


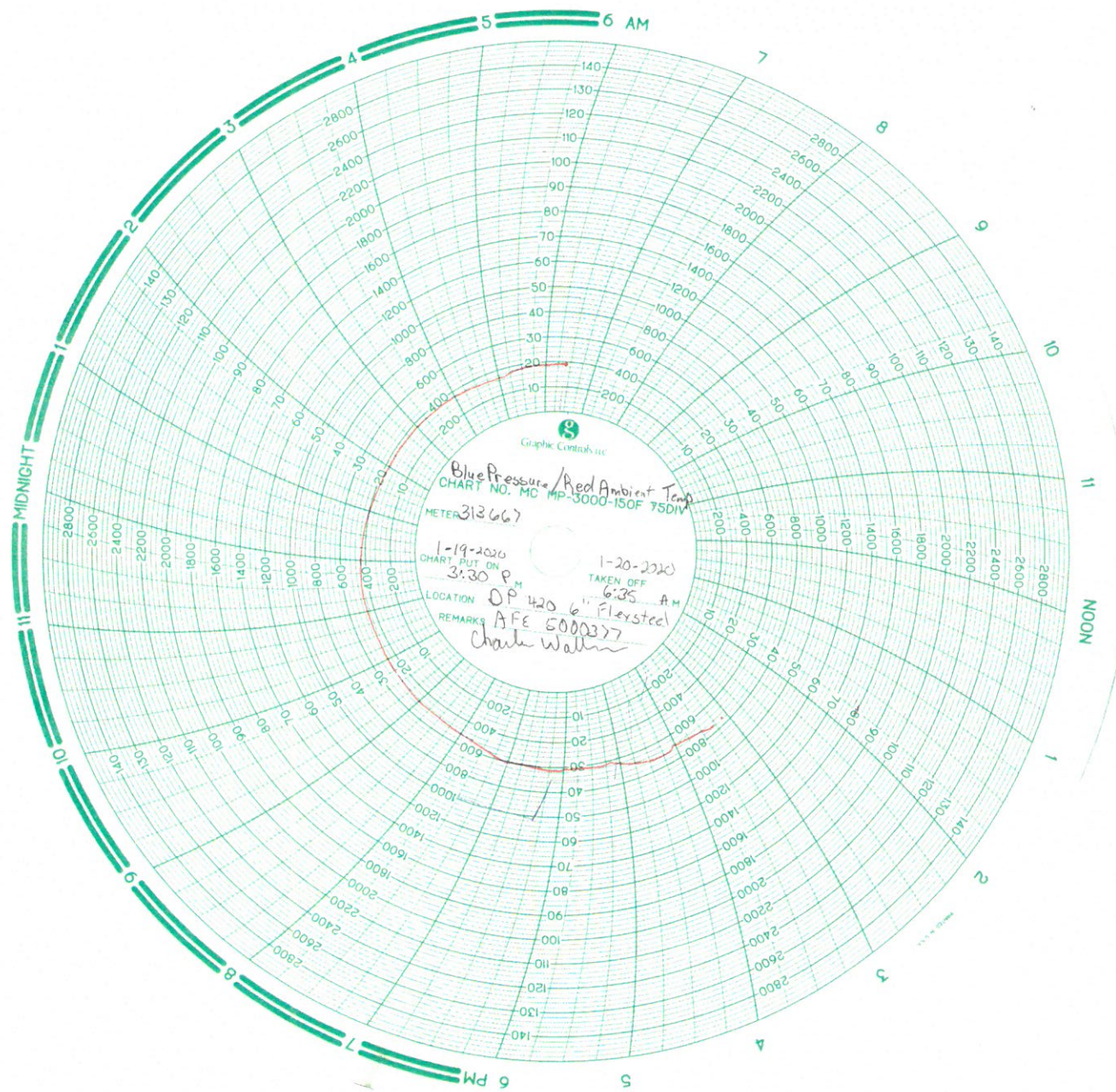
MUP-06-TLE-200-L1

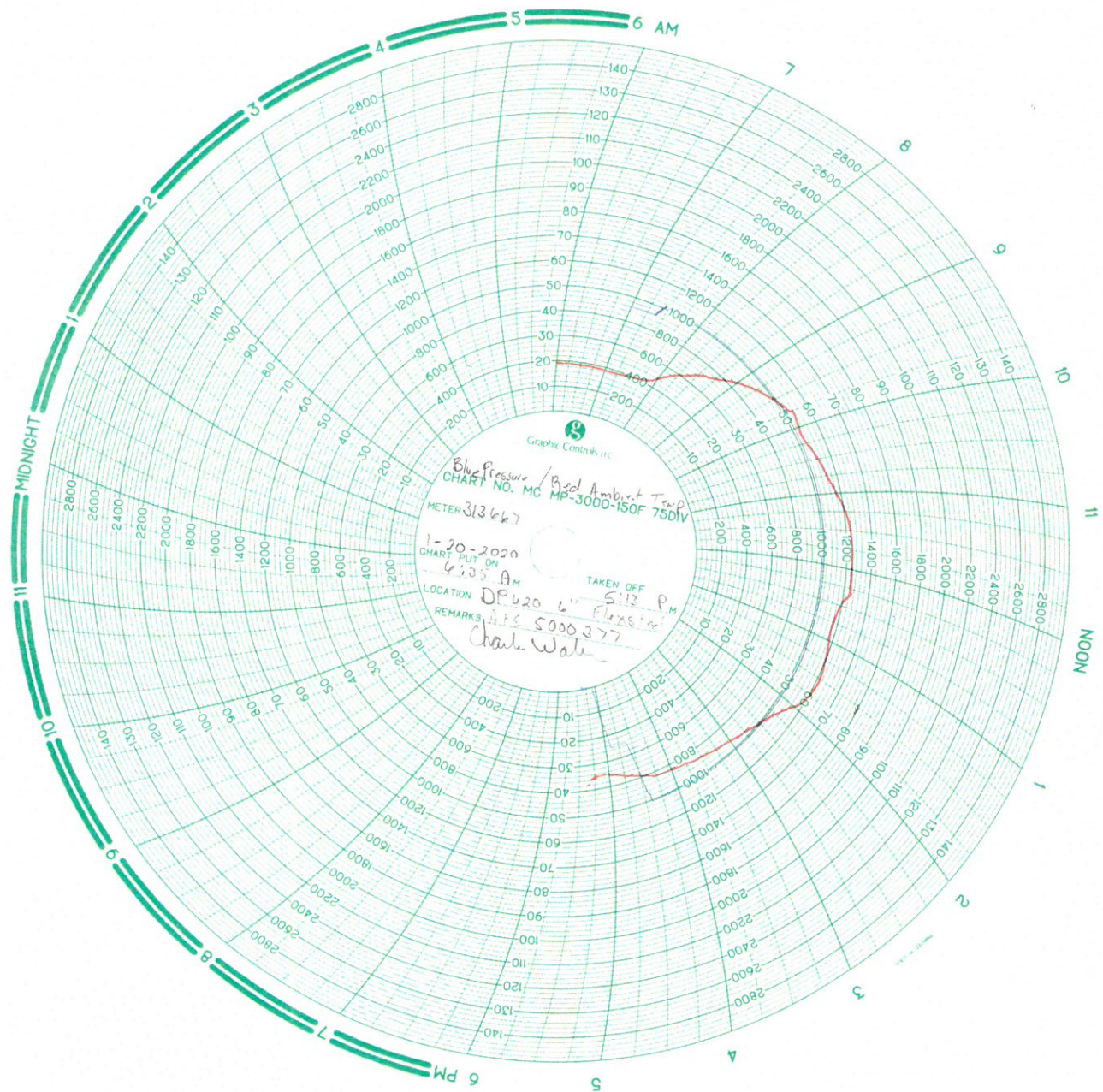
		Pipeline Pressure Test Documentation				
Pressure Test Report		Form :	Revision 3	Revision Date		
Project Name : Mustang Phase II DP 420 6" Produced Water Pipeline						
AFE No. : 5000377						
Contractor / Testing Company :		Mears	Technician :		Kurt	
Test Section No. :			From Station No. :			
Test Description : DP 420 6" Produced Water Main Line/ PL-2003 and PR-2003 Included in Test		To Station No. :				
Test Type :		Start of Test Period :	Date : 1-19-2020	Time : 3:30 PM		
Min. Test Duration : 8 hours		End of Test Period :		Date :	Time :	
Class Location :		ANSI 300				
Low Strength Pipe : O.D. :		6.391	W.T. :	0.787	SMYS :	
Grade :		Flexsteel		Station Piping :		
Test Medium :		Water				
Corrosion Inhibitor :		No	Inhibitor Type :		N/A	
Leak Detection :		No	Material Type :			
Deadweight Tester : Mfg. :		Crystal	Serial # :	919549	Calibration Date : 8-31-2020	
