noble MIDSTREAM PARTNERS

Pipeline Pressure Test Documentation

Pressure Test Report	Form :	Revision 3	Revision Date

Project Name : Non-Piggables Phase II
AFE No. : 5000516

Contractor / Testing Company :	1888 Industrial Services			Technician :	Marc Nichols
Test Section No. :	1			From Station No.:	NA
Test Description:	Colt Aggie			To Station No.:	NA
Test Type :	Hydrostatic	Start of Test Period :	Date : 4/17/2021	Time :	6:30 AM
Min. Test Duration :	8 Hour	End of Test Period :	Date : 4/17/2021	Time :	2:30 PM
Class Location :	750 Flexsteel				
Low Strength Pipe :	O.D. :	W.T. :	SMYS:	Grade:	Station Piping : NA
Test Medium :	WATER	Source of Medium :	City of Greeley		
Corrosion Inhibitor :	No	Inhibitor Type :	NA	Rate :	NA
Leak Detection :	No	Material Type :	NA	Rate :	NA

Deadweight Tester : Mfg:	NA	Serial #:	NA	Calibration Date :	NA
Deadweight Tester Location :	Station No. (ESN) :		Elevation (ft) :		
Pressure Recorder : Mfg:	Crystal-X	Serial #:	904787	Calibration Date :	2/24/2021
Pipe Temp. Recorder : Mfg:	Barton	Serial #:	202A-272617 & 202A-161928	Calibration Date :	5/7/2020

Target Test Pressure Range

Pre-approved Target Test Pressure : 1,050.0 psig
Max Elevation Change: 50ft

Maximum Test Pressure : 1,125.0 psig
Minimum Test Pressure : 925.0 psig

Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
5:30 AM	1,049	56	42	Clear, 8 mph	No Leaks	**FINAL PRESSURE UP / START 1-HOUR PRE-HOLD**
5:45 AM	1,049	56	42	Clear, 8 mph	No Leaks	
6:00 AM	1,051	57	42	Clear, 8 mph	No Leaks	
6:15 AM	1,052	57	42	Clear, 8 mph	No Leaks	
6:30 AM	1,053	57	42	Clear, 8 mph	No Leaks	**START TEST**
6:45 AM	1,054	57	42	Clear, 8 mph	No Leaks	Sunrise
7:00 AM	1,056	57	42	Clear, 8 mph	No Leaks	
7:15 AM	1,059	58	43	Clear, 8 mph	No Leaks	
7:30 AM	1,062	59	44	Partly Cloudy, 9mph	No Leaks	
7:45 AM	1,063	60	44	Cloudy, 9 mph	No Leaks	
8:00 AM	1,064	61	45	Partly Cloudy, 9 mph	No Leaks	
8:15 AM	1,065	62	45	Partly Cloudy, 11 mph	No Leaks	
8:30 AM	1,067	62	46	Partly Cloudy, 10 mph	No Leaks	
8:45 AM	1,069	64	47	Sunny, 11 mph	No Leaks	
9:00 AM	1,072	64	47	Sunny, 11 mph	No Leaks	
9:15 AM	1,075	65	47	Sunny, 11 mph	No Leaks	
9:30 AM	1,078	66	48	Sunny, 11 mph	No Leaks	Bled off 6oz water from 1079 psi to 1048 psi
9:45 AM	1,048	66	48	Partly Cloudy, 12 mph	No Leaks	
10:00 AM	1,051	68	49	Partly Cloudy, 12 mph	No Leaks	
10:15 AM	1,057	70	50	Partly Cloudy, 12 mph	No Leaks	
10:30 AM	1,060	70	50	Partly Cloudy, 12 mph	No Leaks	
10:45 AM	1,064	71	50	Partly Cloudy, 13 mph	No Leaks	

Project Name :

AFE No. : Test Section No. :

