noble MIDSTREAM PARTNERS

HYDROSTATIC DATA SHEET (C-8)

Project: SGCI   AFE/Work Order No.:

Pipeline: DSU 33 (Name) (Location)

Testing Contractor: EPS

Pipe O.D.: 6"   Wall thickness: SCH 40S   Grade: TP316/316L   MFG'R:

Test Fluid: Nitrogen   Additive: N/A

Test Location: Greeley yard   Section No.: Produced Water Riser

Instrumentation: in trailer (Location) (Type)

See Attached (Mfg'r) (S/N) (Date Calibrated)

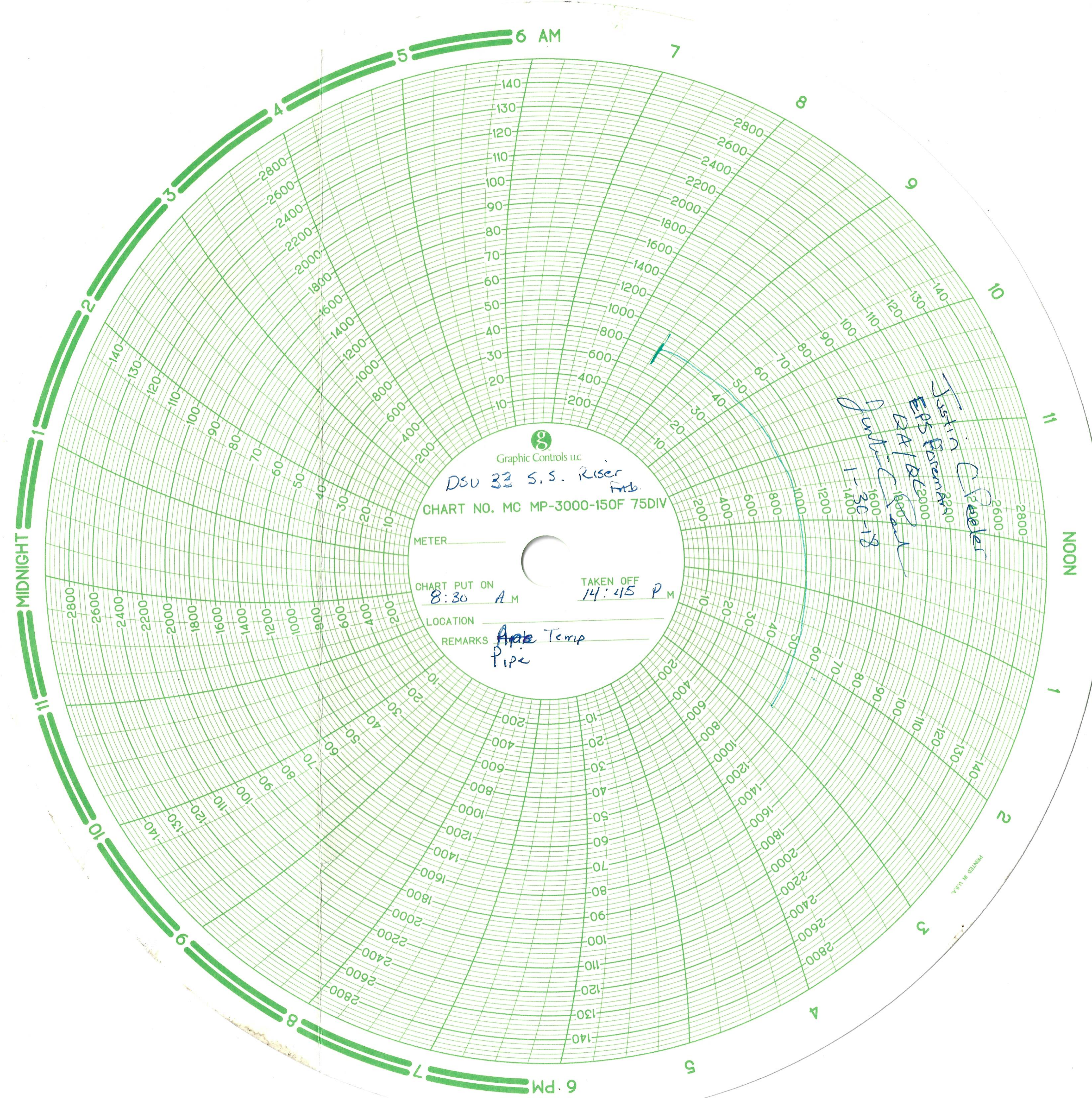
Time	Pressure PSIG	Ambient Temp.	Time	Pressure PSIG	Ambient Temp.	Time	Pressure PSIG	Ambient Temp.
10:35	950	36.04						
10:50	948	36.27						
11:05	946	38.27						
11:20	946	40.65						
11:35	947	40.86						
12:05P	948	42.22						
12:35	950	43.71						
13:05	952	44.95						
13:35	952	45.36						
14:05	950	47.43						
14:35	953	47.87						