Deadweight Tester Location : Station No. (ESN) :			Elevation (ft) :			
Pressure Recorder : Mfg. :		Barton	Serial # :	2020-318667	Calibration Date : 12-9-2020	
Pipe Temp. Recorder : Mfg. :		Barton	Serial # :	265-9709	Calibration Date : 12-9-2020	
Pre-approved Target Test Pressure :		1001	psig			
Max Elevation Change :		134				
Target Test Pressure Range						
Maximum Test Pressure :		939.0	psig			
Minimum Test Pressure :		1,105.0	psig			
Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
3:30 PM	0	30	44	Sunny	OK	
3:45	0	30	44	no wind		Build to 250
4:10	250	30	44		OK	Hold 15 min
4:25	221	30	43			Build to 500
4:37	500	30	43		OK	Hold 15 min
4:52	473	30	42			Build to 750
5:02	750	30	42		OK	Hold 1 hour
5:17	723	30	40	Clear, Dark		
5:32	715	30	39			
5:47	709	30	37			
6:02	705	30	35		OK	Build to Target + = 1301 +
6:17	1030	30	33			Hold
6:30	1017	30	33			
6:45	1006	30	32			
7:00	1001	30	31			
7:30	979	30	31			
8:00	960	30	30			
8:30	945	30	29			
9:00	934	30	28			
9:30	934	30	27			
10:00	931	30	26			
10:30	930	30	25			