Time	Pressure (psig)	Pipe Temp.	Amb. Temp.	Weather	Visual Inspection	Comments
11:00 AM	1,067	71	51	Partly Cloudy, 13 mph	No Leaks	
11:15 AM	1,069	72	52	Partly Cloudy, 11 mph	No Leaks	
11:30 AM	1,073	72	52	Partly Cloudy, 13 mph	No Leaks	
11:45 AM	1,075	73	52	Partly Cloudy, 12 mph	No Leaks	
12:00 PM	1,078	73	53	Snow Flurries, 12 mph	No Leaks	
12:15 PM	1,079	74	53	Snow Flurries, 12 mph	No Leaks	
12:30 PM	1,080	74	54	Snow Flurries, 12 mph	No Leaks	
12:45 PM	1,080	76	55	Partly Cloudy, 12 mph	No Leaks	Bled off 6oz water from 1080 psi to 1039 psi
1:00 PM	1,042	76	55	Partly Cloudy, 11 mph	No Leaks	
1:15 PM	1,046	78	56	Partly Cloudy, 10 mph	No Leaks	
1:30 PM	1,053	78	56	Partly Cloudy, 10 mph	No Leaks	
1:45 PM	1,057	78	56	Partly Cloudy, 11 mph	No Leaks	
2:00 PM	1,059	78	57	Partly Cloudy, 11 mph	No Leaks	
2:15 PM	1,061	79	57	Partly Cloudy, 11 mph	No Leaks	
2:30 PM	1,064	79	58	Partly Cloudy, 11 mph	No Leaks	**END TEST**
2:45 PM	1,064	80	58		No Leaks	**15 MINUTE ADDITIONAL HOLD**
3:00 PM	756	80	58		No Leaks	Bled to 75%
3:15 PM	509	80	59		No Leaks	Bled to 50%
3:30 PM	256	80	59		No Leaks	Bled to 25%
3:45 PM	269	80	59		No Leaks	
4:00 PM	4	80	58		No Leaks	Bled to 0%, Removed Gauge and stopped Charts

