



Pipeline Pressure Test Documentation

Pressure Test Report

Form :

Revision
3

Revision Date

Project Name : **DSU 210 6" PW**

A/E No. : **5000401**

Contractor / Testing Company : **Northwinds**

Technician : **Phil**

Test Section No. : **0**

From Station No. : **0+00**

Test Description: **6938' of 6" Flexsteel**

To Station No. : **69+38**

Test Type : **Subpart E Test**

Start of Test Period :

Date : **11-7-19**

Time : **1:00 Am**

Min. Test Duration : **8 hour**

End of Test Period :

Date : **11-7-19**

Time : **5:15 Pm**

Class Location : **Not Applicable (Liquids)**

Low Strength Pipe : **O.D. : 6.665**

W.T. :

SMYS :

Grade : **Flexsteel**

Station Piping : **Yes**

Test Medium : **water**

Source of Medium :

N/A

Corrosion Inhibitor : **No**

Inhibitor Type :

N/A

Rate :

N/A

Leak Detection : **No**

Material Type :

N/A

Rate :

N/A

Deadweight Tester : Mfg: **Crystal Engineering**

Serial #: **352036**

Calibration Date : **6-14-19**

Deadweight Tester Location : Station No. (ESN) : **0+00**

Elevation (ft) :

Pressure Recorder : Mfg: **Barton**

Serial #: **265A-3511**

Calibration Date : **6-19-19**

Pipe Temp. Recorder : Mfg: **Barton**

Serial #: **242E-41513**

Calibration Date : **11-6-19**

Target Test Pressure Range

Pre-approved Target Test Pressure : **984** psig

Maximum Test Pressure : **1009** psig

Max Elevation Change: **100**

Minimum Test Pressure : **959** psig

Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
11-7-19 1:00 Am	0	42	28	Dark, Foggy	OK	
1:15	0	82	28	no wind		Build to 25% = 246
1:15	245	82	28			Hold 15 minutes
1:30	243	81	28		OK	Build to 50% = 492
1:45	493	80	28			Hold 15 minutes
2:00	492	80	28		OK	Build to 75% = 746
2:15	737	79	28			Hold 15 minutes
2:30	728	77	28		OK	Build to 100% = 984
2:45	984	75	28			Hold
3:00	965	74	28			
3:15	956	74	28			
3:30	951	73	28			
3:35	950	73	28		OK	Build to 984
3:40	984	73	28			
3:45	982	73	28			
4:00	975	72	28			
4:15	969	72	28			
4:30	964	72	28		OK	Build to 984
4:35	984	72	28			
4:45	979	72	28			
5:00	975	72	28			
5:15	972	72	28			

Project Name :

D64 210 PW

AFE No. :

