02856
Temp / RH Datalogger	UX100-011	20369499	8/28/2018	8/28/2019	APX04795

**Checked against NIST traceable Standard Reference Material**

Measure Resistance	Standard	Measured	Offset	Uncertainty	Pass
5 Ohms	5.00 Ω	5.00 Ω	0.02 Ω	0.00 Ω	Pass
100 Ohms	100.00 Ω	100.00 Ω	0.03 Ω	0.00 Ω	Pass
200 Ohms	200.00 Ω	200.00 Ω	0.04 Ω	0.00 Ω	Pass
300 Ohms	300.00 Ω	300.00 Ω	0.06 Ω	0.00 Ω	Pass
400 Ohms	400.00 Ω	400.01 Ω	0.08 Ω	0.01 Ω	Pass

**RTD Probe Verification**

Class B / 3-Wire / PT100, 0.005Ω

Serial Number	32 F	250 F	Offset	Uncertainty	Pass					
687923-1	32.06 °F	250.08 °F	32.22 °F	250.55 °F	0.56 °F	1.64 °F	0.16 °F	0.47 °F	Pass	Pass

-- End of measurement results --



# PSS-COMPANIES



9700 E. 104<sup>TH</sup> AVE, UNIT F- HENDERSON, CO 80640 - Phone (303)857-7986 - Fax (303)389-4945

## CALIBRATION CERTIFICATE

CERTIFICATE NUMBER: CO

Details +/-: 1.0% ACCURACY

DATE CALIBRATED: 03/04/2019  
DUE DATE: 03/04/2020

INDICATED TEMPERATURE RANGE: # 0 - 150°F  
INDICATED PRESSURE RANGE: #0 - 3000 PSI  
SERIAL NO: 11256368003 ID NO: 006980  
MANUFACTURER: BARTON/ 12" RECORDER

TYPE OF INSTRUMENT CALIBRATED: TEMPERATURE / PRESSURE RECORDER

INSTRUMENT FINDINGS/STATUS: UNIT IS IN TOLERANCE/ INSTRUMENT MEETS OR EXCEEDS SPECIFICATIONS.

BASED ON INTERNATIONAL STANDARDS OF GRAVITY: (980.665 cm./sq.).

TYPE OF STANDARD USED TO CALIBRATE: REFINERY DEADWEIGHT TEST UNIT SPT.  
(35225-3) SERIAL No. 5268: KESSLER TEST THERMOMETERS: SERIAL NO. CALIBRATION

ALL STANDARD DIRECTLY TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO: (N.I.S.T.) 2.6/172490 & 6.6/139577.

CALCULATED USING MASS VALUES, AREA, AO, AND STATED GRAVITY.  
ROOM TEMPERATURE/HUMIDITY (AT TIME OF TEST): 66°F / 25%.

CALIBRATED BY: NICK BEDFORD

A handwritten signature in red ink, appearing to read 'NICK BEDFORD', written over a horizontal line.

# PSS-COMPANIES



9700 E. 104<sup>TH</sup> AVE, UNIT F- HENDERSON, CO 80640 - Phone (303)857-7986 - Fax (303)389-4945

## CALIBRATION CERTIFICATE

CERTIFICATE NUMBER: CO

Details +/-: 1.0% ACCURACY

DATE CALIBRATED: 09/19/2018  
DUE DATE: 09/19/2019

INDICATED TEMPERATURE RANGE: # 0 - 150°F  
INDICATED PRESSURE RANGE: #0 - 3000 PSI  
SERIAL NO: 242E-46974  
MANUFACTURER: BARTON/ 12" RECORDER

TYPE OF INSTRUMENT CALIBRATED: TEMPERATURE / PRESSURE RECORDER

INSTRUMENT FINDINGS/STATUS: UNIT IS IN TOLERANCE/ INSTRUMENT MEETS OR EXCEEDS SPECIFICATIONS.

BASED ON INTERNATIONAL STANDARDS OF GRAVITY: (980.665 cm./sq.).

TYPE OF STANDARD USED TO CALIBRATE: REFINERY DEADWEIGHT TEST UNIT SPT. (35225-3) SERIAL No. 5268; KESSLER TEST THERMOMETERS; SERIAL NO, CALIBRATION

ALL STANDARD DIRECTLY TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO: (N.I.S.T.) 2.6/172490 & 6.6/139577.