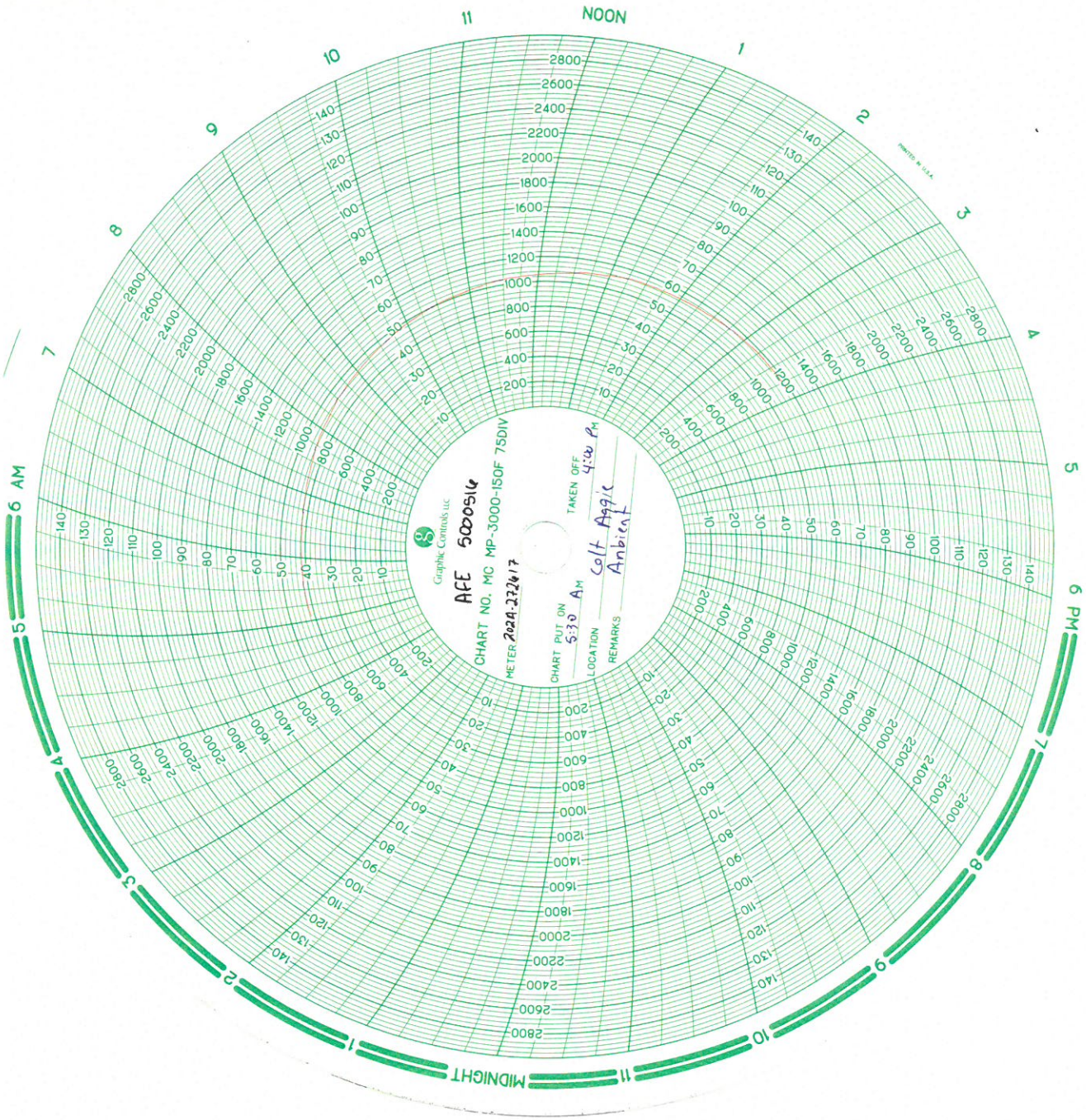
Comments

Pressure Test is :

Recorded by : Marc Nichols — (Contractor Representative) Print/Sign — 4/17/21 (Date)

Witnessed by: Jorge Holguin — (Inspector/Integrity Representative) Print/Sign — 4/17/21 (Date)

Approved by : Ralph h. Cox — (Project Mgr./Construction Mgr.) Print/Sign — 4-17-21 (Date)