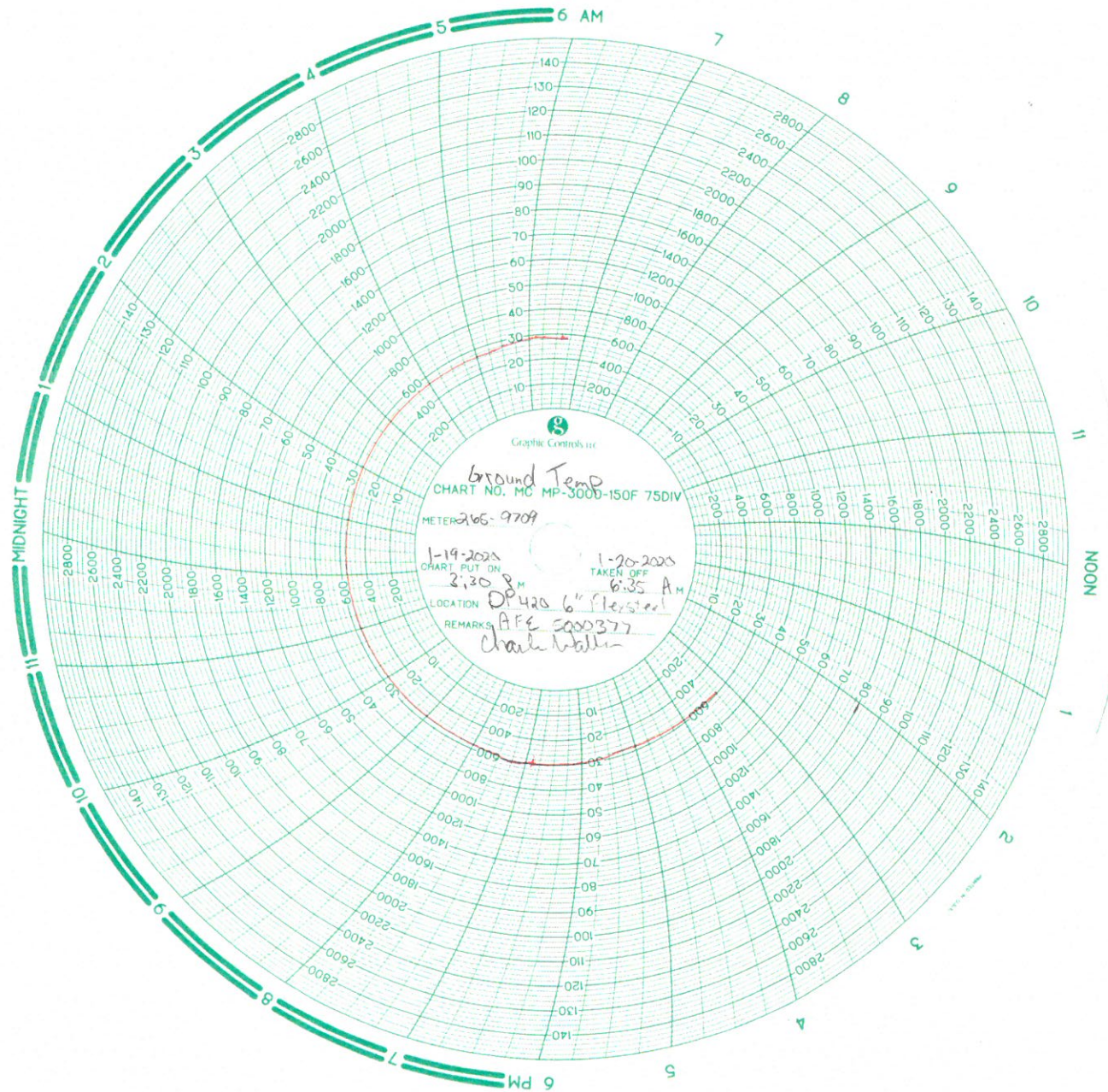
Project Name:		Mustang Ph 2 OP 420 6" PW				
AFE No.:		5000377		Test Section No.:		
Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
11:00	930	30	24			
11:30	930	30	23			
12:00 AM	930	30	22			
12:30	930	30	21			
1:00	930	30	20			
1:30	930	30	19			
2:00	930	30	18			
2:30	930	30	18			
3:00	930	30	17			
3:30	930	30	16			
4:00	930	30	15			
4:30	930	30	15			
5:00	930	30	14	clear, wind	OK	
5:30	930	30	14	@ 6 mph		
6:00	930	30	14			
6:25	930	30	14			Bleed to 0
6:40	0	30	15			Change charts
6:40	0	30	15	Sunrise		
6:55	0	30	16	no wind	OK	Pressure chart backup
6:55	930	30	16			
7:10	930	30	17		OK	Build up to 100+
7:19	1022	30	17			
7:30	1017	30	18	Sunny, no		
7:45	1015	30	18	wind		
* 8:00	1015	30	19		OK	* BEGIN TEST
8:15	1015	30	20			Launchers and
8:30	1015	30	21			Receiver are
8:45	1015	30	22			hooked and
9:00	1015	30	23		OK	heated
9:30	1015	30	25			
10:00	1015	30	30		OK	Check for leaks
10:30	1015	30	35			
11:00	1016	30	39		OK	
11:30	1016	30	40	Sunny, no		
12:00 PM	1016	30	42	wind	OK	
12:30	1016	30	44			
1:00	1016	30	45	Mostly Sunny	OK	
1:30	1017	30	46	a few clouds		
2:00	1017	30	46		OK	
2:30	1017	30	47			
3:00	1017	30	47			Check for leaks
3:30	1017	30	47			
* 4:00	1017	30	46			* END TEST