5000461

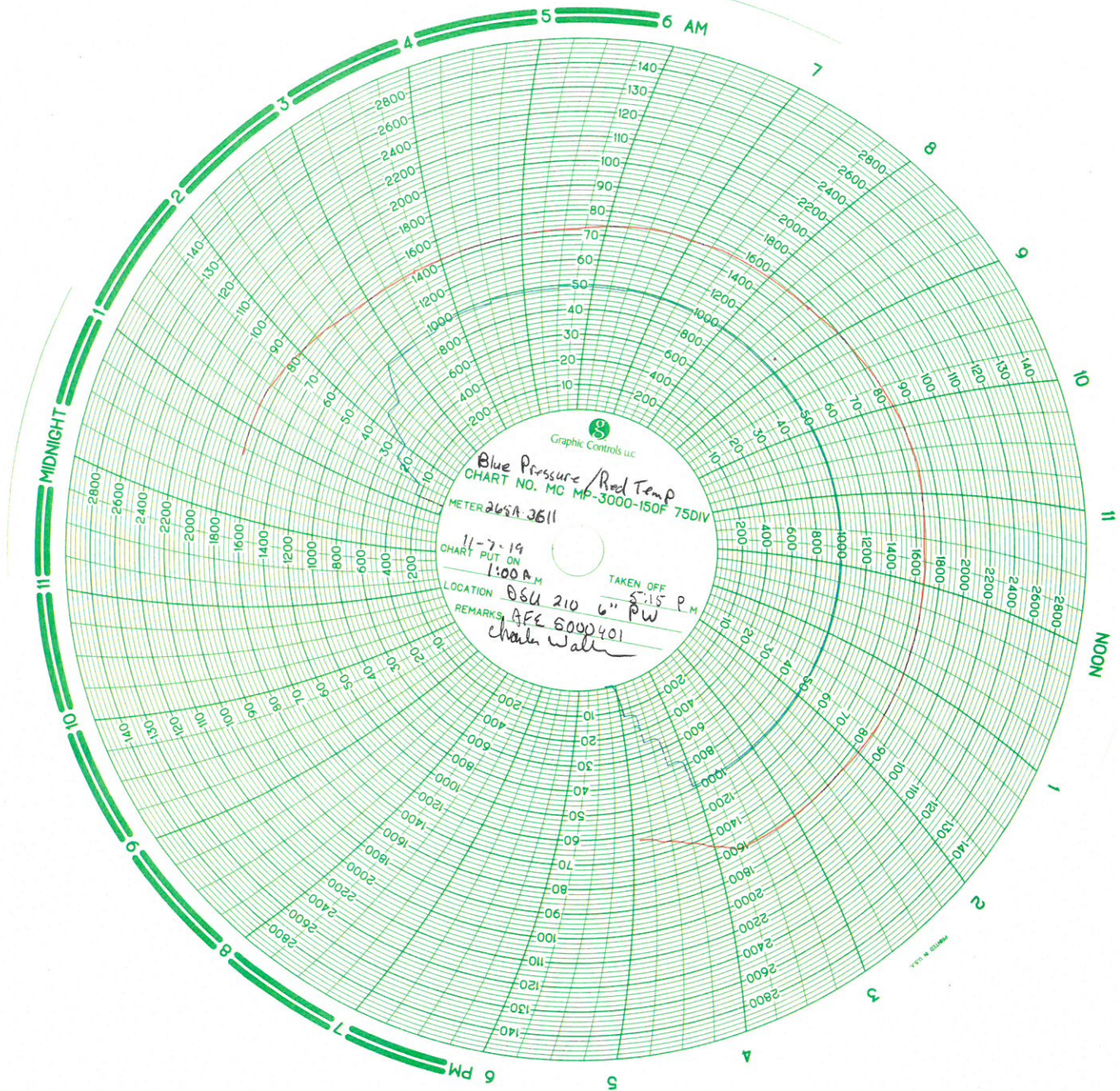
Test Section No. :