Test Started: 10:35 (Time) AM/PM 1-30-18 (Date)   Test Ended: 14:35 (Time) AM/PM 1-30-18 (Date)

Remarks: Bleed 8 lbs total from 13:05 to 14:05

Weather: Mostly Cloudy

	(Name)	(Title)	(Signature)	(Date)
Testing Contractor's Representative	Justin Peeler	foreman	[signature]	1-31-18
Constr. Contractor's Representative				
Company Representative	Jason Knox	Inspection	[signature]	1-31-18
Construction Superintendent				



Graphic Controls LLC
DSU 33 S.S. Riser Fab
CHART NO. MC MP-3000-150F 75DIV
METER
CHART PUT ON 8:30 AM
TAKEN OFF 14:15 PM
LOCATION
REMARKS Pipe Temp
Pipe
Justin C Peeler
EPS Foreman
QA/QC
1-30-18
6 AM
NOON
6 PM
MIDNIGHT

	Chassis	Lower Module	Upper Module	BARO Module	Left Scale	Right Scale
Serial Number	683559	576537	687923		576537	687923
Model	NV	10KPSI	RTD100			
Message Store						
Userspan		1.00000	1.00000			
Offset						
Datatype					Lower	Upper
Units		PSI G	°F		PSI G	°F
Tare						
Average						
User Factor						
User Offset						
User Resolution						
Firmware Version	**R080016**	**R090009**	**R100006**			
Calibration Due		6-Feb-18	6-Feb-18			
Run Index	6					
Run Start Time			30-Jan-18/08:39:58			
Run Duration			6 hours 15 minutes			
Run Tag			DSU33 ss fab			
Logging Interval	300.0					

Data Points

Point #	Time	Left - PSI G	Right - °F
1	00:00:00.0	-1	-459.67
2	00:05:00.0	41	-459.67
3	00:10:00.0	147	37.46
4	00:15:00.0	147	34.26
5	00:20:00.0	247	33.95
6	00:25:00.0	249	33.04
7	00:30:00.0	249	32.31
8	00:35:00.0	248	32.72
9	00:40:00.0	248	32.72
10	00:45:00.0	304	33.39