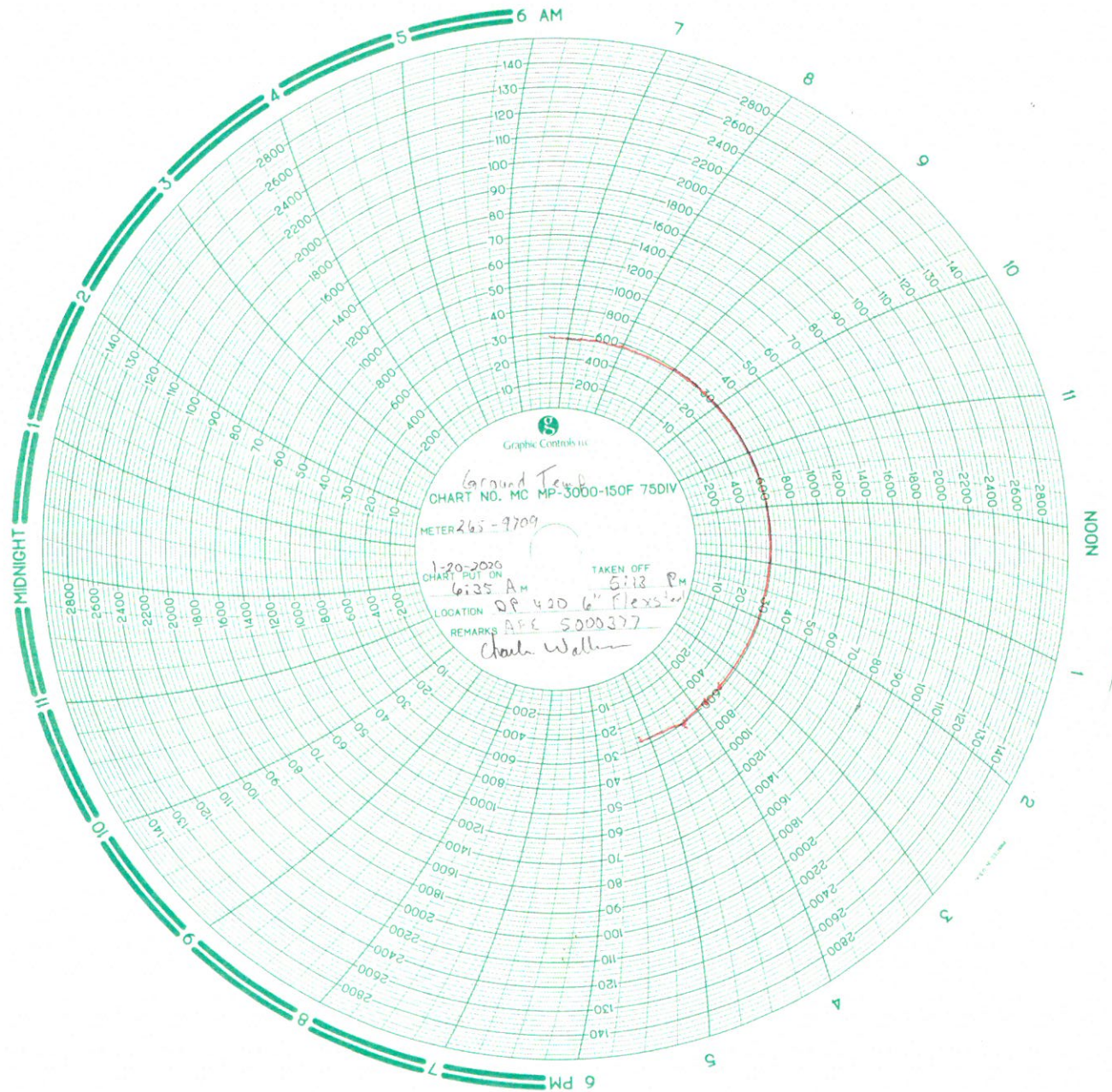
1-20-2020

[illegible]









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	202A-313667	MEARS	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

70 DEG

70 DEG

110 DEG

110 DEG

150 DEG

150 DEG

PO Number

Sales Order Number

Date of Test

Calibrated

Certified

12/9/2019 3:12:12 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	03/01/2019	17-043
Tech Instrumentation	TM99A	Thermometer	03/01/2019	59448

Don F.

Signature

Don Frick 12.9.19

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

Ground

Model Number	Serial Number	Customer	Range	Accuracy
ITT Barton	265-9709	MEARS	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
	75 DEG	75 DEG
	105 DEG	105 DEG
	150 DEG	150 DEG

PO Number	Sales Order Number	Date of Test
Calibrated	Certified	12/9/2019 3:29:49 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	03/01/2019	17-043
Tech Instrumentation	TM99A	Thermometer	03/01/2019	59448

Don F.

Signature

Don Frick 12-9-19

Certificate of Calibration

Calibrations comply with
ISO/IEC 17025:2005 and
ANSI NCSL Z540-1-1994



Device Information	
Module	10KPSI
Serial Number	919549
Calibration Date	31 August 2019
Verification Date	12 September 2019
As Received Condition	New
As Left Condition	In Tolerance

Laboratory Conditions	
Laboratory ambient conditions throughout this calibration	
Temperature	19 to 23° C
Humidity	20 to 60% RH

Definitions

Temperature Measured temperature of Device Under Test (DUT) during data collection.
Reference Reading True value according to our reference standards.
Indicated Reading Displayed reading from test unit.
Condition Pass or Fail.
Difference Indicated reading minus reference reading.
Relative Difference (Difference / reference reading) x 100.
Allowable Tolerance \pm according to manufacturer's specifications.
Pressure Medium Nitrogen.

Traceability Statement

Reference Standards used in this calibration are traceable to the National Institute of Standards and Technology of the United States (NIST) or other NMI.

System Expanded Uncertainty

System expanded uncertainty evaluation includes the calibration reference used and device under test and is calculated in accordance with ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainties reported represent expanded uncertainties using a coverage factor (**k**) to approximate a percentage (%) confidence level.

Decision Rule

In Tolerance or *Pass* conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. Test methods defined by COI-054.