NOON
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6 PM
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11
MIDNIGHT
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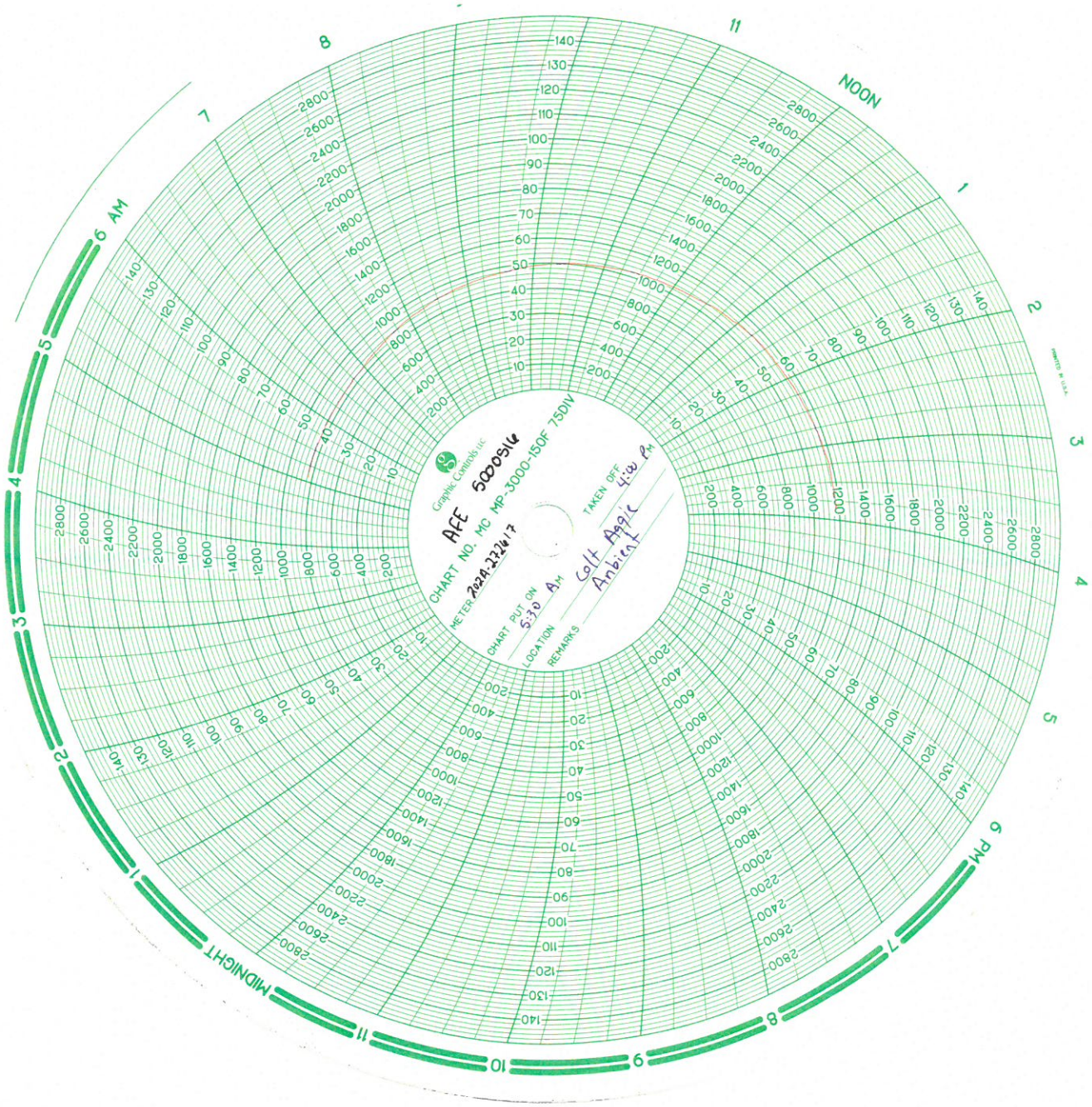
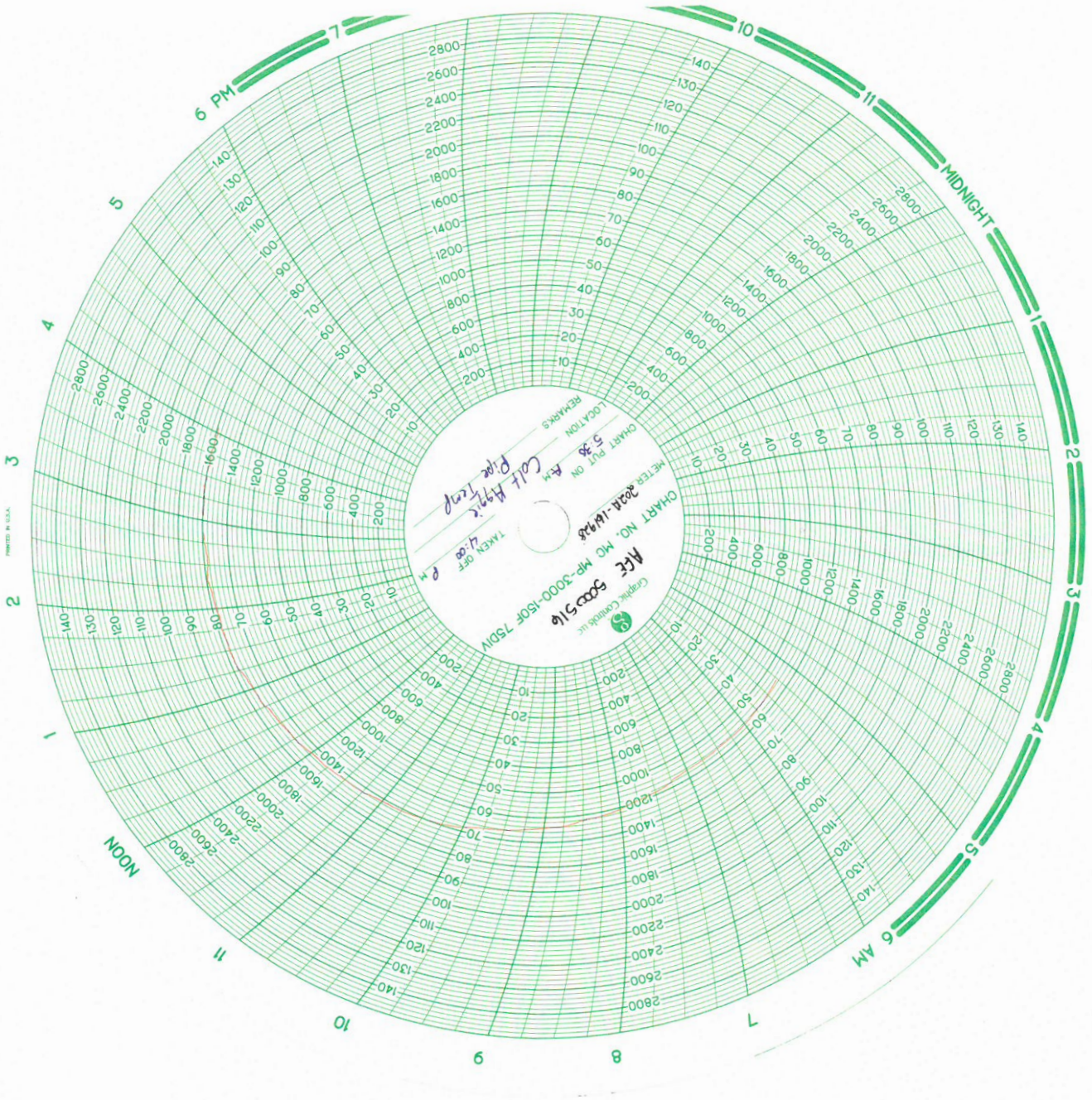
5
6 AM
7
8
9
10
11
Graphic Controls LLC
AFE 5009516
CHART NO. MC MP-3000-150F 75DIV
METER 2024-272417
CHART PUT ON 5:30 AM
TAKEN OFF 4:30 PM
LOCATION Colt Apgar Ambient
REMARKS
PRINTED IN U.S.A.