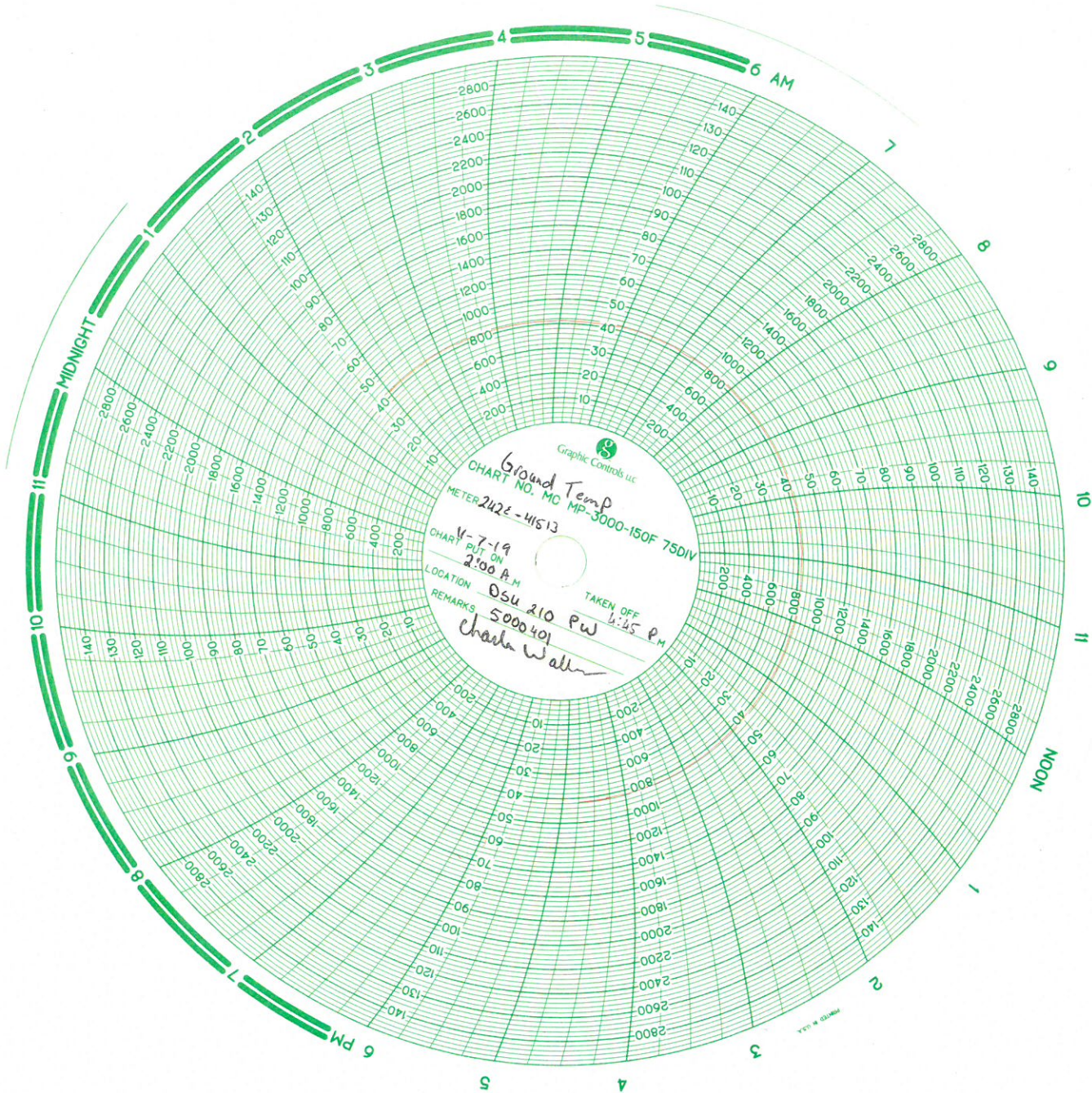
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Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
5:30 AM	969	72	28	Dark Foggy	OK	Build to 984
5:31	984	72	28			
5:45	981	72	27			
6:00	979	73	27			
6:15	977	73	27			
6:30	985	74	27	Day light	OK	Build to 984
6:45	984	74	26	Fog		
7:00	984	75	26			
7:15	983	75	27			
7:30	983	75	29		OK	Build to 984
7:35	983	75	29			
7:37	984	75	29			
* 7:45	984	75	29		OK *	BEGIN TEST *
8:00	984	76	30	Cloudy,		
8:15	984	76	30	Misty		
8:30	984	78	31			
8:45	984	79	32		OK	
9:00	984	80	32			
9:15	984	80	31			
9:30	984	80	31			
9:45	984	82	31		OK	
10:00	984	82	31			
10:30	984	84	30			
11:00	984	84	30			
11:30	985	87	33	Sunny		
12:00 PM	985	84	36	no wind	OK	
12:30	985	84	39			
1:00	985	84	40		OK	
1:30	985	84	41			
2:00	985	83	42			
2:30	985	82	42		OK	
3:00	985	82	42			
3:30	985	82	42			
* 3:45	985	81	42		OK *	END TEST *
4:00	985	81	42			Bleed to 738
4:05	738	80	42			Hold 15 minutes
4:20	746	76	42			Bleed to 492
4:21	492	75	42			Hold 15 minutes
4:36	504	72	41			Bleed to 246
4:40	246	69	41			Hold 15 minutes
4:55	266	66	40			Bleed to 0
5:02	0	65	40			
5:15	0	62	40			

11-7-19

[illegible]





Cross Country Pipeline Supply CO. Inc

Sales and Service

2251 Rifle Street - Aurora, Colorado 80011

Phone 303.361.6797 Fax 303.361.6836

1431

NIST CALIBRATION DATA

Model Number	Serial Number	Customer	Range	Accuracy
ITT Barton	242E-41513	Cross Country	3000# - 150F	1/2%
Work Performed:		Calibration: Output/Reading	Results: Pressure	
Calibrate to Mfg. Spec.		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	
		59 Deg	59 Deg	
		109 Deg	109 Deg	
145 Deg	145 Deg			
PO Number		Sales Order Number	Date of Test	
Recalibrated		Rental Unit	11/6/2019 11:14:58 AM	

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	03/01/2019	17-043
Tech Instrumentation	TM99A	Thermometer	03/01/2019	59448

Don F.

Signature

Don Frick 11-6-19



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

CR-1 Calibration Certificate

Certificate Number: 192453

Customer:

Pipeline Supply & Service
Henderson, CO

Manufacturer: Crystal Engineering
Model Number: XP2i 5000 psi
Serial Number: 352036
Description: Digital Test Gauge
Procedure: CI-001
Calibrated To: Manufacturer's Specifications
Technician: Austin Molyneux

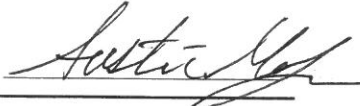
Calibration Date: 6/14/2019
Due Date: 6/14/2020
As Found: In Tolerance
As Left: In Tolerance
Temperature: 69.7 F
Humidity: 38.2 %

Tolerance Specs:

0 - 20%: +/- (0.02% of FS)
20% - 100%: +/- (0.1% of Rdg)

Technician Notes:

As Left Userspan: 1.00075

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.