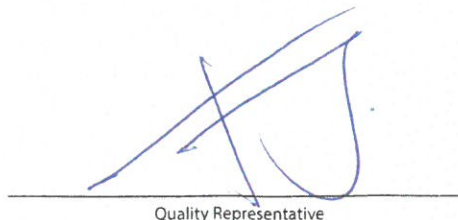
Coverage Factor (k)	2
Confidence Level (%)	~95

Traceable Reference Standards

Manufacturer	Calibration Reference Used	Serial Number	Report No.	Reference Cal. Due
DHI	PG7202 w/ 1 MPa/kg PC	875	1500227253	06 November 2019


Laboratory Representative

Troy Burns


Quality Representative

Test Results

As Left Results - - Span Multiplier: 1.00000

Temperature (Celsius)	Reference Reading (psi)	Indicated Reading (psi)	Deviation (psi)	Relative Deviation (% of Reading)	Allowable Tolerance (psi)	Expanded Uncertainty (psi)	Condition
-20	0.0	0	0.0		1.5		Pass
-20	2501.1	2501	-0.1	-0.004	1.5	0.77	Pass
-20	5003.2	5003	-0.2	-0.004	2.5	0.79	Pass
-20	7502.6	7503	0.4	0.005	3.8	0.81	Pass
-20	9943.8	9944	0.2	0.002	5.0	0.84	Pass
-20	10002.4	10003	0.6	0.006	5.0	0.84	Pass
-20	10147.7	10148	0.3	0.003	5.1	0.85	Pass
-20	7502.6	7503	0.4	0.005	3.8	0.81	Pass
10	0.0	0	0.0		1.5		Pass
10	2501.1	2501	-0.1	-0.004	1.5	0.77	Pass
10	5003.2	5003	-0.2	-0.004	2.5	0.79	Pass
10	7502.6	7502	-0.6	-0.008	3.8	0.81	Pass
10	9943.8	9944	0.2	0.002	5.0	0.84	Pass
10	10002.3	10002	-0.3	-0.003	5.0	0.84	Pass
10	10147.7	10147	-0.7	-0.007	5.1	0.85	Pass
10	7502.6	7502	-0.6	-0.008	3.8	0.81	Pass
20	0.0	0	0.0		1.5		Pass
20	2501.1	2501	-0.1	-0.004	1.5	0.77	Pass
20	5003.2	5003	-0.2	-0.004	2.5	0.79	Pass
20	7502.6	7502	-0.6	-0.008	3.8	0.81	Pass
20	9943.8	9944	0.2	0.002	5.0	0.84	Pass
20	10002.3	10003	0.7	0.007	5.0	0.84	Pass
20	10147.7	10148	0.3	0.003	5.1	0.85	Pass
20	7502.6	7502	-0.6	-0.008	3.8	0.81	Pass
30	0.0	0	0.0		1.5		Pass
30	2501.1	2501	-0.1	-0.004	1.5	0.77	Pass
30	5003.2	5003	-0.2	-0.004	2.5	0.79	Pass
30	7502.6	7503	0.4	0.005	3.8	0.81	Pass
30	9943.8	9944	0.2	0.002	5.0	0.84	Pass
30	10002.3	10002	-0.3	-0.003	5.0	0.84	Pass
30	10147.7	10147	-0.7	-0.007	5.1	0.85	Pass
30	7502.6	7503	0.4	0.005	3.8	0.81	Pass
50	0.0	0	0.0		1.5		Pass
50	2501.1	2501	-0.1	-0.004	1.5	0.77	Pass
50	5003.1	5003	-0.1	-0.002	2.5	0.79	Pass
50	7502.6	7503	0.4	0.005	3.8	0.81	Pass
50	9943.8	9944	0.2	0.002	5.0	0.84	Pass
50	10002.3	10003	0.7	0.007	5.0	0.84	Pass
50	10147.7	10148	0.3	0.003	5.1	0.85	Pass
50	7502.6	7503	0.4	0.005	3.8	0.81	Pass

Manufacturer's specifications: 0-30% of Full Scale: $\pm(0.015\%$ of Full Scale); 30-100% of Full Scale: $\pm(0.05\%$ of Reading).

Certificate of Calibration

Calibrations comply with
ISO/IEC 17025:2005 and
ANSI NCSL Z540-1-1994



Device Information	
Module	RTD100
Serial Number	920543
Calibration Date	21 September 2019
Verification Date	25 September 2019
As Received Condition	New
As Left Condition	In Tolerance

Laboratory Conditions	
Laboratory ambient conditions throughout this calibration	
Temperature	19 to 23° C
Humidity	20 to 60% RH

Definitions

Temperature Measured temperature of Device Under Test (DUT) during data collection.

Reference Reading True value according to our reference standards.

Indicated Reading Displayed reading from test unit.

Condition Pass or Fail.

Difference Indicated reading minus reference reading.

Relative Difference (Difference / reference reading) x 100.

Allowable Tolerance ± according to manufacturer's specifications.

Traceability Statement

Reference Standards used in this calibration are traceable to the National Institute of Standards and Technology of the United States (NIST) or other NMI.

System Expanded Uncertainty

System expanded uncertainty evaluation includes the calibration reference used and device under test and is calculated in accordance with ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainties reported represent expanded uncertainties using a coverage factor (**k**) to approximate a percentage (%) confidence level.


Decision Rule

In Tolerance or *Pass* conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. Test methods defined by COI-054.