Graphic Controls LLC
CHART NO. MC MP-3000-150F 7DIV
METER
CHART PUT ON
LOCATION
REMARKS
TAKEN OFF
NOON
6 AM
MIDNIGHT
6 PM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MIDNIGHT
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6 AM
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NOON
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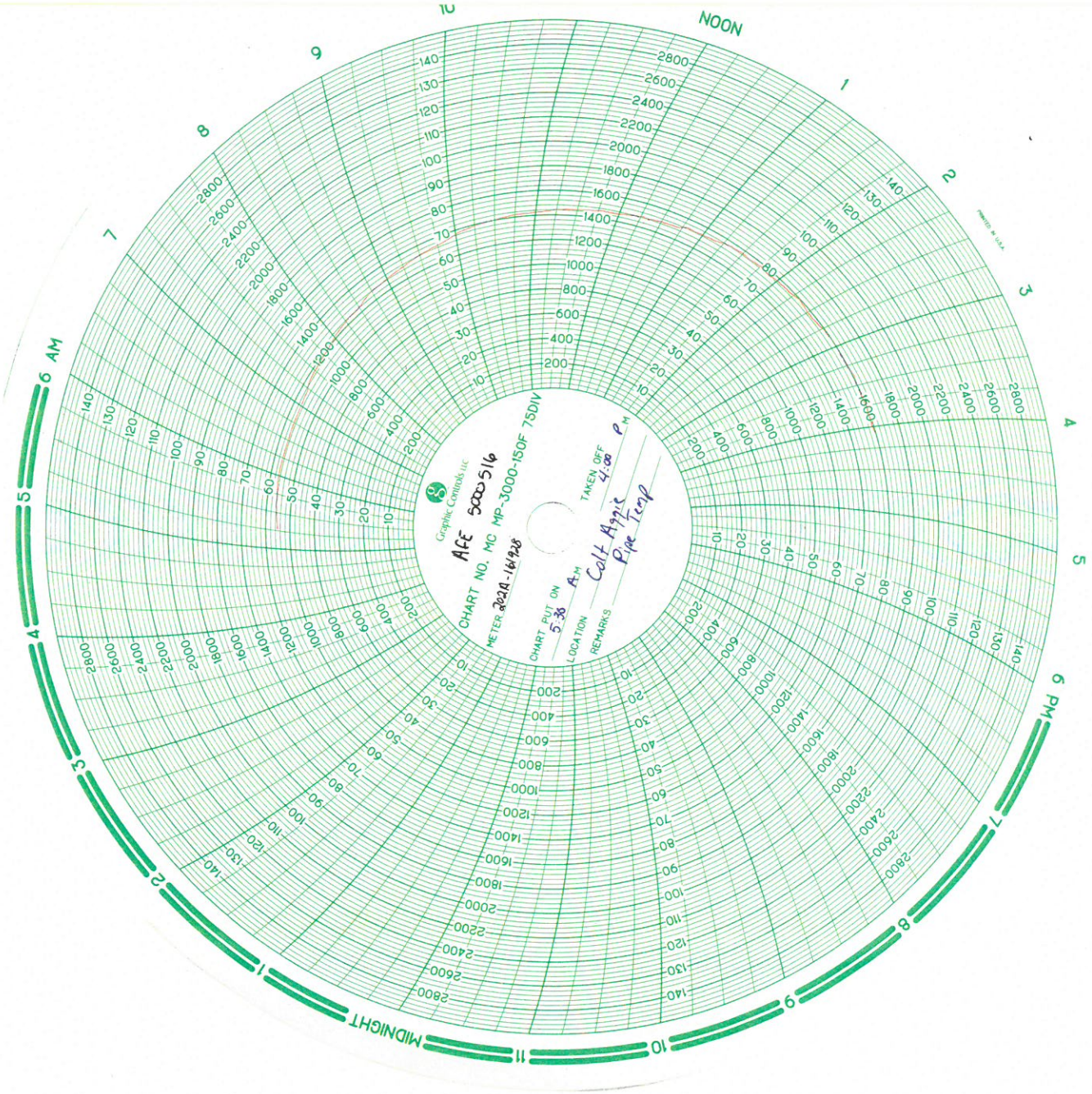
5
Graphic Controls LLC
CHART NO. MO MP-3000-150F 7DIV
METER 2024-16948
CHART PUT ON