CALCULATED USING MASS VALUES, AREA, AO, AND STATED GRAVITY.  
ROOM TEMPERATURE/HUMIDITY (AT TIME OF TEST): 66°F / 25%.

CALIBRATED BY: NICK BEDFORD

A handwritten signature in black ink, appearing to read 'Nick Bedford', written over a horizontal line.

SIGNATURE

# Cross Country Pipeline Supply L.O. Inc

Sales and Service

2251 Rifle Street - Aurora, Colorado 80011

Phone 303.361.6797 Fax 303.361.6836

## NIST CALIBRATION DATA

Model Number	Serial Number	Customer	Range	Accuracy
Barton	242E-46974	WOOD	3000# - 150F	1/2%
<b>Work Performed:</b>		<b>Calibration:</b>	<b>Results:</b>	
		Output/Reading	Pressure	
<b>Calibrate to Mfg. Spec.</b>		0 PSI	0 PSI	
		600 PSI	600 PSI	
		1200 PSI	1200 PSI	
		1800 PSI	1800 PSI	
		2400 PSI	2400 PSI	
		3000 PSI	3000 PSI	
		33 Deg	33 DEG	
		56 DEG	56 DEG	
		115 DEG	115 DEG	
		147 DEG	147 DEG	
<b>PO Number</b>		<b>Sales Order Number</b>	<b>Date of Test</b>	
Recalibrated		Recerted	2/13/2019 5:26:30 PM	

**Remarks: ALL CALIBRATIONS ARE GOOD FOR ONE YEAR FROM DATE OF TEST**

### Standard Used:

Manufacturer	Model	Instrument	Calibration Date	Certification #
Perma-Cal	101FTM15B21	Pressure Gauge	08/08/2018	17-043
Tech Instrumentation	TM99A	Thermometer	08/18/2018	59448

Signature *Don L. Leib* 2-13-19

	Hydrostatic Pressure Test Procedure Bost Lateral – 4” and 8” PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	



Greeley Crescent II - Gathering System

Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline (CL 300)

Hydrostatic Pressure Test Procedure



1	03/07/2019	DMT	Issued for Implementation – Added 4” Section	DAN	
0	12/20/2018	DMT	Issued for Implementation	DAN	
REV	DATE	BY	DESCRIPTION	CHKD	APPVD
			Noble Midstream Partners, LLC		
			Hydrostatic Pressure Test Procedure		
			Doc. No. N/A		

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## 1 EXECUTIVE SUMMARY

This procedure and the accompanying site-specific Hydrostatic Test Plan define the minimum requirements for the hydrostatic pressure testing of the **Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline**. The piping and components to be tested using this procedure meet or exceed the pressure requirements of the ASME Class 300 flange rating for Type 2.2 materials between -20 °F and 100 °F.

The hydrostatic pressure test has been analyzed for acceptable practices per applicable codes.

## 2 PRE-TEST CONSIDERATIONS

The pressure test shall comply with American Petroleum Institute’s “Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide.” (*API RP 1110*) Chapter 6 of API’s handbook provides general guidelines for pressure test implementation of steel pipe. In addition, testing will be in accordance with *ASME B31.4*, *ASME B16.5*, *49 CFR Part 195*, and the *FlexSteel Technical Manual*.

### 2.1 TEST PRESSURE

The **Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline** shall be tested at a minimum test pressure of **940 PSIG** (125% the internal pressure rating) and a maximum test pressure of **1,100 PSIG** (150% the internal design pressure rounded to the next highest 25 psig increment). The upper and lower bounds of the test pressures are derived from *ASME B16.5* and *ASME B31.4 / 49 CFR Part 195* respectively.

The **Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline** internal design pressure is **720 PSIG**, limited by the stainless steel flange rating.

The **Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline** final hydrostatic test pressure shall be either **1,000 PSIG** or **990 PSIG**, at the point of filling, depending on where the operator chooses to fill the pipeline. See the table in **Section 3.4** for the two possible locations.