APX00674

C1

PSS-COMPANIES



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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER: CO

Details +/-: 1.0% ACCURACY

DATE CALIBRATED: 06/19/2019

DUE DATE: 06/19/2020

INDICATED TEMPERATURE RANGE: # 0 – 150°F

INDICATED PRESSURE RANGE: #0 – 3000 PSI

SERIAL NO: 265A3511

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


SIGNATURE



Pipeline Pressure Test Documentation

Pressure Test Report

Form :

Revision
3

Revision Date

Project Name : Sanford (DSU 210) Produced Water

AFE No. : 5000401

Contractor / Testing Company : North winds

Technician : Phil

Test Section No. : 0

From Station No. :

Test Description : hydrostatic test of 100' of 6" flexsteel between lact and launcher

To Station No. :

Test Type : Subpart E Test

Start of Test Period :

Date : 12-5-19

Time : 8:15 AM

Min. Test Duration : 8 hours

End of Test Period :

Date : 12-5-19

Time : 9:25 PM

Class Location : Not Applicable (Liquids)

Low Strength Pipe : O.D. :

6.000

W.T. :

SMYS :

Grade : flexsteel

Station Piping :

Yes

Test Medium : Water

Source of Medium :

N/A

Corrosion Inhibitor : No

Inhibitor Type :

N/A

Rate :

N/A

Leak Detection : No

Material Type :

N/A

Rate :

N/A

Deadweight Tester : Mfg. :

Crystal Engineering

Serial # :

364359

Calibration Date :

9-25-2019

Deadweight Tester Location :

Station No. (ESN) :

Elevation (ft) :

Pressure Recorder : Mfg. :

Barton

Serial # :

265A-3511

Calibration Date :

6-19-2019

Pipe Temp. Recorder : Mfg. :

Barton

Serial # :

242E-41513

Calibration Date :

11-6-2019

Target Test Pressure Range

Pre-approved Target Test Pressure :

984

psig

Maximum Test Pressure :

1009

psig

Max Elevation Change :

0

Minimum Test Pressure :

959

psig

Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
8:15 AM	0	40	38	Cloudy	OK	
8:35	0	40	38	Misting rain		Build to 25%
8:40	252	40	38		OK	Hold 15 min
8:55	233	40	37			Build to 50%
8:58	443	40	37		OK	Hold 15 min
9:13	476	40	37			Build to 75%
9:15	749	40	37		OK	Hold 1 hour
9:30	711	40	35			
9:45	702	40	33	light rain		
10:00	700	40	31			
10:15	699	40	30		OK	Build to 100%
10:20	984	40	30			Hold -
10:35	962	40	30			
10:50	958	40	30			
11:05	956	40	30			
11:20	954	40	29		OK	Build to 100%
11:21	988	40	29			
11:35	987	40	29	Cloudy		
11:45	986	40	29	Mist	OK	* BEGIN TEST *
12:00 PM	986	40	29			ALL exposed pipe
12:15	986	40	28	snow		is covered and
12:30	986	40	27			heated