5:30 A.M.
TAKEN OFF
4:00 P.M.
LOCATION
REMARKS
Cold Aging
Pipe Temp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6 PM
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11
MIDNIGHT
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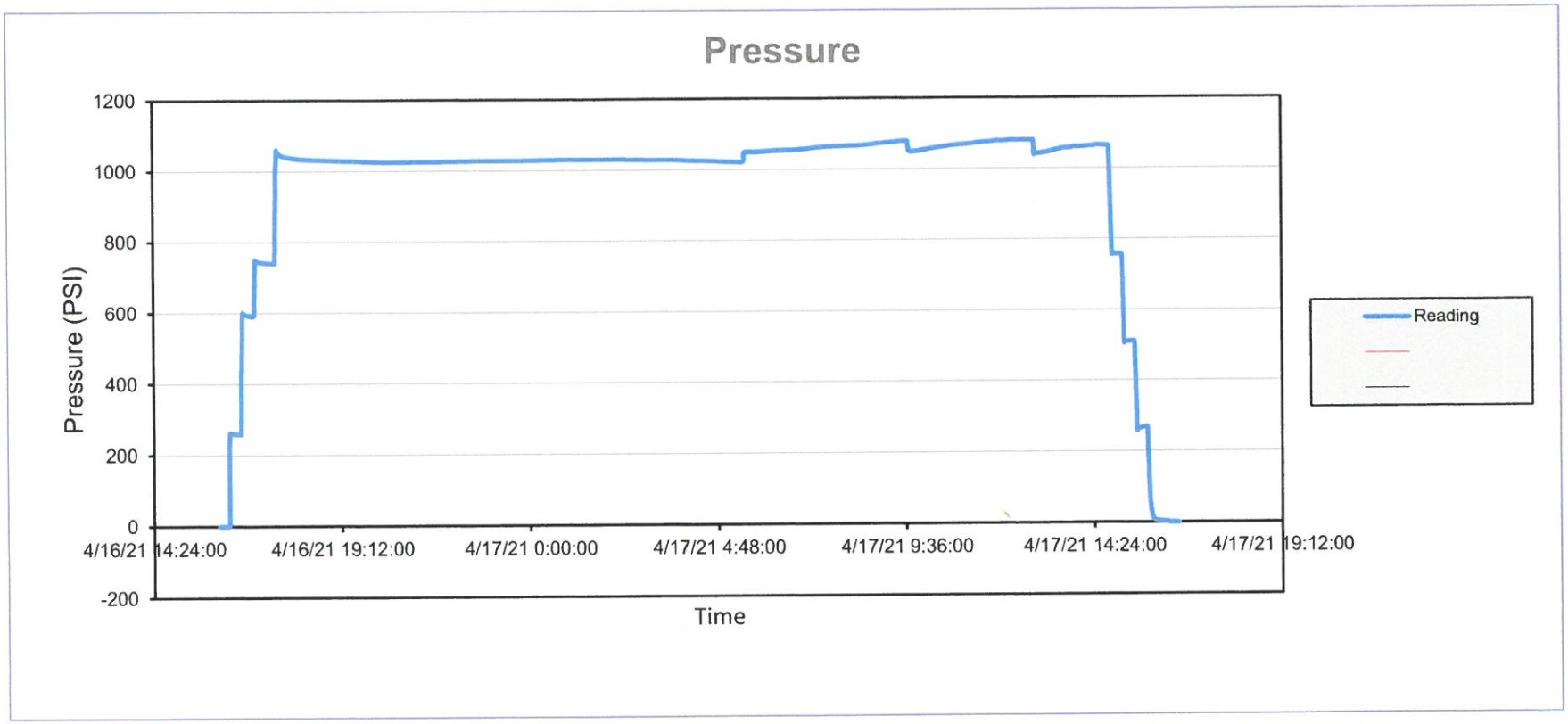
3
4
5
6 AM
7
8
9
10
11
Graphic Controls LLC
CHART NO. MC MP-3000-150F 750IV
ACE 5000516
METER 202A-161928
CHART PUT ON 5:38 A.M
TAKEN OFF 4:00 P.M
LOCATION Colt Argyle Pipe Temp
REMARKS