**Table 1: Upper and Lower Bound Test Pressures**

SIZE & ASME Flange Class	Pipeline Wall Thickness (in)	Design Pressure – DP (psig)	Pipe Pressure Rating – PR (psig)	Minimum Test Pressure 125% PR (psig)	Maximum Test Pressure 150% DP (psig)
4” - 300	0.4535	720	750	940	1,100
8” - 300	0.746	720	750	940	1,100

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## 2.2 TEST DURATION

The hydrostatic test pressure shall be maintained for **8 hours** after final test pressure has stabilized, and the pipe has been conditioned properly in the field. With pipe conditioning, accounted for, the test commonly takes **16 – 20 hours**. This is dependent, however on how well the pipe responds to the conditioning procedure (**times up to 24 hours may be required**).

The test pressure shall be considered stabilized after **5 minutes** without fluctuation.

## 2.3 SAFETY PRECAUTIONS

This safety information is in addition to the safety information in other sections of this document.

Always take precautions to eliminate hazards to persons near lines being tested. For the entire duration of the procedure, including filling, initial pressurization, time at test pressure, and depressurization, only persons conducting the test or inspecting the system should be allowed near the section under test. These persons should be fully informed of the hazards of field pressure testing. All other persons should be kept a safe distance away. The test section must be supervised at all times. Failure may result in sudden, violent, uncontrolled, and dangerous movement of system piping, or components, or parts of components.

## 2.4 TEST EQUIPMENT AND MATERIALS

Pressure test equipment shall be selected to meet the hydrostatic test conditions and shall be in working order. The measurement equipment shall be designed for the pressures expected during the pressure test.

### 2.4.1 FILL PUMP

The pump used to fill the line shall be a high-volume pump which provides adequate pressure to overcome static head and maintains sufficient velocity to move pigs, spheres, and any debris in the pipeline.

The fill pump or associated discharge piping shall be equipped with a flow measurement device capable of maintaining a specified fill rate.

### 2.4.2 SUPPLY WATER FILTER

The pump discharge piping shall be equipped with an in-line filter capable of capturing debris greater than **1 mm**.

### 2.4.3 PRESSURIZATION PUMP

The pressurization pump shall be a variable speed, positive displacement pump that pressurizes the line to the specified test pressure. The pump shall have a known volume per stroke and shall be equipped with a stroke counter.

A constant-speed pump with a variable flowrate control may be used in lieu of the above pump if the liquid test medium injected into the pipeline is measured during pressurization.

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2.4.4 CALIBRATION DEVICES

2.4.4.1 Pressure Calibration Device

A deadweight tester or an equivalent pressure sensing device that is capable of measuring in increments of less than or equal to one (1) psig shall be used. The device shall have a certificate of calibration that is not more than one year old at the start of testing.

2.4.4.2 Temperature Calibration Device

A certified thermometer shall be provided. The device shall have a certificate of calibration that is not more than one year old at the start of testing.

2.4.5 RECORDING DEVICES

2.4.5.1 Pressure Recording

This procedure refers to the recording device used during the test duration as a chart recorder. A digital recorder may be used in lieu of the more traditional chart recorder.

Pressure recording equipment shall be provided and qualified as follows:

- A continuous-recording pressure measurement device that provides a permanent record of pressure versus time. This device should be calibrated immediately before each use with the deadweight tester.
- Electronic pressure/temperature monitoring and recording systems that assist in the analysis of test data. Such systems can be used in lieu of the components listed above provided that the individual pressure sensors included in the systems have a level of sensitivity and can be field calibrated in a manner similar to those instruments listed above.

2.4.5.2 Temperature Recording

Temperature recording equipment shall be provided and qualified as follows:

- A test medium temperature sensing and display instrument that is properly calibrated to a range suitable for anticipated test temperatures. Temperature instrument accuracy should be within 1 °F of actual temperature. Temperature instrument sensitivity should be within 0.1 °F.
- A continuous-recording temperature measurement device that provides a permanent record of test medium temperature versus time. This device should be calibrated immediately before each use with a certified thermometer.
- An ambient temperature sensing and display instrument that is properly calibrated to a range suitable for anticipated ambient temperatures. Temperature instrument accuracy should be within 1 °F of actual temperature. Temperature instrument sensitivity should be within 0.1 °F.
- A continuous-recording temperature measurement device that provides a permanent record of ambient temperature versus time. This device should be calibrated immediately before each use with a certified thermometer.

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#### 2.4.6 SAFETY RELIEF VALVE

The hydrostatic test fill pump and pressurization pump or associated discharge piping shall be equipped with a pressure relief valve. The pressure relief valve shall be set to relieve at **1,100 PSIG**, maximum test pressure.