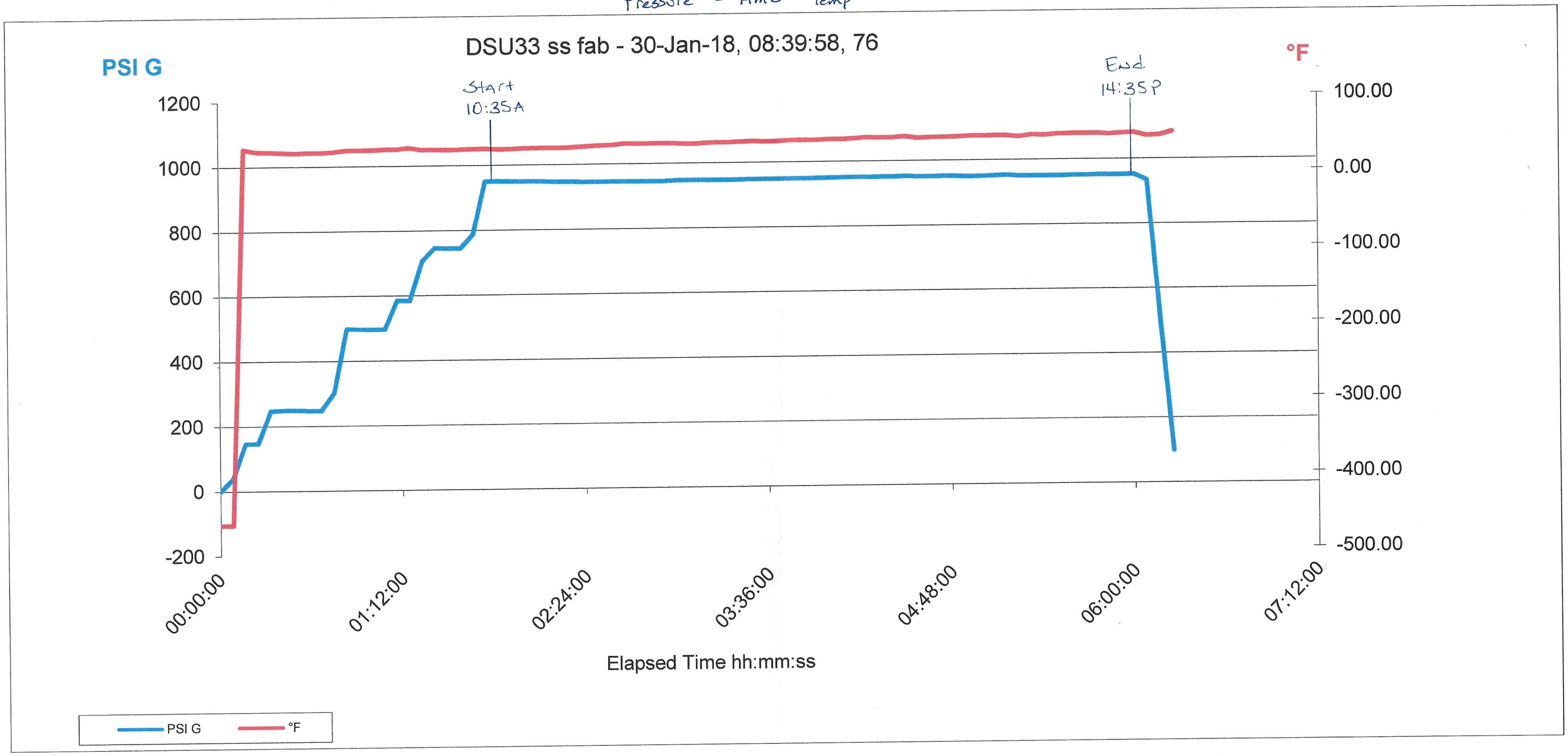
11	00:50:00.0	499	35.58
12	00:55:00.0	497	35.75
13	01:00:00.0	496	35.96
14	01:05:00.0	496	36.36
15	01:10:00.0	586	36.25
16	01:15:00.0	585	38.08
17	01:20:00.0	706	35.65
18	01:25:00.0	746	35.65
19	01:30:00.0	744	35.32
20	01:35:00.0	744	35.57
21	01:40:00.0	788	35.97
22	01:45:00.0	951	36.23
23	01:50:00.0	952	35.39
24	01:55:00.0	950	35.78
25	02:00:00.0	949	36.27
26	02:05:00.0	949	36.57
27	02:10:00.0	948	36.27
28	02:15:00.0	947	36.49
29	02:20:00.0	947	37.24
30	02:25:00.0	946	38.01
31	02:30:00.0	946	38.73
32	02:35:00.0	946	39.56
33	02:40:00.0	946	41.11
34	02:45:00.0	946	40.63
35	02:50:00.0	946	40.64
36	02:55:00.0	946	40.99
37	03:00:00.0	947	40.64
38	03:05:00.0	947	40.16
39	03:10:00.0	947	40.40
40	03:15:00.0	947	40.99
41	03:20:00.0	947	41.17
42	03:25:00.0	948	41.76
43	03:30:00.0	948	42.37
44	03:35:00.0	948	42.00
45	03:40:00.0	948	42.36
46	03:45:00.0	949	42.81
47	03:50:00.0	949	43.13

48	03:55:00.0	950	43.03
49	04:00:00.0	950	44.12
50	04:05:00.0	951	43.82
51	04:10:00.0	951	44.91
52	04:15:00.0	951	45.68
53	04:20:00.0	952	44.99
54	04:25:00.0	952	45.08
55	04:30:00.0	953	46.60
56	04:35:00.0	951	44.41
57	04:40:00.0	951	45.12
58	04:45:00.0	952	45.22
59	04:50:00.0	952	45.64
60	04:55:00.0	950	46.09
61	05:00:00.0	951	46.30
62	05:05:00.0	952	46.60
63	05:10:00.0	953	46.57
64	05:15:00.0	950	45.22
65	05:20:00.0	950	47.16
66	05:25:00.0	950	46.71
67	05:30:00.0	950	48.09
68	05:35:00.0	951	48.33
69	05:40:00.0	951	48.31
70	05:45:00.0	952	48.64
71	05:50:00.0	952	47.15
72	05:55:00.0	952	48.40
73	06:00:00.0	953	49.16
74	06:05:00.0	935	44.95
75	06:10:00.0	500	45.74
76	06:15:00.0	99	50.42