Data Collection Report

Gauge Information	
Serial Number	904787
Model	3KPSIXP2I
Message Store	----------
Units	PSI

Run Info	
Start Time	4/16/21 4:03:53 PM
Stop Time	4/17/21 5:15:37 PM
Logging interval	20
Location	Colt Aggie



Certificate of Accredited and Traceable Calibration

LAERIE
Calibration & Metrology Services

Laerie, Inc. Issues this Certificate of Calibration to:

Cross Country

2251 Rifle St Aurora, CO 80011

Certificate Number: 93968.1779

Customer Purchase Order: DUR

Calibration Order: **CAL-1**

For Asset: **AFFIRM5**

This calibration is traceable to the international system of units(SI), through National Institute of Standards and Technology (NIST).

Hutchinson's method is used including Guard Banding and TUR Strategy, False-Accept Risk normal distribution and 95% confidence level typical with coverage factor of 2.

Cross Country : accepts and understands measurement uncertainties and risk assessment in all measurements involved in calibration.

Manufacturer	Model	Serial Number	Description	Calibrated	Int. MTh's	Re-Cal
Crystal Pressure	XP2i	903921	Digital Test Pressure Gauge	24-Feb-2021	12	24-Feb-2022

C-Procedure	Environmental	As-Received Physical Condition(s)
MPS	73.4°F ±9°F, 40 to 65%RH	1) AS-Received Annual maintenance performed, nominal exterior cosmetic wear, exterior cleaned where possible, initial inspection PASS.
Calibration Event:		

1FL: Calibration performed no adjustments required or performed.

Primary Standards Traceability Number Used in Calibration

REF	Projected Re-Cal.	Description	REF	Projected Re-Cal.	Description
40023	8/2021	Pressure Calibrator			

Comments:

www.laerie.com

Veridical Review By:

L. E. Armfield CEO/President

TCC 2020-16C

Laboratory Altitude: 5,044 Ft.

56 Gateway Circle Berthoud, Colorado 80513
877-532-7990 970-532-7990

Procedure Executed by:

JRN

CALIBRATION LOCATION: Laerie Inc. Laboratory

Certificate of Accredited and Traceable Calibration

LAERIE Calibration & Metrology Services

Laerie, Inc. Issues this Certificate of Calibration to:

Cross Country

2251 Rifle St Aurora, CO 80011

Certificate Number: 189035.9132

Customer Purchase Order: DUR

Calibration Request: **CAL-1**

For Asset: **AFFIRM4**

This calibration is traceable to the international system of units(SI), through National Institute of Standards and Technology (NIST).

Hutchinson's method is used including Guard Banding and TUR Strategy, False-Accept Risk normal distribution and 95% confidence level typical with coverage factor of 2.

Cross Country : accepts and understands measurement uncertainties and risk assessment in all measurements involved in calibration.

Manufacturer	Model	Serial Number	Description	Calibrated	Int. MTh's	Re-Cal
Crystal Pressure	XP2i	904787	Digital Test Pressure Gauge	24-Feb-2021	12	24-Feb-2022

C-Procedure	Environmental	As-Received Physical Condition(s)
MPS	73.4°F ±9°F, 40 to 65%RH	1) AS-Received Annual maintenance performed, nominal exterior cosmetic wear, exterior cleaned where possible, initial inspection PASS.
Calibration Event:		

1FL: Calibration performed no adjustments required or performed.

Primary Standards Traceability Number Used in Calibration

REF	Projected Re-Cal.	Description	REF	Projected Re-Cal.	Description
40023	8/2021	Pressure Calibrator			

Comments:

www.laerie.com

Laboratory Altitude: 5,044 Ft.