Coverage Factor (k)	2
Confidence Level (%)	~ 95

Traceable Reference Standards

Manufacturer	Calibration Reference Used	Serial Number	Report No.	Reference Cal. Due
HP	Analog System-Ohm 2823A00569	2823A00569	10541730107	29 October 2019


Laboratory Representative

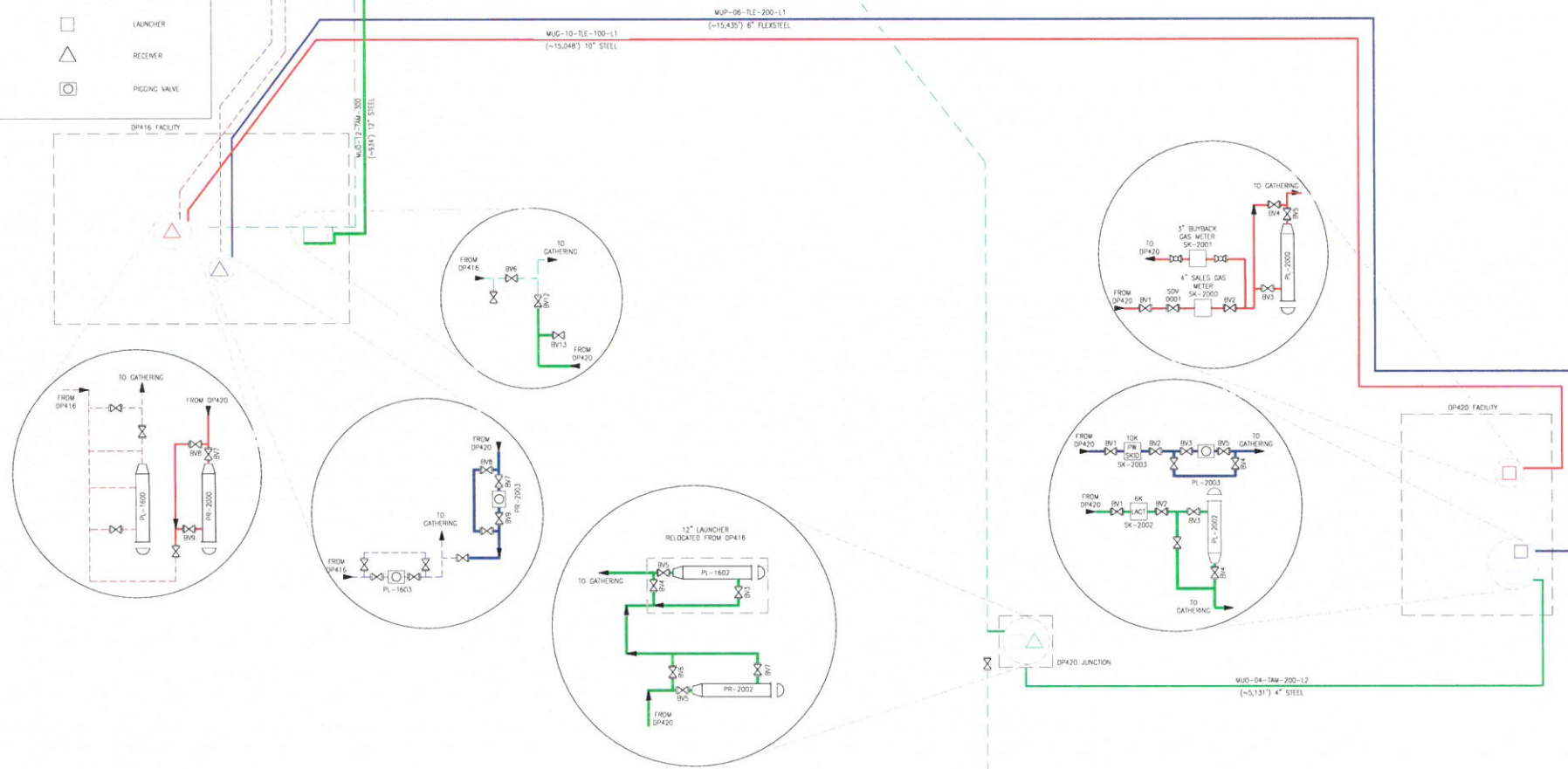
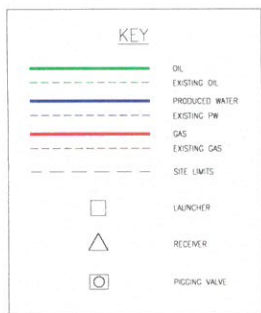
Tony Ly


Tanner Jennings



Quality Representative

Test Results

As Left Results - Resistance Measure - Span Multiplier: 1.00000 - Calibration Performed Using 4-Wire Mode							
Temperature (Celsius)	Reference Reading (Ohms)	Indicated Reading (Ohms)	Deviation (Ohms)	Relative Deviation (% of Reading)	Allowable Tolerance (Ohms)	Expanded Uncertainty (Ohms)	Condition
-20	0.000	0.00	0.000		0.020		Pass
-20	100.027	100.02	-0.007	-0.007	0.035	0.012	Pass
-20	200.286	200.28	-0.006	-0.003	0.050	0.0069	Pass
-20	398.573	398.56	-0.013	-0.003	0.080	0.0073	Pass
10	0.000	0.00	0.000		0.020		Pass
10	100.028	100.02	-0.008	-0.008	0.035	0.012	Pass
10	200.285	200.28	-0.005	-0.002	0.050	0.0069	Pass
10	398.573	398.57	-0.003	-0.001	0.080	0.0073	Pass
20	0.000	0.00	0.000		0.020		Pass
20	100.028	100.03	0.002	0.002	0.035	0.012	Pass
20	200.285	200.28	-0.005	-0.002	0.050	0.0069	Pass
20	398.572	398.57	-0.002	-0.001	0.080	0.0073	Pass
30	0.000	0.00	0.000		0.020		Pass
30	100.028	100.03	0.002	0.002	0.035	0.012	Pass
30	200.285	200.29	0.005	0.002	0.050	0.0069	Pass
30	398.572	398.58	0.008	0.002	0.080	0.0073	Pass
50	0.000	0.00	0.000		0.020		Pass
50	100.028	100.03	0.002	0.002	0.035	0.012	Pass
50	200.285	200.29	0.005	0.002	0.050	0.0069	Pass
50	398.573	398.58	0.007	0.002	0.080	0.0073	Pass
Manufacturer's specifications: 0% to 100% of Full Scale: $\pm(0.015\%$ of Reading + 0.02 Ohms)							



LINE LENGTHS ARE APPROXIMATE FOR PLANNING PURPOSES.
CONSULT ALIGNMENT SHEETS FOR PRECISE FOOTAGES.