#### 2.5 QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL

Qualifications of contractor and operator personnel for conducting pressure tests will be based on certification requirements by *49 CFR Part 195*, Code, or Noble standards and procedures.

Noble personnel and contractors involved with designing, planning, conducting, or approval of a pressure test should be qualified by both training and experience. Noble is responsible for establishing these qualifications. The following factors to determine qualifications are recommended per *API RP 1110*:

- Performance of applicable calculations and interpretation of test data and results.
- Knowledge of code requirements and regulations.
- Qualification requirements of governing authority to conduct or witness testing.
- Governmental or operator requirements to certify test results.
- Familiarity with equipment and pressure test set-up.
- Familiarity with test procedures.

#### 2.6 PERMIT TO WORK

Prior to commencing work, work permits shall be obtained. At a minimum, the below documents shall be submitted:

- Operator Qualification records for each person performing tasks.
- Test equipment certifications.
- Water source.
- Biocide injection plan. (If Applicable)
- Biocide Safety Data Sheets (SDS). (If Applicable)
- Leak monitoring plan.
- Depressurization plan.
- Water disposal plan.
- Drying plan (If Applicable).

### 3 TEST PROCEDURE

As part of the work permit, a hydrostatic test plan for each section of pipe shall be developed and submitted to the appointed Noble representative prior to commencing work. The test plan shall, at a minimum, address the requirements specified in this procedure.

#### 3.1 SOURCE WATER

The quality and source of the test water shall be determined prior to the permitting process.

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Non-potable water shall be treated with biocide prior to entering the pipeline. The SDS sheets and injection rate for the Biocide shall be submitted and approved by a Noble representative prior to work permit issuance. **Note: Biocide treatment may not always be required.**

Water shall be filtered prior to entering the pipeline. The maximum allowable particle size is **1 mm.**

### 3.2 EQUIPMENT INSTALLATION

If possible, excavated segments shall be backfilled prior to the initial pressurization.

Temporary piping shall be properly anchored and adequately secured from movement. Pipe couplings shall have safety devices or restraints to limit movement due to unexpected piping separation.

A flow meter shall be placed in the line to monitor and maintain the planned design rate of fill.

The sensor on each temperature recording device shall be installed so that it is in contact with the pipeline at a point where it has normal cover. Additionally, it shall be at a distance far enough from the injection point so that the effects of the exposed piping and make-up injection(s) on temperature is minimized. The backfill around the temperature recording device sensor shall be tamped.

Insulation, if appropriate, shall be used on the capillary lines to the temperature recorder and the temperature recorder should be installed in an insulated box. Large centrifugal pumps and storage tanks will affect the temperature of the test medium.

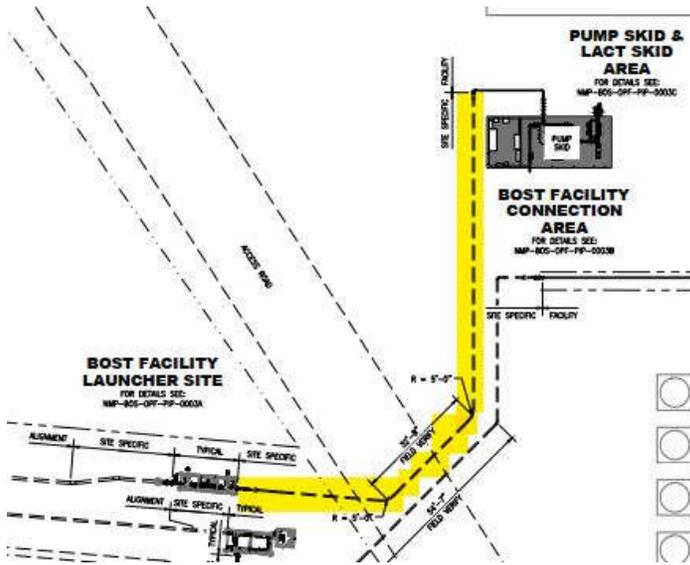
NOTE: According to the *FlexSteel Commissioning Field Notes*, FlexSteel recommends that the vent valves on all end fittings be removed during the hydrostatic test and replaced thereafter.