56 Gateway Circle Berthoud, Colorado 80513

877-532-7990 970-532-7990

Veridical Review by:

L. E. Armfield CEO/President

TCC 2020-16C

Procedure Executed by:

JRN

CALIBRATION LOCATION: Laerie Inc. Laboratory

Cross Country Infrastructure Services. Inc

Sales and Service

2251 Rifle Street - Aurora, Colorado 80011

Phone 303.361.6797 Fax 303.361.6836

Pipe Temp

NIST CALIBRATION DATA

Model Number	Serial Number	Customer	Range	Accuracy
Barton	202A-161928	1888	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
	63 Deg	63 Deg
	110 Deg	110 Deg
	150 Deg	150 Deg

PO Number	Sales Order Number	Date of Test
Calibrated	Certified	5/7/2020 8:40:38 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 5-7-20

Cross Country Infrastructure Services. Inc

Sales and Service

2251 Rifle Street - Aurora, Colorado 80011

Phone 303.361.6797 Fax 303.361.6836

AMB Temp

NIST CALIBRATION DATA

Model Number	Serial Number	Customer	Range	Accuracy
Bartom	202A-272617	1888	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
	67 Deg	67 Deg
	104 Deg	104 Deg
	149 Deg	149 Deg

PO Number	Sales Order Number	Date of Test
Calibrated	Cerified	5/7/2020 11:00:26 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 5-7-20

noble MIDSTREAM PARTNERS

Wells Ranch Colt Aggie

Non-Piggable Replacement

B31.4

General

CL300 Piping/750#Flexsteel

Hydrostatic Pressure Test Procedure

REV	DATE	BY	DESCRIPTION	CHKD	APPVD
3	03/02/2020	MJS	Re-Issued for Use		
2	02/04/2020	MJS	Re-Issued for Use	MJS	
1	11/01/19	TKC	Revised per Client Comments	MS	
0	11/01/19	TKC	Issued for Construction		

Noble Midstream Partners, LLC

Hydrostatic Pressure Test Procedure

Doc. No. N/A

TABLE OF CONTENTS

Revision History		
Revision	Section	Description
2	1	Modification to an incorrect reference to CL150 piping being included in the scope of this procedure.
3	2.2	Updated to note that only a 4 hour test is required for aboveground piping.

1 EXECUTIVE SUMMARY

This procedure defines the requirements for the hydrostatic pressure testing of **General CL300 Piping / 750 Flexsteel at Wells Ranch Wellpad Connections**. 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 1.1 materials between -20 °F and 100 °F.

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

This procedure may be used in conjunction with a site-specific test plan where applicable.

This procedure is acceptable to use with ASME Class 300 carbon steel piping being installed under B31.4.

This procedure assume flexsteel adapter flanges are ASME Class 300 per flexsteel standard.

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.*

2.1 TEST PRESSURE

The **General CL300 Piping, 750# Flexsteel** upper and lower bounds of the test pressures are derived from ASME B16.5 and ASME B31.4.

The **General CL300 Piping, 750# Flexsteel** maximum internal design pressure is **740 PSIG at 100°F**, limited by the flange rating.

The **General CL300 Piping, 750# Flexsteel** maximum hydrostatic test pressure shall be **1,125 PSIG** per B16.5 maximum flange allowable hydrostatic pressure.

The **General CL300 Piping, 750# Flexsteel** piping specification minimum hydrostatic test pressure is defined by B31.4 minimum test pressure requirements.

Table 1: Upper and Lower Bound Test Pressures

ASME Flange Classification	Design Factor	Spec Design Pressure - DP (psig)	Minimum Test Pressure 125% DP (psig)	Maximum Test Pressure 150% DP (psig)
300	.72	740	925	1125

2.2 TEST DURATION

For aboveground piping, the hydrostatic test pressure shall be maintained for **4 hours** after final test pressure has stabilized.

For underground piping, 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 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

If required, the pump discharge piping shall be equipped with an in-line filter capable of capturing debris greater than the maximum allowable particle size specified by the Noble representative. Pressurization Pump

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.

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 **1175 PSIG**.

2.5 QUALIFICATION OF CONTRACTOR AND OPERATOR PRESONNEL

Qualifications of contractor and operator personnel for conducting pressure tests will be based on certification requirements by 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.

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.**

Contractor to confirm with Noble representative if water sample is required for record prior to work permit issuance.

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

If line fill water volume is required see Noble Midstream Engineering Representative.

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.

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.

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 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 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)*

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.

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 **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

See Noble Representative to determine if drying operations are required.

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

Drying shall be accomplished by sweeping the pipeline with nitrogen. The pipeline must be dried until the **dew point** temperature in the pipe is **-40 °F** or value approved by the Noble Representative.

Upon completion of the nitrogen sweep, a **5 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
- Hydrostatic Test Log, including:
  - Date and time of the test
  - Test duration
  - 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) "FlexSteel Technical Manual"
5) "FlexSteel Commissioning Field Notes"
6) Site Specific Hydrostatic Test Plan