12-5-19

*

*

Project Name : Sanford (DSU 210) Produced Water

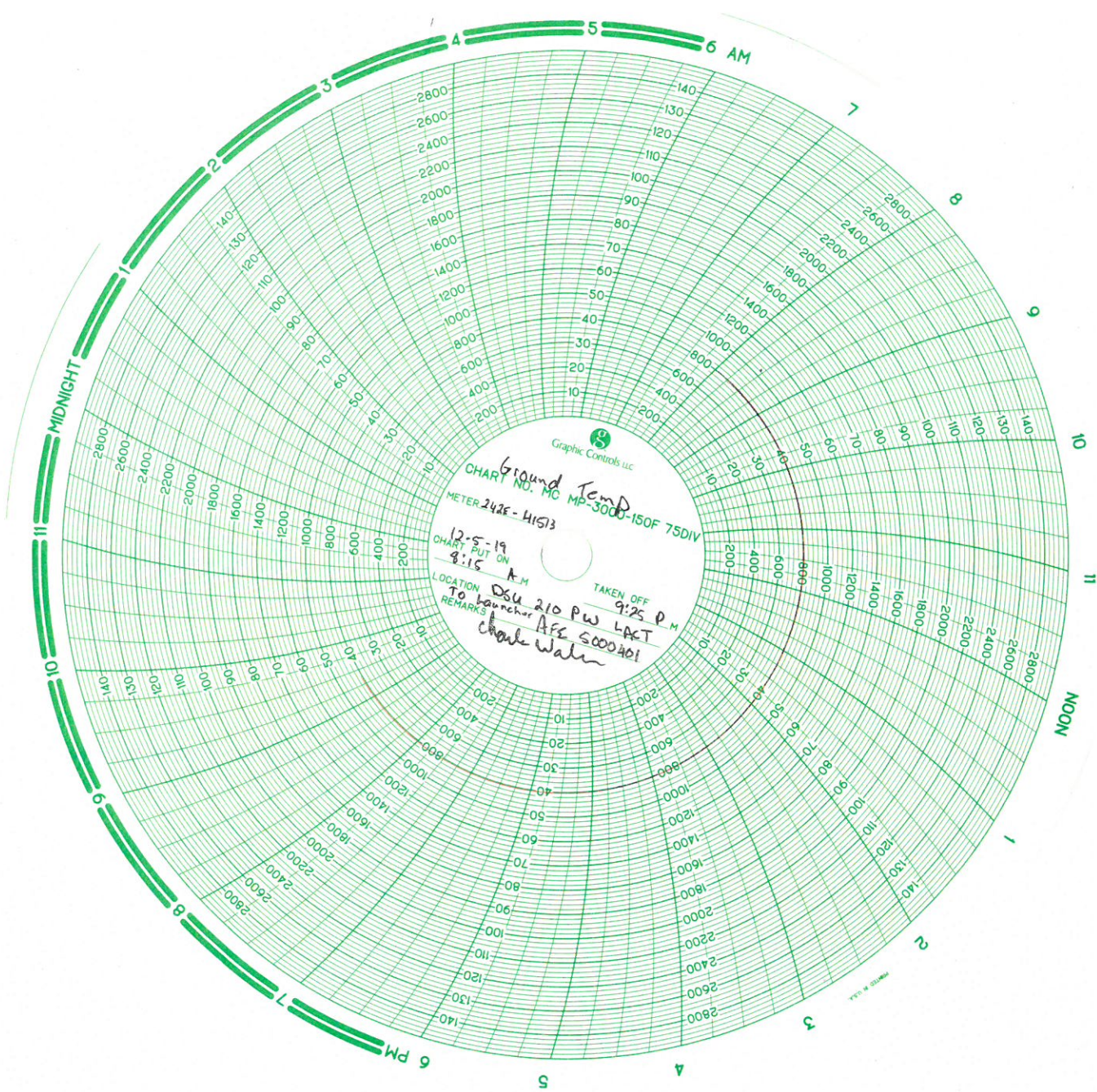
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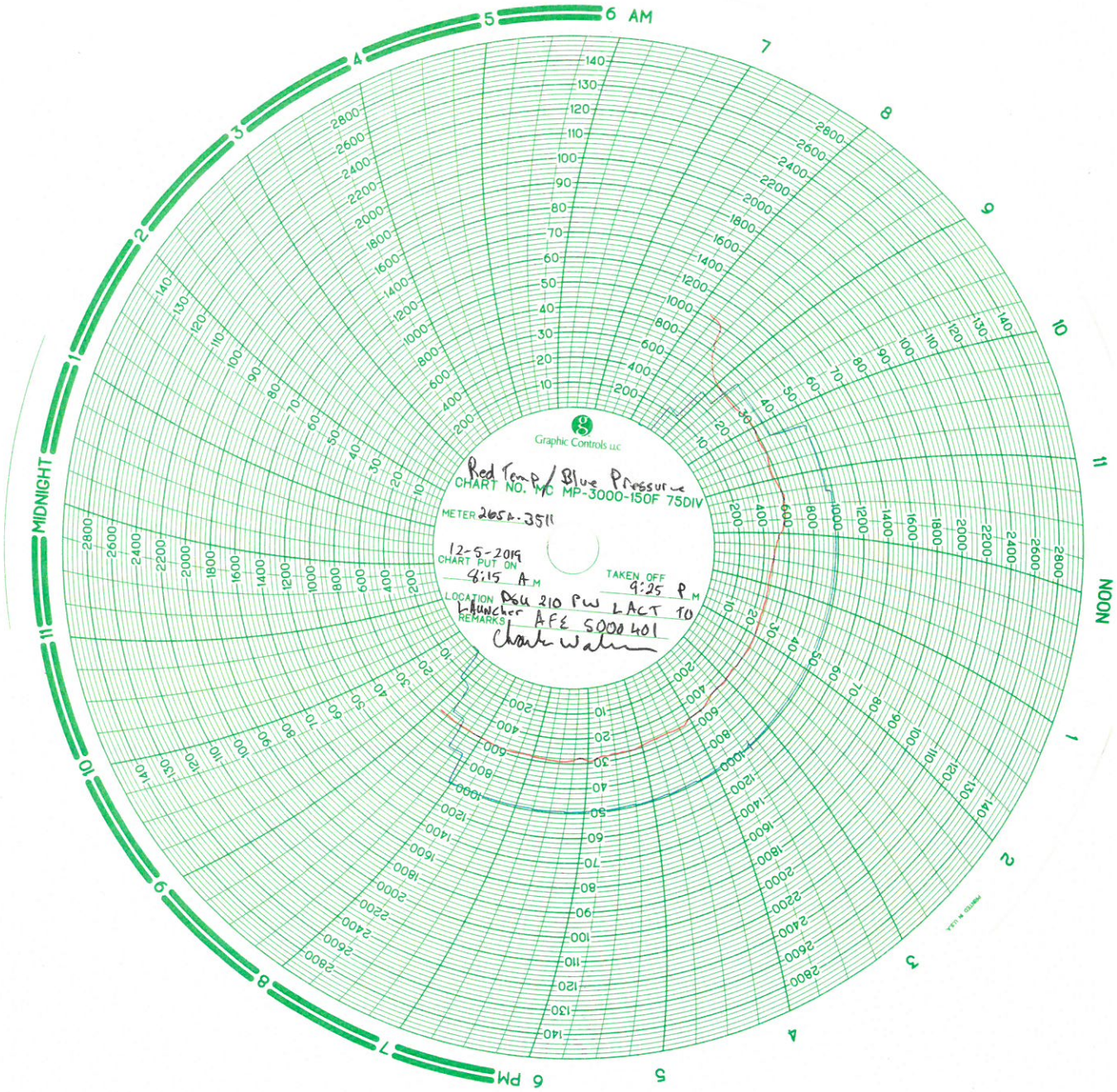
Test Section No. : 0

Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
12:45 pm	986	40	27	snow	OK	
1:00	946	40	27		OK	
1:15	986	40	27			
1:30	986	40	25			
1:45	986	40	24			
2:00	986	40	23		OK	
2:15	986	40	23			
2:30	987	40	23			
2:45	987	40	23		OK	
3:00	990	40	23	Cloudy, rain		
3:15	994	40	24			
3:30	999	40	24			Bleed to 986
3:45	990	40	24			
4:00	994	40	25		OK	
4:15	999	40	26			Bleed to 999
4:30	989	40	26			
4:45	996	40	26	Cloudy		Bleed to 986
5:00	990	40	27	Dark	OK	
5:15	996	40	27			Bleed to 986
5:30	991	40	27			
5:45	996	40	28			Bleed to 986
6:00	991	40	28		OK	
6:15	996	40	27			Bleed to 986
6:30	990	40	27			
6:45	993	40	26			Bleed to 986
7:00	989	40	26		OK	
7:15	991	40	26			
7:30	993	40	26			
* 7:45	994	40	26			* END TEST
8:00	994	40	26			Bleed to 7590
8:07	739	40	26			Hold 15 min
8:22	741	40	25			Bleed to 5090
8:28	493	40	25			Hold 15 min
8:43	495	40	25			Bleed to 2590
8:48	246	40	25			Hold 15 min
9:03	248	40	25			Bleed to 0
9:10	0	40	25			
9:25	0	40	25			

12-5-19

[illegible]





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PSS-COMPANIES



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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER: CO

Details +/-: 1.0% ACCURACY

DATE CALIBRATED: 06/19/2019

DUE DATE: 06/19/2020

INDICATED TEMPERATURE RANGE: # 0 – 150°F

INDICATED PRESSURE RANGE: #0 – 3000 PSI

SERIAL NO: 265A3511

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


SIGNATURE



9829 E. Easter Ave. • Centennial, CO 80112
303.794.8833 • Fax 303.730.1220
Toll Free 1.800.327.7257
www.jmcinstruments.com

CR-2

CERTIFIED CALIBRATION

CUSTOMER Cross Country ORDER NO. _____

ITEM Digital Gauge RANGE 0-5000PSIG ITEM NO. 5002-2

TRUE VALUE	INDICATED VALUE	
	INCREASING READINGS	DECREASING READINGS
PSIG		
0.00	0	0
500.00	499.5	499.6
1000.00	999.3	999.3
1500.00	1498.1	1498.6
2000.00	1999.2	1997.9
2500.00	2497.9	2497.4
3000.00	2997.7	2997.4
3500.00	3496.5	3495.7
4000.00	3995.8	3994.2
4500.00	4495.4	4494.0
5000.00	4995.3	4995.3