REFERENCE: DRAWINGS		REVISIONS										APPROVALS		 energy chemicals resources REV. C-D		 MUSTANG IDP DP420 FLOW SCHEMATIC					
												SIGNATURE DATE DRAWN CHECKED APPROVED									
DWG NO.	TITLE	0	ISSUED FOR CONSTRUCTION										CLP	31-OCT-2019	RE	31-OCT-2019	-	-	SCALE:	DRAWING NO.	REV.
		REV	DESCRIPTION										BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE	N15	DP420-GPO-FLOW-0001	0

THIS DRAWING AND THE DESIGN IT COVERS ARE CONFIDENTIAL AND REMAIN THE PROPERTY OF NOBLE MORTGAGE PARTNERS AND SHALL NOT BE DISCLOSED TO OTHERS OR REPRODUCED IN ANY MANNER OR USED FOR ANY PURPOSE WHATSOEVER EXCEPT BY THE OWNER.
FILE PATH: C:\JACOBI\NOBLE\NOVA PROJECT SEND TO PW\0420.DWG BY:CP226876 DATE:Nov 01, 2019 10:40pm



Mustang Gathering System

Noble Midstream Partners

Hydrostatic Pressure Test Procedure for Produced Water FlexSteel Pipelines

MP2-JAC-PI-RPT-0003 | 0

October 18, 2018

Charles Walter

1-20-2020

KIRTHALE

1-20-2020

Ralphley

1-21-2020

Hydrostatic Pressure Test Procedure for Produced Water
FlexSteel Pipelines



Mustang Gathering System

Project No: 704161
Document Title: Hydrostatic Pressure Test Procedure for Produced Water FlexSteel Pipelines
Document No.: MP2-JAC-PI-RPT-0003
Revision: 0
Date: October 18, 2018
Client Name: Noble Midstream Partners
Project Manager: Blake Evans
Author: Shawn Heath
File Name: MP2-JAC-PI-RPT-0003

9191 South Jamaica Street
Englewood, Colorado 80112
United States
T +1.303.771.0900

www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
0	10/18/18	Issued for Construction	SH	BE	BE

Contents

EXECUTIVE SUMMARY	1
1. REFERENCES	1
2. PRE-TEST PRECAUTIONS	1
2.1 SAFETY PRECAUTIONS	1
2.2 TEST PRESSURE AND DURATION	1
2.2.1 TEST PRESSURE	1
2.2.2 TEST DURATION	1
2.3 TEST EQUIPMENT AND MATERIALS	2
2.3.1 FILL PUMP	2
2.3.2 SUPPLY WATER FILTER	2
2.3.3 PRESSURIZATION PUMP	2
2.3.4 CALIBRATION DEVICES	2
2.3.4.1 PRESSURE CALIBRATION DEVICE	2
2.3.4.2 TEMPERATURE CALIBRATION DEVICE	2
2.3.5 RECORDING DEVICES	2
2.3.5.1 PRESSURE RECORDING	2
2.3.5.2 TEMPERATURE RECORDING	3
2.3.6 SAFETY RELIEF VALVE	3
2.4 QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL	3
2.5 PERMIT TO WORK	4
3. TEST PROCEDURE	4
3.1 SOURCE WATER	4
3.2 EQUIPMENT INSTALLATION	4
3.3 LINE FILL	5
3.4 INITIAL PRESSURIZATION	5
3.5 PIPE CONDITIONING	6
3.6 TEST PERIOD	7
3.7 SEARCHING FOR LEAKS	7
3.8 PRESSURE TEST FAILURES	8
3.9 DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF TEST WATER	8
3.10 DRYING OPERATIONS	8
4. RECORDS	9

Appendix A. Site Specific Testing Information

EXECUTIVE SUMMARY

This general procedure defines the minimum requirements for hydrostatic pressure testing of FlexSteel pipelines. This document is intended to be used in conjunction with site-specific testing information to be provided in Appendix A.

1. REFERENCES

Testing procedures shall comply with the latest editions of the following industry standards:

- Title 49 CFR DOT Part 195 – Transportation of Hazardous Liquids by Pipeline
- API RP 1110 – Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide
- ASME B31.4 – Pipeline Transportation Systems for Liquids and Slurries
- ASME B16.5 – Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard
- FlexSteel Technical manual
- FlexSteel Commissioning Field Notes

2. PRE-TEST PRECAUTIONS

2.1 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.

2.2 TEST PRESSURE AND DURATION

2.2.1 TEST PRESSURE

Pipelines shall be tested at a minimum test pressure of 125% of the internal design pressure.

A site-specific pressure test range calculated based on pipeline elevation, pipeline material, corrosion allowance, and minimum code requirements for each test section shall be included in Appendix A of this procedure.

2.2.2 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 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 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.

2.3.1 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.

2.3.2 SUPPLY WATER FILTER

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

2.3.3 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.

2.3.4 CALIBRATION DEVICES

2.3.4.1 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.

2.3.4.2 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.