Justin C Peeler
EPS QA/QC
Test foreman
[signature]

1-30-18

Pressure - Amb Temp



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

Calibration Certificate

Certificate Number: 170428

Customer:
Cross Country Pipeline Supply
Aurora, CO

Manufacturer:	Crystal Engineering	*Calibration Date:*	2/6/2017
Model Number:	nVision RTD100	*Due Date:*	2/6/2018
Serial Number:	687923	*As Found:*	In Tolerance
Description:	Temperature Module (RTD)	*As Left:*	In Tolerance
Procedure:	CRY_R_RTD100p	*Temperature:*	72 F
Calibrated To:	Manufacturer's Specifications	*Humidity:*	30 %
Technician:	Austin Molyneux		

Tolerance Specs:

Range: 0 to 400 ohms ; -328 to 1562 degF (PT100 0.00385)

Resistance 0 to 100% of FS: +/- (0.015% of Rdg + 0.02 ohms)
Class B Probe Temperature Deviation: +/- (0.3 + 0.005*T) degC

Technician Notes:

As Left Userspan: 1.00000

Approved Signatory:

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

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

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

Standards Used

Description	Model Number	Serial Number	Calibration Date	Due Date	ID
Multifunction Calibrator	5520A	1044011	3/8/2016	3/8/2017	APX00013
Reference Thermometer Readout	1502A	B64070	5/11/2016	5/11/2017	APX00014
Standard PRT	5628-12-D	3526	5/11/2016	5/11/2017	APX00016

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

Calibration Certificate

Certificate Number: 170429

Customer:
Cross Country Pipeline Supply
Aurora, CO

Manufacturer:	Crystal Engineering	*Calibration Date:*	2/6/2017
Model Number:	nVision 10,000 psi	*Due Date:*	2/6/2018
Serial Number:	576537	*As Found:*	In Tolerance
Description:	Pressure Module	*As Left:*	In Tolerance
Procedure:	CRY_P_nVPM	*Temperature:*	72 F
Calibrated To:	Manufacturer's Specifications	*Humidity:*	30 %
Technician:	Austin Molyneux		

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

Technician Notes:

As Left Userspan: 1.00000

Approved Signatory: [signature]

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.

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

Standards Used

Description	Model Number	Serial Number	Calibration Date	Due Date	ID
Electronic Deadweight Tester	RPM4-E-DWT A100M/A10M	1709	11/2/2016	11/2/2017	APX00024

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
Barton265	8891	Elkhorn Pipeline Srvs.	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	32 DEG
	61 DEG	61 DEG
	91 DEG	91 DEG
	148 DEG	148 DEG

PO Number	Sales Order Number	Date of Test
Recalibrated	Recerted	5/4/2017 10:33:55 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	07/25/2016	14-369A
Tech Instrumentation	TM99A	Thermometer	07/26/2016	56349

Don F.

Signature Don Frick 5-4-2017

Greeley Crescent

Gathering Project

GC – DSU 33 Lateral (CL 300)

Pneumatic Leak Test Procedure

1	7/18/2017	LZT	Issued for Review	DAN	
REV	DATE	BY	DESCRIPTION	CHKD	APPVD

	Noble Midstream Partners, LLC
	Pneumatic Leak Test Procedure
	Doc. No. N/A

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

This procedure is written as a basis for the **eight-hour** leak test performed on various size steel pipelines. The piping and components to be tested using this procedure meet or exceed the pressure requirements of ANSI Class 300.

A pneumatic leak test and a hydrostatic leak test should be analyzed for acceptable practices for applicable codes (listed below). For this procedure, a pneumatic leak test shall be evaluated.