Tested On: Deadweight Tester S/N# 1GA4474

Traceable to National Institute of Standards and Technology certificate
17-043

Tested By: BMZ Date 25 Sept 2019

Remarks: Serial# miss printed by tester 25 sept. Cert corrected by BMZ on 17 Oct, 2019

Crystal	XP2i	S/N 36435.9
Accuracy is +/-	.25	% of Full Scale or Better
Test Conditions	72 °F;	mmHg Atm. Pressure

Cross Country Pipeline Supply CO. 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
ITT Barton	242E-41513	Cross Country	3000# - 150F	1/2%
Work Performed:		Calibration: Output/Reading	Results: Pressure	
Calibrate to Mfg. Spec.		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	
		59 Deg	59 Deg	
		109 Deg	109 Deg	
145 Deg	145 Deg			
PO Number		Sales Order Number	Date of Test	
Recalibrated		Rental Unit	11/6/2019 11:14:58 AM	

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	03/01/2019	17-043
Tech Instrumentation	TM99A	Thermometer	03/01/2019	59448

Don F.

Signature Don Erick 11-6-19



Hydrostatic Pressure Test Procedure
DSU 210 Lateral – 6" PW Pipeline

NMP Doc.
No.:

N/A

Rev.:

0

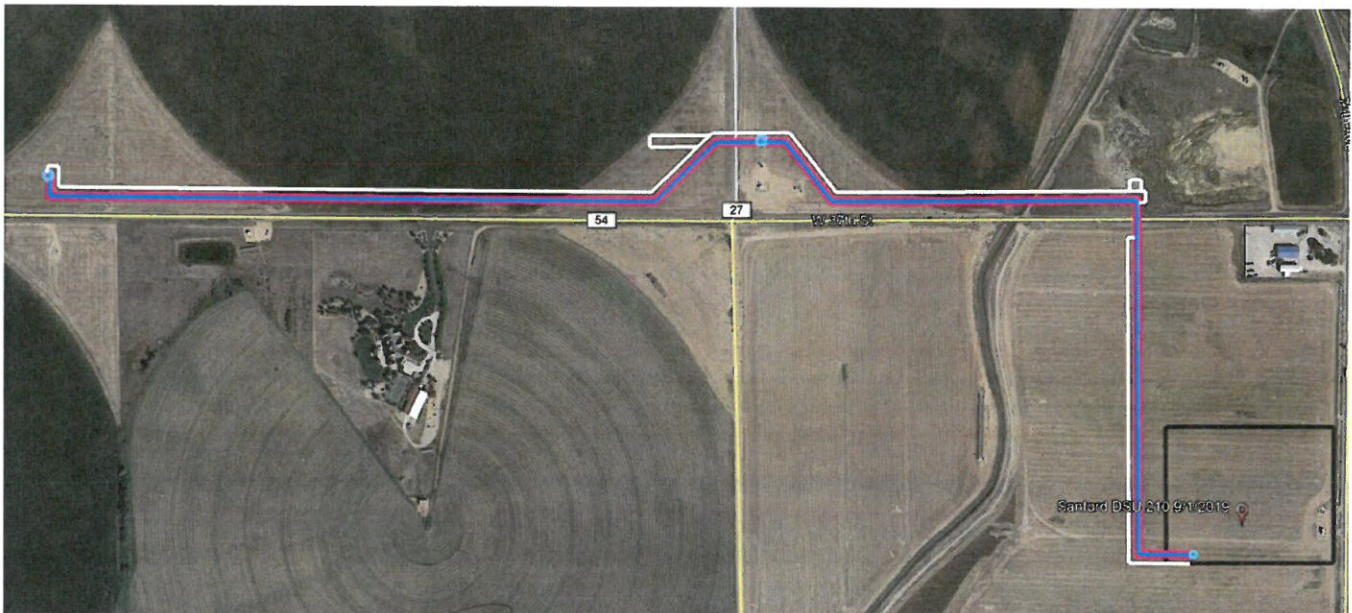
DJBU



DSU 210 Lateral

6" Flexsteel Produced Water Pipeline (CL 300)

Hydrostatic Pressure Test Procedure



Ralph L. Conner

11-7-19

Mike Moberg

11-7-19

Chad Walker

11-7-19

0	9/26/2019	SSD	Issued for Implementation	DAN	
REV	DATE	BY	DESCRIPTION	CHKD	APPVD
			Noble Midstream Partners, LLC		
			Hydrostatic Pressure Test Procedure		
			Doc. No. N/A		


	Hydrostatic Pressure Test Procedure DSU 210 Lateral – 6" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