### 3.3 LINE FILL

Calculated line fill water volume: **247 US Oil Barrels (2 bbl for the 4” section and 245 bbl for 8” section)**

The 4” section of piping is located at the Facility and Launcher Site between the pump skid and launcher and is pictured below.

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**Figure 1: 4” FlexSteel Pipeline Section**

All temporary piping and test heads shall be adequately secured before the line fill process is started.

If pigs or spheres are used in the filling process, they shall be equipped with trackers for monitoring location and speed during the line fill process.

NOTE: Only polyurethane pigs are allowed to be used with FlexSteel. (*FlexSteel Commissioning Field Notes*)

The fill pump shall be sized for the pigs to travel at a speed that will maintain a seal with the pipeline. This will reduce the risk of introducing air behind the pigs. A travel speed of 2 – 3 mph shall be maintained. The line fill flow rate for the **Bost Lateral – 8” FlexSteel Produced Water Pipeline** must be **420 – 630 GPM (10 – 15 BPM)** in order to maintain the pig velocity in the 2 – 3 mph range.

High velocities may cause excessive wearing of the pigs and may cause the displaced air to mix with the test medium. As pigs travel down the line and down a slope, unless backpressure is applied during the line fill, the weight of the column of fluid could cause the pig to travel faster than the specified speed and introduce air behind the pig.

Air shall be bled during the filling process to minimize the time for line pressure stabilization. The total amount of residual air shall be less than 0.2% of the volume of the test section.

If it is determined that air is trapped in the pipeline, vents or traps at high elevation points may be installed in order to bleed the air from the pipeline. Any equipment added to the pipeline shall be removed after the pipeline has been dewatered.

The temperature, pressure, and flow rate of the test medium during line fill shall be recorded. All applicable conditions shall be monitored to prevent over-pressurization during line fill.

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### 3.4 INITIAL PRESSURIZATION

A pipe maintained at high pressure is potentially dangerous. Established safety guidelines in accordance with the work permit shall be followed at all times.

The amount of water required to increase the pressure from the initial fill to the final test pressure shall be calculated prior to the pressure test and made available to test personnel.

The initial pressurization of the segment of pipe to be tested begins once the segment is full of fluid and the appropriate measures have been taken to bleed all air.

Personnel conducting the test shall maintain continuous surveillance over the operation to ensure that it is carefully controlled. Test personnel should be located at a safe distance from the test section.

Pipe connections shall be periodically checked for leaks during the pressurization process.

The flowrate shall be monitored and logged for the preparation of a pressure-volume plot.

A pressure-volume plot shall be initiated at the start of the pressurization process and continue until the test pressure is reached. The lower end of the pressure-volume plot can be used to determine the total amount of residual air in the test section. The upper end of the pressure-volume plot can be used to determine if any pipe in the test segment may have reached its elastic limit.

The **Bost Lateral – 4” and 8” FlexSteel Produced Water Pipeline** is **150 feet of 4.576” OD 0.4535” w.t.** FlexSteel pipe and **4,325 feet of 9.117” OD 0.746” w.t.** FlexSteel pipe. It will be pressurized to either of the following hydrostatic test pressures at the corresponding location:

<b>DSU 24/27 Tie-In Site (0+00.00)</b>	<b>1,000 psig</b>
<b>DSU 21 Launcher Site (43+25.00)</b>	<b>990 psig</b>

Pressurization up to 25% of the final test pressure shall occur at a rate of **10 PSIG/MIN**.

Once 25% of the final test pressure is reached, the pressure must be allowed to stabilize for a minimum of **15 minutes**. The pressure shall be considered stabilized after **5 minutes** without fluctuation.

This process should be repeated for pressurizing the pipe to 50% of the final test pressure. Once the pressure has stabilized for **15 minutes**, the pipe should be pressurized to 75% of the final test pressure at a rate of **10 PSIG/MIN**. Now, the pressure should be allowed to stabilize for 1 hour.

After the pressure has stabilized to 75% of the final test pressure, pressurization at a rate of **5 PSIG/MIN** shall be used to complete the pressurization process up to the final test pressure. The final test pressure shall be considered stabilized after **5 minutes** without fluctuation.

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When the final test pressure is reached and has stabilized, pressurization shall cease, the pipe blocked in, and all valves and connections to the line shall be inspected for leakage.