2 PRE-TEST CONSIDERATIONS

Disclaimer: Liquids such as water are preferred as test fluids because less energy is released if something in the test section fails catastrophically. During a pressure leak test, energy is applied to stress the test section. If the test fluid is an incompressible liquid such as water, the energy applied to pressurize the liquid transfers primarily to the pipe and components in the test section. However, if the test fluid is a compressible gas, energy is applied to compress the gas as well as to stress the piping section. If a catastrophic failure occurs during a pressurized liquid leak test, the overall applied energy is much lower, and energy dissipation is rapid. However, if a catastrophic failure occurs during a pressurized gas test, energy release is many times greater, much more forceful, and has a longer duration. *(PPI Handbook of PE Pipe Chapter 2)*

2.1 TEST PRESSURE

The minimum, and maximum test pressures are 925 psig (1.25 x DP) and 975 psig (min + 50 psig), respectively. The **MOP** for this section of pipeline is **700 psig**. The minimum test duration by code is 4 hours at 1.25 x DP and another 4 hours at 1.1 x DP, but **Noble has opted to deliver a more stringent 8-hour test at 1.25 x DP within these test boundaries. Nitrogen will be the preferred test medium.**

The leak test shall comply with the American Petroleum Institute's "Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide." 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, 49 CFR Part 195, and ASME B16.5*.

Minimum Pneumatic Test Requirements: Per *ASME B31.4 Section 437.4.3,* a 1-hour pneumatic leak test may be used for piping systems to be operated at a hoop stress of 20% or less of the specified minimum yield strength of the pipe. The pneumatic test gage pressure shall be 100 psi or that pressure which would produce a nominal hoop stress of 25% of the specified minimum yield strength of the pipe, whichever is less. However, Noble is using the test pressures mentioned above, as they are more stringent.

2.2 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. *(ASTM F2164)*

2.3 TEST EQUIPMENT AND MATERIALS

Equipment for a pressure test should be carefully selected and be in working order. The measurement equipment should be appropriate for the pressures expected during the pressure test.

In some instances, this procedure refers to the recording device used during the test duration as a deadweight tester. It should be stated that a digital recorder can be used in lieu of the traditional deadweight tester. This is verified per *API RP-1110 Chapter 4.3*:

- 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. The device should have a certificate of calibration that is not more than one year old at the start of testing.
- A continuous-recording pressure measurement device (such as a chart recorder) 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 QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL

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

3 TEST PROCEDURE

A site-specific "test plan" for each section should be developed before a pressure test begins. This should include detailed information regarding test pressures, test location points, and the duration of the pressure test.

3.1 LINE FILL AND CLEANING

Note: The following paragraph is for tests conducted on in-service pipelines.

The line fill operation typically accomplishes several functions, such as clean the line, displace product and introduce the necessary test medium into the test segment. It should be noted that pigging operations normally will not remove all hydrocarbons from the piping segment. Residual product, gasses, or vapors may remain in the test segment. Consideration should also be given to running a batch/train of cleaning pigs to remove sediments, paraffin, and so forth from those pipeline segments that are not under a normal pigging program. Residual product, gasses, or vapors may remain in the test segment. Before the actual line filling operation, consideration should be given to run a sizing pig, caliper, or deformation tool in an effort to identify any geometric abnormalities that may exist in the line prior to the test.

Many of the same safety concerns in the Depressurization, Displacement, and Disposal of the Test Medium section, also apply to the use of temporary piping and couplings in the line filling and cleaning process. Temporary piping should be properly anchored and adequately secured from movement. Pipe couplings should have safety devices or restraints to limit movement due to unexpected pipe separation.

Pigs or spheres are usually inserted to separate the nitrogen from the contents in the remainder of the pipeline. Locators may be inserted in the pigs to track them during the filling process and to ensure that the pigs are in the correct location.

The compressor should be sized so that the pigs will travel at a speed that will maintain a good seal with the pipeline. This will reduce the risk of introducing air or other compressible mixtures behind the pigs. A minimum of 2 to 3 mph is a suggested starting point for the velocity of the pigs. High velocities may cause excessive wearing of the pigs and may cause the displaced product, air, or gas mixture to mix with the test nitrogen.

A flow meter should be placed in-line to monitor and maintain the planned design rate of fill. The meter will allow the test personnel to make adjustments as necessary as pressure builds and fill rates drop as the line pack progresses. It will also assist in matching the actual fill volume with the calculated fill volume. To a lesser extent, tank level or tank gauging equipment may also be used for this purpose.