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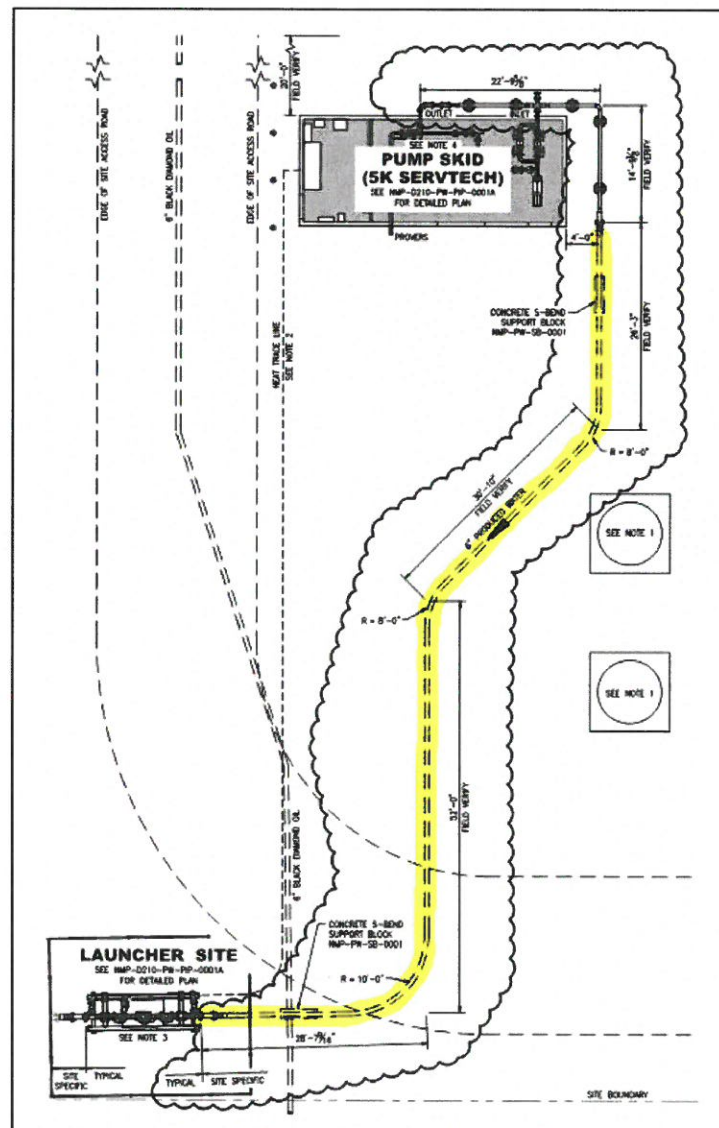
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1 EXECUTIVE SUMMARY

This procedure and the accompanying site-specific Hydrostatic Test Plan define the minimum requirements for the hydrostatic pressure testing of the **DSU 210 Lateral – 6" 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.

The hydrotest will be done on the **DSU 210 Lateral – 6" Flexsteel Produced Water Pipeline** and will include the **6" FlexSteel between the launcher and the above grade transition flange on the pump skid as seen below:**



	Hydrostatic Pressure Test Procedure DSU 210 Lateral – 6" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

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 **DSU 210 Lateral – 6" 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 **DSU 210 Lateral – 6" Flexsteel Produced Water Pipeline** internal design pressure is **720 PSIG**, limited by the carbon steel flange rating.

The **DSU 210 Lateral – 6" Flexsteel Produced Water Pipeline** final hydrostatic test pressure shall be either **1,025 PSIG** or **984 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

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)
300	0.665	720	750	940	1,100


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.

	Hydrostatic Pressure Test Procedure DSU 210 Lateral – 6" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

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.


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.

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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.

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.

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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.


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.

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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**

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 **DSU 210 Lateral – 6" Flexsteel Produced Water Pipeline** must be **260 – 390 GPM (6 – 9 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 **DSU 210 Lateral – 6" Flexsteel Produced Water Pipeline** is **6,830 feet of 6.93" OD 0.665" w.t.** FlexSteel pipe. It will be pressurized to either of the following hydrostatic test pressures at the corresponding location:

DSU 210 Pump Skid Flange (-1+08.00)	1,025 psig
DSU 210 Tie-In Site (43+25.00)	984 psig


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.

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.

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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*)

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.

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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.

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.

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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.

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

Upon completion of drying, a **5 PSIG** nitrogen blanket shall be maintained on the pipeline until commissioning.

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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

DSU 210 Lateral - 6" Flexsteel Produced Water Pipeline Hydrostatic Pressure Test Plan