### 3.5 PIPE CONDITIONING

FlexSteel must be conditioned prior to commencing a “hold” or test period. This is for the purpose of allowing the polymer liner in the FlexSteel to creep to bed into the tensile elements in the FlexSteel. *(FlexSteel Technical Manual)*

After the test pressure has stabilized in the Initial Pressurization phase, the pipe should be blocked in. Then, the pressure drop in the pipe should be monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. After that, the pipe should be re-pressurized to the test pressure, blocked in, and have its pressure monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. *(FlexSteel Technical Manual)*

The two recorded pressure drops should be compared. If the rate of pressure drop is smaller for the second run, the pipe is conditioning and not leaking. *(FlexSteel Technical Manual)*

However, if the pressure drop rate does not decrease, there is a possibility that leak exists in the pressure boundary system. These leaks are usually in the test equipment or flanges rather than the pipe. If this occurs, testing should continue for two (2) additional cycles to verify that the pressure drop rate is still not changing. If the pressure drop rate remains constant, or increases, the test fittings and flange connections should be checked for leakage. Following this, if there is still no decline in the rate of pressure drop, the pipe is leaking. A leak in the pipe is rare, and if it occurs, it could result from a faulty end fitting or end fitting installation. Thus, the end fittings should be carefully inspected and/or replaced to determine if the leak occurred at an end fitting. *(FlexSteel Technical Manual)*

If the rate of pressure drop did decrease without any issues, the cycle of pressurizing to the test pressure, blocking the pipe in, and monitoring and recording the test pressure for an hour should continue a few more times to get more data and demonstrate that the rate of pressure drop is decreasing with each cycle. If an issue arises, then the steps mentioned above to determine if a leak is present should be followed.

Otherwise, the anticipated 24-hour test pressure drop shall be calculated. That is, in a hypothetical 24-hour test, the anticipated pressure drop shall be calculated assuming the most recent pressure drop rate is maintained. If the predicted pressure is less than the Lower-Bound Test pressure (see the Site-Specific Hydrostatic Test Plan), then more conditioning cycles are needed. After each cycle, the predicted pressure drop shall be calculated for a 24-hour test to see if the pressure will always stay above the Lower-Bound Test Pressure. Once this has been confirmed, the pipe has been properly conditioned. The pipe should be re-pressurized to the test pressure, blocked in, and The Test Period shall start. *(FlexSteel Technical Manual)*

NOTE: The conditioning process can take several hours (8 – 12). It may be the case that the pipe needs to be pressurized up to the final test pressure a few times to finalize the conditioning before being blocked in and starting the test period. Also, it is recommended that all personnel be at least 50 feet away from the pipe during the pressure test. *(FlexSteel Commissioning Field Notes)*

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Conditioning may occur during the evening and/or in cold weather situations and precautions must be taken to eliminate the possibility of freezing in the appurtenances, such precautions may include the use of thermal blankets and heaters.

3.6 THE TEST PERIOD

The Test Period shall begin after the temperature of the test medium, pipe temperature, and ground temperature have stabilized. When this stabilization process is complete, the pressurization pump should be isolated from the test section.

After inspecting for leakage, test personnel shall verify that the specified test pressure is being maintained.

Pressure and temperature shall be continuously monitored during the test. Data shall be recorded every half hour throughout the duration of the test.

The maximum allowable range of pressure fluctuation during the pressure test is defined by the “**Upper Bound Test Pressure**” and “**Lower Bound Test Pressure**” as shown in the **site-specific Hydrostatic Test Plan**, which is supplemental to this Hydrostatic Test Procedure. Any pressure excursions outside of these limits shall be reported to the Noble representative for further analysis.

Weather changes, such as the development of rain or clouds, which could affect the pressure and temperature of the pipe and test medium shall be documented on the test log.

The volume of any added or subtracted test medium shall be documented on the test log as well as its temperature and pressure at that time and be accounted for in the assessment of the results of the pressure test. For any pressure test of piping that cannot be 100% visually checked for leaks, it is mandatory that the volume of any test medium added or removed be accounted for to determine if the pressure test has been completed without evidence of leakage.