2.3.5 RECORDING DEVICES

2.3.5.1 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.

2.3.5.2 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.

2.3.6 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 the site-specific calculated maximum testing pressure to be provided in Appendix A.

2.4 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 192/195, 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.

2.5 PERMIT TO WORK

Prior to commencing work, work permits shall be obtained. At a minimum, the below documents shall be provided by the contractor for submittal:

- 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 by the contractor 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. 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.

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

3.3 LINE FILL

The line fill water volume shall be calculated for each test section and be included in Appendix A of this procedure.

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. Per the *FlexSteel Commissioning Field Notes*, only polyurethane pigs are allowed to be used with FlexSteel.

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.

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 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.

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.

Pressurization up to 75% 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 which point 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 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 in order to allow 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. 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 by assuming the most recent pressure drop rate is maintained over a 24-hour test. If the predicted pressure is less than the calculated minimum test

pressure, 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 minimum 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*)

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.

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. It is also recommended that all personnel be at least 50 feet away from the pipe during the pressure test. (*FlexSteel Commissioning Field Notes*)

3.6 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.

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.

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 site-specific maximum and minimum test pressures as defined in Appendix A 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 commissioned.

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 for 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
- Title 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

APPENDIX A. SITE SPECIFIC TESTING INFORMATION

Hydrotest Summary Page - FlexSteel

Project: Mustang DP420
Client: Noble Midstream Partners
Location: Weld County, CO

						420		416			
						Start of Line		End of Line			
Test Segment	Process Fluid	Test Medium	Test Duration (hrs)	MOP (psig)	Min Test Pressure (psig)	Max Test Pressure (psig)	Min Test Pressure (psig)	Max Test Pressure (psig)	Max % Burst Pressure (psig)	Est. Water Volume (gal)	
1 PL-2003 to PR-2003	Produced Water	Water	8	750	939	1068	976	1105	75.0%	19,769	

Notes:

- 1.) See attached calculations for specific information on each test section.

Hydrostatic Pressure Test Plan - FlexSteel

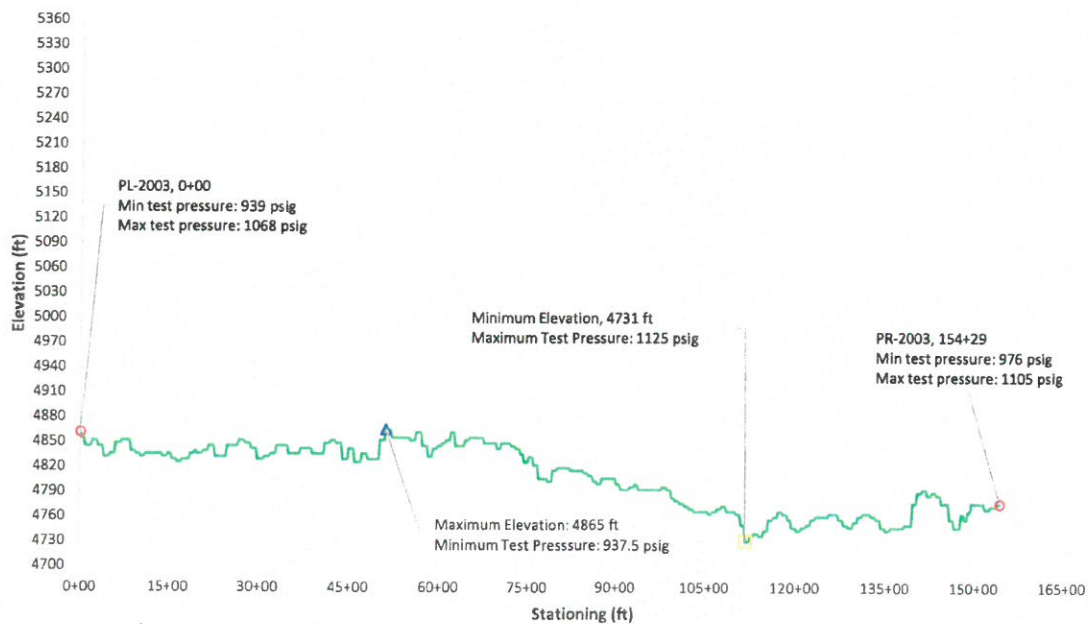
Project: **Mustang DP420**
 Client: **Noble Midstream Partners**
 Location: **Weld County, CO**
 Segment: **PL-2003 to PR-2003**

By: SH
 Checked By: BE
 Date: 10/24/2019
 Revision: A

Design Criteria		Calculated values	
PW	Process Fluid	6.93	Outside Pipe Diameter (in)
750	FlexSteel Rating (psig)	5.60	Inside Pipe Diameter (in)
6	Pipe Nominal Diameter (in)	0.66	Wall Thickness (in)
750	MAOP (psig)	937.5	Min Test Pressure (psig)
1.25	Hydrotest design factor	1125	Max Allowable Test Pressure (psig)
300	ANSI Fitting Rating	1500	Burst Pressure (psig)
Water	Test Medium	1.281	Water volume, gal/ft
8	Test Duration (hours)	15,429	Test section length (ft)
		19,769	Water volume (gal)

Test Pressure Summary						
	Station	Elevation	Minimum (Allowable)		Maximum (Allowable)	
			psig	% burst	psig	% burst
Begin	0+00	4862.20	939	63%	1068	71%
High	51+20	4865	938	63%	1067	71%
Low	111+80	4731	996	66%	1125	75%
End	154+29	4776.90	976	65%	1105	74%

Hydrostatic Pressure Test Plan - Mustang DP420 - PL-2003 to PR-2003



H2O Pad

416
Pad