If possible, excavated segments should be backfilled prior to the initial pressurization. The sensor on each temperature recording device should be installed so that it is in contact with the pipeline at a point where it has normal cover. Additionally, it should be at a distance far enough from the injection point so that the effect of the exposed piping and make-up injection(s) on temperature is minimized. The backfill around the recording temperature device sensor should be tamped. Insulation, if appropriate, should be used on the capillary lines to the temperature recorder, and the temperature recorder should be installed in an insulated box. The temperature of the buried line should be recorded until the pressure test is completed. *(API RP 1110)*

3.2 INITIAL PRESSURIZATION

Keep safety in mind at all times! A pipe maintained at high pressure is potentially dangerous. Established safety guidelines should be followed at all times.

Personnel conducting the test should 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. All temporary piping and test heads should be adequately secured before the pressurization process is started.

Initial pressurization of the section should occur at a controlled rate to avoid surging the pipeline. The site-specific test plan should determine the pressurization rate up to the target test pressure **(the pressurization rate is typically 10 PSIG/MIN or lower)**.

It is recommended that all flanges in the test section be duct taped, and punctured with small holes around the flange. Then, soapy water should be put around the duct taped flanges. Pressurization should commence at 10 PSIG/MIN until the pressure is at 10 PSIG. All duct taped flanges should be checked for bubbling on the soapy water. This would indicate an improper seal on the flange. If this is present, ALL PRESSURIZATION SHOULD CEASE. The line should be de-pressurized and the adequate repairs made. All repairs must be made and approved by the Noble Representative prior to commencing another pressure test.

Once this is complete, all personnel should move to a safe distance of 200 feet away from the pipe.

Pipe connections should be periodically checked for leaks during the pressurization process. The flow rate should be monitored and logged for the preparation of a pressure-volume plot, if applicable. Calculations indicating the amount of the nitrogen that is required to increase the pressure from the fill pressure to the test pressure should be made prior to the pressure test and made available to test personnel. This information aids in determining the tightness of the segment and assists in determining, along with the pressure-volume plot, if leaks have occurred or if the pipe has yielded.

It is preferable for a pressure-volume plot to 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.

Once 80% to 90% of the target pressure is reached, the rate of pressurization should be reduced, especially when the pressure is at or near 100% of the target pressure. Prior to the start of the test, it may be desirable to have a stabilization period, which would allow both the temperature and pressure to stabilize. A 1 to 2 hour stabilization period is required once 80% of the target pressure is reached. Once the desired test pressure is reached, the pressurization equipment should be stopped and isolated from the section. *(API RP 1110)*

3.3 THE TEST PERIOD

When the test pressure is reached, pressurization should cease and all valves and connections to the line should be inspected for leakage. After inspecting for leakage, test personnel should verify that the specified test pressure is being maintained. Pressure transients may occur during the pressurization process and residual air may go into the solution. A period of temperature stabilization may be required before the start of the test. The time required for thermal stabilization is dependent on the temperature of the nitrogen at the time of filling, the heat capacity of the nitrogen, pipe diameter, depth of pipe burial, and the ground temperature. The test period shall begin after the temperature of the nitrogen, pipe temperature, and ground temperature has stabilized. When this stabilization process has been completed, the injection pump should be isolated from the test section.

Pressure and temperature should be continuously monitored during the test, and all of the pressure and temperature readings should be recorded. Deadweight tester comparisons with pressure recorder readings should be made at the beginning of the test, periodically during the test, and at the end of the test. The results of the deadweight tester checks and temperature readings should be recorded on the pressure and temperature logs for the predetermined intervals during the pressure test. Typically, temperature and pressure data are recorded every half hour throughout the duration of the test. Weather changes, such as the development of rain or clouds that could affect the pressure and temperature should be documented on the test log. The volume or pressure of any added or subtracted nitrogen should be documented on the test log, as well as the temperature and pressure at that time and be accounted for in the assessment of the results of the pressure test. It is mandatory that the volume of any nitrogen added or removed be accounted for to determine if the pressure test has been completed without evidence of leakage for any pressure test of piping that cannot be 100% visually checked for leaks.

Minor or gradual pressure changes during the test can be a result of residual air in the segment, temperature effects, or leaks through loose connections. Extending the test duration may be necessary to demonstrate that air and temperature effects have been accounted for. *(API RP 1110)*

3.4 PRESSURE TEST FAILURES

The site-specific test procedure should specify the preferred method(s) for locating leaks or failures. 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. A visual inspection is usually performed on all fabricated assemblies.