3.7 SEARCHING FOR LEAKS

Prior to commencing work, the method(s) for locating leaks or failures shall be approved by the Noble representative. The operator may choose to fly, drive and/or walk the pipeline right-of-way to visually check for evidence of leaks during the pressure test. The operator should develop contingency plans for locating large and small leaks in areas of difficult terrain or in the event of inclement weather.

Acceptable methods for finding leaks during a pressure test are listed as follows:

- Sectioning or segmenting the pipeline and monitoring the pressure of each section. Closing mainline block valves will isolate the pipeline into smaller segments. Freeze plugs may also be used to isolate sections of the pipeline for evaluation.
- Acoustical monitoring equipment may be employed to narrow the search area.
- Odorants or tracers introduced into the test medium during the filling process will allow the operator to detect leaks with sensing equipment.

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### 3.8 PRESSURE TEST FAILURES

All leaks and test failures shall be reported to the Noble representative immediately.

Any pipeline leaks or failures shall be documented in the test report.

If a rupture or a substantial leak occurs, the test shall be stopped and the pipeline depressurized. The cause of failure shall be understood, test procedures shall be reevaluated, and approval from the Noble representative shall be obtained before proceeding with repairs and starting a new hydrostatic test.

Pipe, valves, fittings, and test components that fail during a pressure test shall be investigated to determine the cause of failure and to minimize the possibility of a recurrence.

Pipe or other failed components shall be preserved for further examination and failure analysis.

If a small leak occurs, the pressure should be reduced to 80% of the final test pressure while locating the leak. After repairs are completed and authorization from the Noble representative has been obtained, the test can be restarted per the initial pressurization steps above.

Pressure excursions outside of the **Maximum and Minimum Test Pressures** as defined in **Section 2.1** of this procedure are considered test failures.

### 3.9 DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF TEST WATER

Prior to commencing work, a depressurization, displacement, and disposal plan shall be submitted to and approved by the Noble representative.

Depressurization activities shall not commence without authorization from the Noble representative. Once authorization is received, depressurization should commence at a rate of **10 PSIG/MIN** in increments of 25% of the final test pressure. The pressure should be allowed to stabilize for **15 minutes** between increments.

Displacement and disposal activities shall not commence prior to Noble engineering acceptance of the hydrostatic test results.

A disposal plan for the test medium must be developed and the Noble representative shall review and approve the disposal plan.

Pigs or spheres used in the dewatering process shall be equipped with trackers for monitoring location and speed during the dewatering process.

The travel speed for the dewatering pigs shall be maintained at **2 – 3 MPH**.

### 3.10 DRYING OPERATIONS

If the pipeline will not be placed into service within seven (7) days of dewatering, drying operations are required.

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Prior to commencing work, a drying plan shall be submitted to and approved by the Noble representative.

Upon completion of drying, a **50 PSIG** nitrogen blanket shall be maintained on the pipeline until commissioning.

#### 4 RECORDS

After the hydrostatic test has been completed, the following records shall be submitted as part of the Final Test Report, **which must be reviewed and accepted by an authorized Noble representative**. These records must be retained as long as the pipeline is in use.

- Pressure / Volume Plot
- Pressure Recording Chart / Plot
- Calibration Records
  - Deadweight Tester
  - Chart Recorder
  - Temperature Recorders
  - Certified Thermometer
- 49 CFR Part 195 Operator Qualifications
  - Operator
  - Person responsible for making the test
  - Test company used, if any
- Hydrostatic Test Log, including:
  - Date and time of the test
  - Minimum test pressure
  - Test medium
  - Description of the pipeline tested and the test apparatus
- Leak Reports
- Failure Reports
- Site-specific hydrostatic test plan including:
  - Elevation profile of the pipeline
  - Locations of test sites over the entire length of the pipeline
- Temperature Chart / Plot

#### 5 REFERENCES

- 1) API RP1110 “Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide”
- 2) ASME B31.4 “Pipeline Transportation Systems for Liquids and Slurries”
- 3) ASME B16.5 “Pipe Flanges and Flanged Fittings”
- 4) 49 CFR Part 195 “Transportation of Hazardous Liquids by Pipeline”
- 5) “FlexSteel Technical Manual”
- 6) “FlexSteel Commissioning Field Notes”
- 7) Site Specific Hydrostatic Test Plan

# GCS II Phase 2 - Bost Lateral - 8" & 4" Flexsteel Produced Water Pipeline Hydrostatic Pressure Test Plan