Pipe, valves, fittings and test components that fail during a pressure test should be investigated to determine the cause and to minimize the possibility of a recurrence. Any leaks or failures of the pipeline should be properly documented in the test report. Proper documentation will be vital to subsequent investigations and follow-up activities.

The mode or manner of failure will be important and will guide any subsequent actions taken by Noble Midstream Partners.

- If a rupture or a substantial leak occurs, the test should be stopped to determine the cause and the necessary steps should be taken to repair the source of leak or area of failure. If possible, the cause of failure should be understood before proceeding with repairs and re-pressurization of the test segment. Initial findings may indicate that changes should be made to test pressures or test procedures. Pipe or other failed components should be preserved for further examination and failure analysis if necessary. Once repaired, the test should be restarted with a new hold period.
- If a small leak occurs, the pressure should be reduced to an appropriate level while locating the leak. After repairs, the test should be restarted with a new hold period.

If leaks are discovered, the line should be depressurized and temporary or permanent repairs made. The line may be re-pressurized following the repairs. Temporary repairs may be used for the test if allowed by company procedures. Permanent repairs should be made prior to starting or returning the pipeline to service. The operator should confirm that there is no evidence of leakage by performing an additional leak test or conducting a leak survey.

Although it is not desirable, it is important to note that a small amount of leakage from ancillary piping and/or the test equipment may be acceptable if the piping/equipment will not be part of the final pipeline system and if it is allowed by the governing regulations and/or design codes. Any leakage from ancillary piping and/or the test equipment should be accurately measured and accounted for as part of the acceptance criteria calculations. *(API RP 1110)*

3.5 SEARCHING FOR LEAKS

Locating leaks can be a difficult and time-consuming process. Various methods and techniques may be used to improve Noble's ability to find leaks during a pressure test. *API RP 1110* recommends the following:

- 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.

3.6 DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF THE TEST MEDIUM

As part of the site-specific procedure for removal of the nitrogen from the test section, release rates and velocity should be considered in the design of the removal system and the potential environmental impacts caused by erosion, drainage, and flooding. Nitrogen removal lines should be properly anchored and compatible with the service pressures expected during the removal of the nitrogen. Significant and sudden variations in pressure often occur within the main pipeline and temporary removal lines. These sudden pressure changes produce surges that are transferred from the main pipeline to the temporary removal line. This can result in movement of the temporary removal line, as it is possible for these sudden changes in pressure to exceed the working pressures and bending capabilities of the temporary removal piping system. Movement can also occur when the entire removal manifold is inadequately designed for the stresses that can be imposed while removing the nitrogen. *(API RP 1110)*

Once testing has been completed, depressurization should follow a control plan outlined in the pressure test plan. The control plan should indicate the number of locations to bleed off pressure. Release points should be monitored.

A minimum 6-foot blow off stack should be used when depressurizing the test nitrogen. This is due to safety concerns of oxygen displacement when nitrogen is released into the atmosphere. A four gas detection monitor should be worn by any personnel in the discharge area to notify personnel if any oxygen deficiency has occurred. A minimum 5 psig nitrogen blanket should be left in the pipeline until it is ready to be put in service.

4 TEST DURATION RESULTS

The particular conditions for the pneumatic test on the **Greeley Crescent DSU 33 Lateral Line** were modeled and analyzed. It was determined that the **484 foot** stretch of **3 and 8-inch** pipe being pneumatically tested contains an estimated volume of **167 cubic feet**. An estimated mass of **775 pounds (mass)** of nitrogen is required in order to fill the necessary volume at a pressure of **925 psig**. The fill time at particular fill flow rates, given in cubic feet per minute (cfm), between stabilization periods is shown below:

- Incremental Time to Fill Pipe **0 - 250 psig** @ **136 cfm = 26 minutes**, **23 seconds**
- Incremental Time to Fill Pipe **250 - 500 psig** @ **136 cfm = 25 minutes**, **9 seconds**
- Incremental Time to Fill Pipe **500 - 750 psig** @ **136 cfm = 25 minutes**, **9 seconds**
- Incremental Time to Fill Pipe **750 - 925 psig** @ **68 cfm = 35 minutes**, **13 seconds**

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) 49 CFR Part 195 "Transportation of Hazardous Liquids by Pipeline"
4) ASME B16.5 "Pipe Flanges and Flanged Fittings"
5) PPI "Handbook of PE Pipe"
6) ASTM F2164 "Standard Practice for Field Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems"