BLACK DIAMOND GATHERING	Issued:	Created By:
	Revised: 6/30/16	Revision Number: 1

MOP Establishment and Pressure Testing of Pipelines
TG1601.190

LIQUID PIPELINE
PRESSURE TEST REPORT

Pressure Test Number Ona 9-12-2018

MOP of tested facility is 1480 PSIG

Company: Black Diamond **Operations Area:**

Project: Ward **AFE:** 5000 267

Pipeline:

Section:

Station or Milepost From: 0+00 To: 42+89

BLACK DIAMOND
GATHERING

INSTRUCTIONS

In this worksheet, cells containing formulas are protected against input.
Cells with **BLUE** text labels allow or require input.

General Information	• Complete this Report and attached necessary exhibits for all BDM installed pipelines or pipeline segments or those re-qualified for service. • Fill in all applicable information. If information is not applicable, write NA in the corresponding space on the Report.
Pipe Data	• Record the details for each pipe section tested, including lengths, line fill, pipe fittings, etc. • Add together pipe section lengths and line fill for a total pipe section length and line fill.
Test Water Data	• Enter water source information (i.e., from municipal supply, well, river, lake, pond) in the Test Log or notes section of the Report. • Source water temperature compared to ground temperature can assist with understanding the time for the water to stabilize.
Pressure Calculations	• Elevation or high and low points and the elevation of the test pressure measure sites is required for calculation of the target test pressures.
Test Log	• Fill out the Test Log at the time or the test. This is the actual log of the test. • From the start of filling the test section, record pressure readings from the calibrated test gauge or deadweight tester used in the test. • Record the test pressure and temperatures at intervals of 30 minutes to an hour and as necessary to represent the test pressure during the test period. • The below ground pipe temperature sensor should be placed away from exposed pipe and far enough from the water injection point so that water injected will not affect the readings. • In the Remarks column, enter start of test, end of test, and any remarks concerning unusual events, such as liquid added or withdrawn, weather conditions, etc.
Notes	• Enter all pertinent comments about the test, including such things as weather conditions, radical weather changes, equipment malfunctions, or any other noteworthy event that may affect testing.
Profile	• An elevation profile is required for any test section where the elevation varies more than 100 feet. The following should be noted on the profile: - Location and elevation where test pressure measurements are taken - High and low points - Stationing or mileposts - Horizontal and vertical scale of the drawing • Elevation data is available in electronic format from the KPL mapping system • If electronic elevation data is not available, take profile elevations from survey information or from U.S. Geological Service 7 ½ minute topographical maps.
Failure Log	• Record each failure event that causes the line to be taken "off test". • Enter the date, time, and pressure at the time of failure. • List the apparent cause of the failure if the actual cause cannot be determined. Pipe seam failure or leaking flange, for example, could be entered as the cause of test failure. • Describe the repair method (i.e., changed-out pipe or tightened flange).
Supplementary Documentation	• Check each supplementary documentation attached as part of this test record (i.e., test charts and/or equipment certifications). • Write the corresponding Exhibit Number on the attached supplementary documentation.
Certification	• Signatures of the Company and Contractor representatives in charge of the test are MANDATORY.

BLACK DIAMOND GATHERING

PRESSURE CALCULATIONS

Location of Test Point	Elevation of Test Point	High Point	Low Point
4" Future at Lakeview A	4730 Ft. (Elevation) 0+00 Ft. (Station)	4732 Ft. (Elevation) 30+75 Ft. (Station) _____ Location Name	4722 Ft. (Elevation) 38+00 Ft. (Station) _____ Location Name
Target MOP: 1480 Target Test Pressure Range 1st Min: Maximum: 1902 2nd Min: 1852	Test Duration: 0 hr High Point Low Point	Start Point 4730 Ft. (Elevation) 0+00 Ft. (Station) _____ Location Name	End Point 4730 Ft. (Elevation) 42+89 Ft. (Station) _____ Location Name

TEST LOG

DATE	TIME	PRESSURE	AMBIENT TEMP	BELOW GROUND TEMP	ABOVE GROUND TEMP	REMARKS
9-11-19	12:00PM	274	68	60		Sunny, wind @ 3 Build to 500 PSI
	12:30	504	66	60		
	1:00	504	68	60		Check for leaks
	1:30	505	70	60		
	2:00	505	74	60		
	2:30	506	77	60		
	3:00	507	75	60		
	3:30	508	75	60		Clouds moving in
	4:00	507	70	60		Wind picking up
	4:30	496	70	60		
	5:00	485	70	60		
	5:30	485	71	60		
	6:00	485	67	60		
	6:30	483	66	60		Check for leaks
	7:00	480	63	60		
	7:30	479	64	60		DARK
	8:00	479	64	60		
	8:30	477	62	60		
	9:00	476	60	60		
	9:30	475	60	60		
	10:00	474	60	60		
	10:30	473	58	60		
	11:00	473	55	60		
	11:30	472	54	60		
	12:00AM	471	53	60		

BLACK DIAMOND GATHERING

TEST LOG (CONTINUED)

DATE	TIME	PRESSURE	AMBIENT TEMP	BELOW GROUND TEMP	ABOVE GROUND TEMP	REMARKS
9.12.14	12:30AM	471	52	60		
	1:00	470	51	60		
	1:30	469	50	60		
	2:00	468	49	60		
	2:30	467	48	60		
	3:00	465	46	60		
	3:30	464	48	60		
	4:00	463	46	60		
	4:30	462	47	60		
	5:00	462	47	60		Bleed chart boy down
	5:10	0	47	60		
	5:15	0	47	60		Change charts
	5:45	0	47			
	5:30	461	45	60		Build pressure to 50% = 940 PSI
	6:00	940	47	60		
	6:15	940	47	60		Build to 80% = 1504
	6:35	1504	44	60		Sunrise
	6:50	1504	41	60		Build to 100% = 1877
	7:00	1490	42	60		
	7:15	1877	42	60		
*	7:30	1877	43	60		*BEGIN TEST*
	8:00	1877	50	60		Sunny, no wind
	8:30	1878	54	60		check for leaks
	9:00	1879	61	60		
	9:30	1881	65	61		
	10:00	1883	70	61		
	10:30	1887	77	61		Sunny, wind @ 6 MPH
	11:00	1889	80	61		Shaded above ground piping
	11:30	1893	87	61		to control/slow down gain
	12:00PM	1897	88	61		check for leaks
	12:30	1898	89	60		
	1:00	1899	90	60		
	1:30	1900	91	60		
	2:00	1900	91	60		

BLACK DIAMOND GATHERING

TEST LOG (CONTINUED)

DATE	TIME	PRESSURE	AMBIENT TEMP	BELOW GROUND TEMP	ABOVE GROUND TEMP	REMARKS
9-12-18	2:30 pm	1900	90	60		Sunny hot wind @ 10 mph
	3:00	1900	89	60		check for leaks
*	3:30	1901	89	60		*END TEST*
	3:45	1901	88	60		Bleed to 80% - 1504
	3:48	1504	88	60		
	3:54	1504	87	60		Bleed to 50% - 940
	4:00	939	86	60		
	4:05	939	86	60		Bleed to 0
	4:15	0	86	60		
	4:30	0	86	60		

BLACK DIAMOND GATHERING

TEST EQUIPMENT

PRESSURE RECORDER 1:

Mfg: Barton
Model:
Serial No.: 202A-161894
Range: 0-3000 PSI
0-150° F
Notes: Cal on 7-16-18

PRESSURE RECORDER 2:

Mfg:
Model:
Serial No.:
Range:
Notes:

DEADWEIGHT TESTER OR CALIBRATED TEST GAUGE:

Mfg: Crystal
Model: XP2i
Serial No.: 364359
Date of Last Calibration: 4-14-18
Calibrated By: APEX
Range: 0-5000 PSI
Notes:

TEMPERATURE RECORDER:

Mfg: Barton
Model:
Serial No.: 265-3312
Range: 0-150° F
Notes:
CAL on 7-16-18

CALIBRATION OF TEMPERATURE RECORDER

Temperature recorder reading	Test mercury thermometer reading	Remarks
43	43	S/N 05141802

CALIBRATION OF PRESSURE RECORDER 1

Pressure recorder reading	Deadweight tester reading	Remarks
469	470	S/N 364359

CALIBRATION OF PRESSURE RECORDER 2

Pressure recorder reading	Deadweight tester reading	Remarks

NOTES

BLACK DIAMOND GATHERING

EQUIPMENT CALCULATED MOP SUMMARY WORKSHEET

1. Test Information:

Target MOP 1480

Enter the desired MOP, If less than pipe Internal design pressure.

Date 9-11-2018 Time 10:00 Am

Test Point Location 4" Future Lakeview A on CR 29

Test Medium Water Test Duration 8 hr

Specific Gravity of Test Medium

Min. Test Press. At test site 125% of min. MOP + elv. 1880

Maximum allowable % of SMYS = 150

2. Pipe Specifications:

Manufacture Type

Pipe (#1) O.D. 4.5" MOP 1480

Grade X-52 SMYS 52,000 Seam Joint Factor

Wall thickness .188 Design Factor (F)

Length (ft.) 4289 Volume 71 6615

Max allowable test pressure, psig 2225

3. Pipe Specifications:

Manufacture Type

Pipe (#2) O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Length (ft.) Volume

Max allowable test pressure, psig

4. Pipe Specifications:

Manufacture Type

Pipe (#3) O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Length (ft.) Volume

Max allowable test pressure, psig

5. Pipe Specifications:

Manufacture Type

Pipe (#4) O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Length (ft.) Volume

Max allowable test pressure, psig

6. Pipe Specifications:

Manufacture Type

Pipe (#5) O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Length (ft.) Volume

Max allowable test pressure, psig

7. Pipe Fitting Specifications:

Manufacture Type

Fitting Description

Pipe O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Max allowable test pressure, psig

8. Pipe Fitting Specifications:

Manufacture Type

Fitting Description

Pipe O.D. MOP

Grade SMYS Seam Joint Factor

Wall thickness Design Factor (F)

Max allowable test pressure, psig

BLACK DIAMOND
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EQUIPMENT CALCULATED MOP SUMMARY WORKSHEET (CONTINUED)

9. Pipe Fitting Specifications:

Pipe O.D._____ MOP_____

Manufacture Type_____ Grade_____ SMYS_____ Seam Joint Factor_____

Fitting Description_____ Wall thickness_____ Design Factor (F)_____

Max allowable test pressure, psig

10. Manufactured:

Weldolet, etc. O.D._____ Working Pressure_____

Manufacture Type_____ Grade_____

Fitting Description_____

Max allowable test pressure, psig

11. Manufactured:

Pipe Flanges O.D._____ Working Pressure_____

Manufacture Type_____ Class_____

Temperature Derating Factor (T)_____

Max allowable test pressure, psig

12. Manufactured:

Pipe Flanges O.D._____ Working Pressure_____

Manufacture Type_____ Class_____

Temperature Derating Factor (T)_____

Max allowable test pressure, psig

13. Manufactured:

Block Valve Size_____ Working Pressure_____

Manufacture Type_____ Class_____

Temperature Derating Factor (T)_____

Max allowable test pressure, psig

14. Calculated MOPs (psi):

Test Pressure Range @Test Site, psig | 125% to psig | 110% to psig

Note: Add [ ] psi to min. test range

Maximum test pressure at test site, psig

CALCULATED TARGET MOP OF PIPELINE SECTION PSIG

BLACK DIAMOND
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FAILURE LOG

FAILURE:
Date:_____ Time:_____am / pm Failure Pressures:_____

Apparent Cause: _____

_____

REPAIR:

Describe Repair Method: _____

_____

FAILURE:
Date:_____ Time:_____am / pm Failure Pressures:_____

Apparent Cause: _____

_____

REPAIR:

Describe Repair Method: _____

_____

FAILURE:
Date:_____ Time:_____am / pm Failure Pressures:_____

Apparent Cause: _____

_____

REPAIR:

Describe Repair Method: _____

_____

FAILURE:
Date:_____ Time:_____am / pm Failure Pressures:_____

Apparent Cause: _____

_____

REPAIR:

Describe Repair Method: _____

_____

BLACK DIAMOND GATHERING

SUPPLEMENTARY DOCUMENTATION

The following marked exhibits are attached as a part of this Test Report:

EXHIBIT No. 1	€ Sketch of Tested Piping (including how section is isolated), with material list
EXHIBIT No. 2	€ Profile of pipeline section and/or segment
EXHIBIT No. 3	€ Pressure Chart, with pressure test number, date, test section name, Inspector name and signature
EXHIBIT No. 4	€ Temperature Chart, with pressure test number, date, test section name, Inspector name and signature
EXHIBIT No. 5	€ Pressure Recorder Certification Papers
EXHIBIT No. 6	€ Temperature Recorder Certification Papers
EXHIBIT No. 7	€ Deadweight or Calibrated Test Gauge Certification Papers
EXHIBIT No. 8	€ Field test data log, if handwritten
EXHIBIT No. 9	€ Pressure Test Procedure, if applicable with MOP Area Representative and Engineer signature approval

CERTIFICATION

I certify this pipeline or pipeline section has been tested and successfully met the terms of BDM MOP Establishment and Pressure Testing of Pipelines Technical Guideline and, where applicable, the contract document between BDM and its prime contractor.

MOP Area Representative

By: Charles Wallace (Please print) Charles Wallace (Signature) Date: 9-12-2018

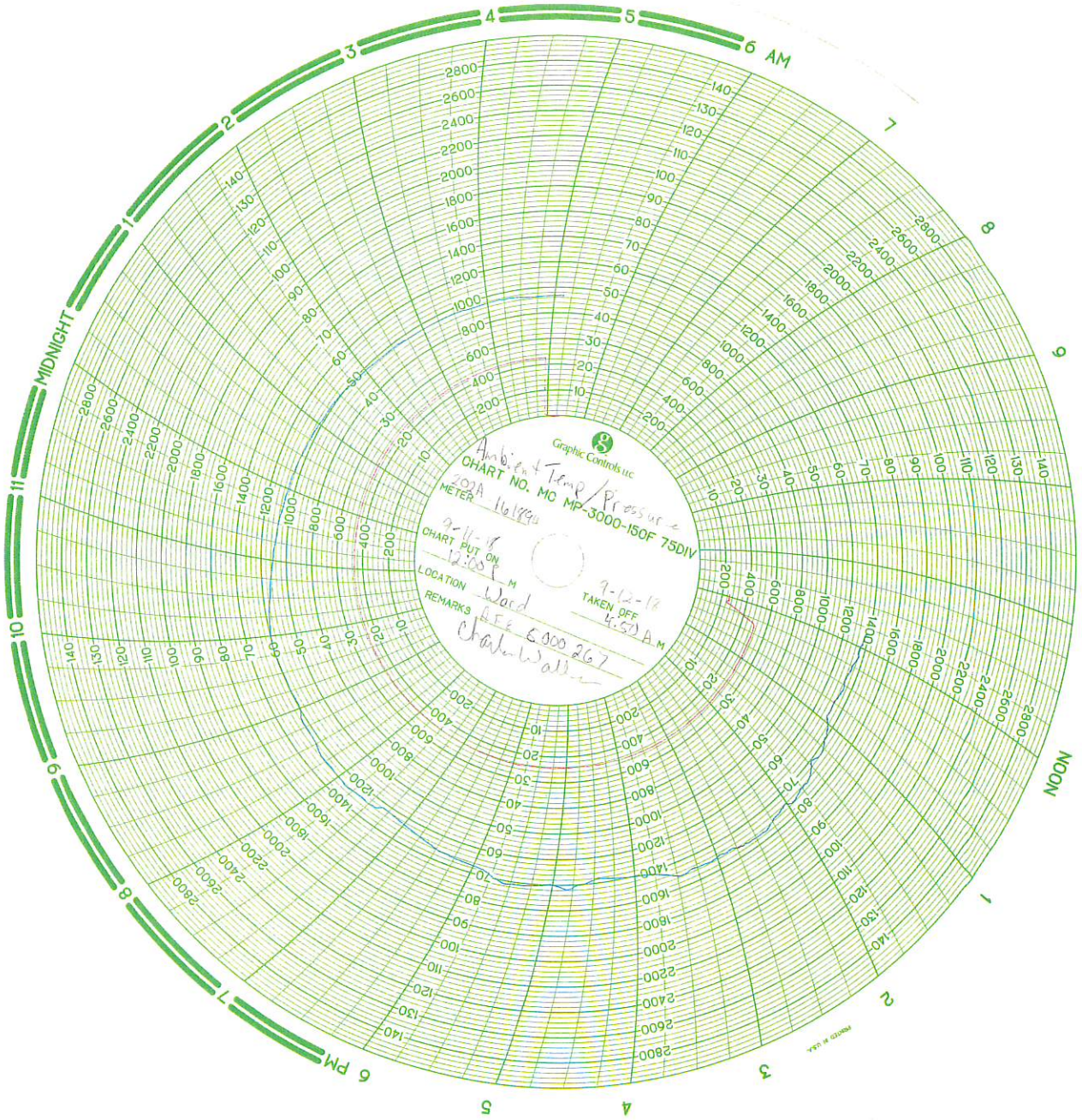
Engineer

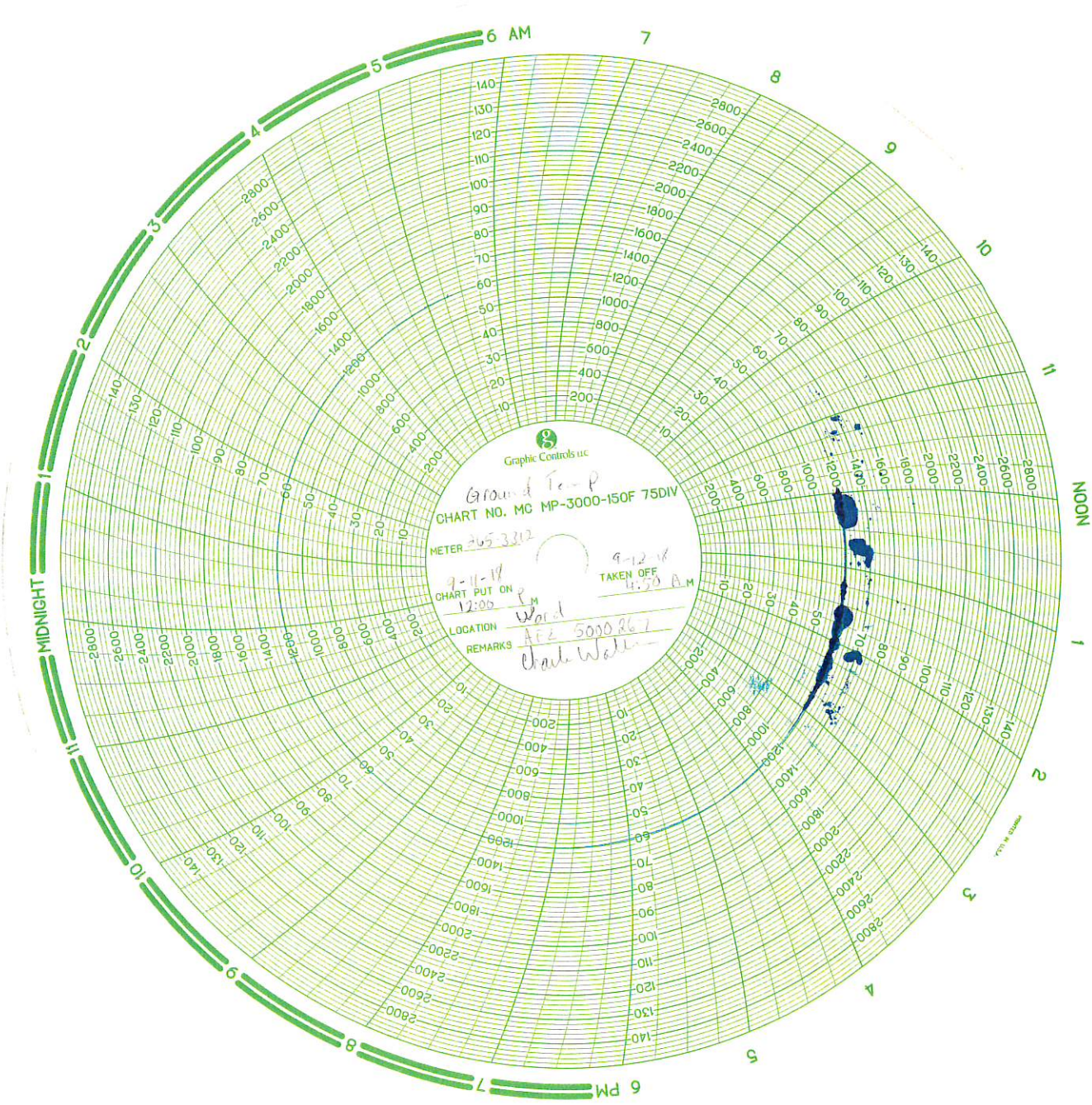
By: _____ (Please print) _____ (Signature) Date: _____

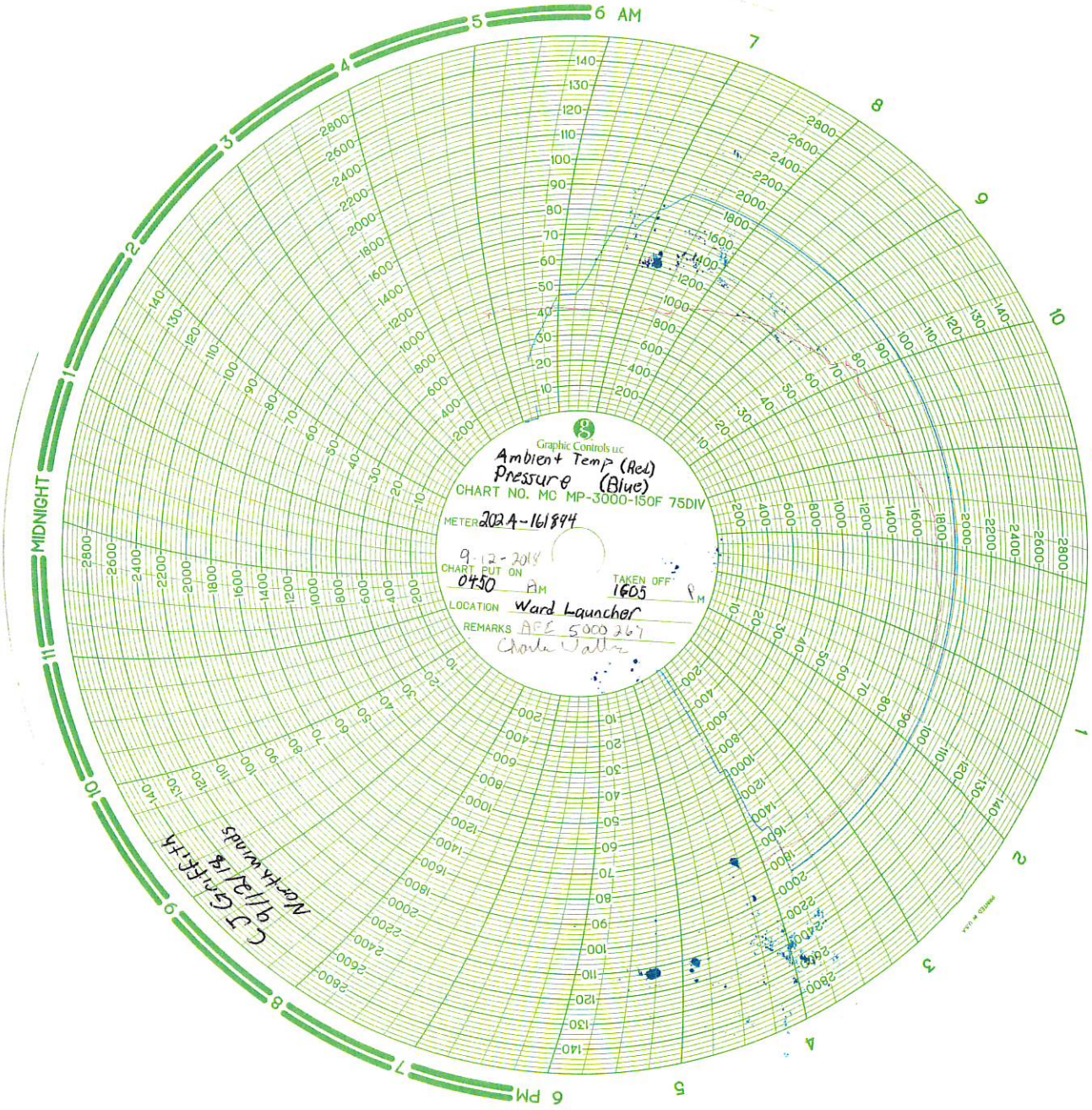
Name of Testing Contractor

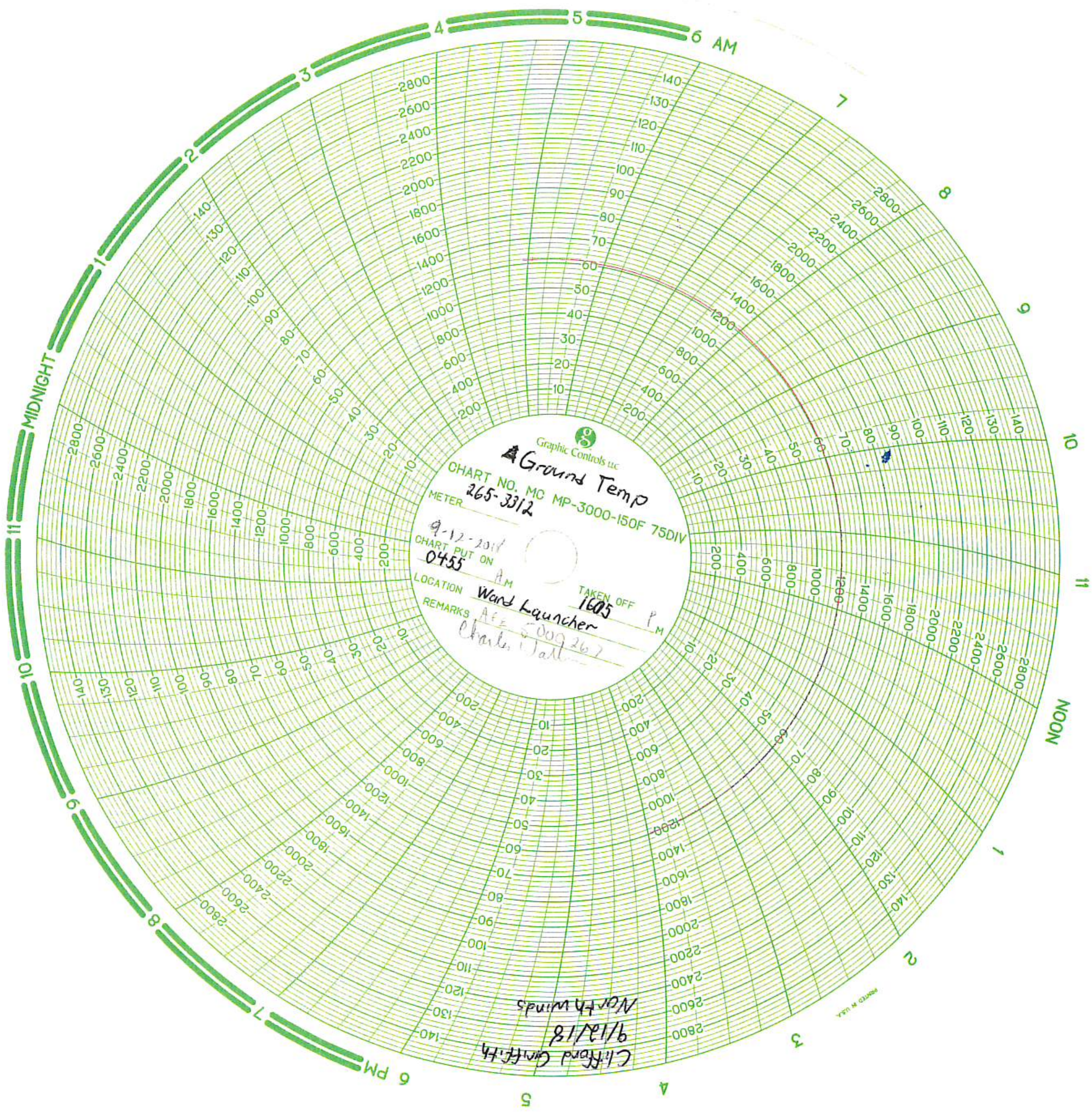
Northwinds of Wyoming

By: Clifford Griffith (Please print) [signature] (Signature) Date: 9-12-18


Graphic Controls LLC
Ambient Temp/Pressure
CHART NO. MC MP-3000-150F 75DIV
METER 207A 161990
CHART PUT ON 9-11-18 12:00 PM
TAKEN OFF 9-12-18 4:52 AM
LOCATION Ward
REMARKS Eff. 6000267
Charles Wall
MIDNIGHT
6 AM
NOON
6 PM


6 AM
NOON
6 PM
MIDNIGHT
Graphic Controls LLC
Ground Temp
CHART NO. MC MP-3000-150F 75DIV
METER 265 3312
CHART PUT ON 9-11-18 12:00 P.M.
TAKEN OFF 9-12-18 4:30 A.M.
LOCATION Wood
REMARKS AFB 5000 Roof Under Wall


Graphic Controls LLC
Ambient Temp (Red)
Pressure (Blue)
CHART NO. MC MP-3000-150F 75DIV
METER 202A-161894
9-12-2018
CHART PUT ON 0450 AM
TAKEN OFF 1605 PM
LOCATION Ward Launcher
REMARKS AFE 5000267
Charlie Salter
MIDNIGHT
NOON
6 AM
6 PM
C-3 Green Fish
9/13/18
North winds


Graphic Controls LLC
Ground Temp
CHART NO. MC MP-3000-150F 75DIV
265-3312
METER
9-12-2018
CHART PUT ON
0455 AM
LOCATION Ward Launcher
TAKEN OFF 1605 PM
REMARKS
MIDNIGHT
6 AM
NOON
6 PM
Clifford Griffith
9/12/18
North Winds

C-4

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
J-W Measure	202A - 168994	North Winds of Wyo.	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
	113 Deg	113 Deg
	144 Deg	144 Deg

PO Number	Sales Order Number	Date of Test
Recalibrated	Recerted	7/16/2018 11:15:27 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	08/08/2017	17-043
Tech Instrumentation	TM99A	Thermometer	08/21/2017	59448

Dan Leigh 07-11-18

CR-2

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: 185016

Customer:
Pipeline Supply & Service
Henderson, CO

Manufacturer:	Crystal Engineering	***Calibration Date:***	4/18/2018
Model Number:	XP2i 5000 psi	***Due Date:***	4/18/2019
Serial Number:	364359	***As Found:***	In Tolerance
Description:	Digital Test Gauge	***As Left:***	As Found
Procedure:	CRY_P_XP2i	***Temperature:***	73 F
Calibrated To:	Manufacturer's Specifications	***Humidity:***	22 %
Technician:	Austin Molyneux		

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

Technician Notes:

As Left Userspan: 1.00049

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
Electronic Deadweight Tester	RPM4-E-DWT A100M/A10M	1709	11/13/2017	11/13/2018	APX00024

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CERTIFICATE of CALIBRATION

Tech Instrumentation
750 East Kiowa Avenue
Elizabeth, CO 80107
(303) 841-7567

Date of Calibration 7/18/2018
Date Due 7/18/2019

Laboratory Test Number 62824

Tested for: Northwinds of Wyoming

PO Number:

Instrument Under Test

Manufacturer: Cooper Instruments

Model: TM99A

Serial Number: 051418021

Manufacturer's specified accuracy: ±0.3°F or ±0.5%

As received, this meter meets specifications (Y/N) Y

After calibration, this meter meets specifications (Y/N) Y

Test Results - Thermometer Only - Resistive Input to simulate an ideal probe

Simulated Temperature	Calibration as Received		After Calibration*	
-31.0°F / -35.0°C	-31.0	-35.0		
-22.0°F / -30.0°C	-22.0	-30.0		
5.0°F / -15.0°C	4.9	-15.0		
34.0°F / 1.1°C	33.9	1.0		
77.0°F / 25.0°C	77.0	25.0		
98.6°F / 37.0°C	98.6	37.0		
113.0°F / 45.0°C	113.0	45.0		
212.0°F / 100.0°C	212.0	100.0		
293.0°F / 145.0°C	293.0	145.0		

*Note: If no "After Calibration" data is provided, no adjustments were made to the calibration of the meter. The calibration was left "As Received".

SYSTEM CALIBRATION RESULTS -

The data below represents your system calibration -- Your thermometer with probe(s). Please note that since this is a system calibration, this certification is valid only with the specific probes tested. If you have multiple meters and/or probes, you must use care not to switch them. The accuracy of our system is at least 4 times better than the specified accuracy of your instrument, unless noted below. Our systems uncertainty used for this calibration is 0.096 °F.

The standard used to verify the calibration of your system is a: Hart Scientific, Model 1502A, S/N: 77946

Calibrated on 10/13/2017 Recall date 10/13/2018

Tech Instrumentation, Inc. certifies that your system meets or exceeds all published specifications unless otherwise noted in the comments section below. The calibration data below was obtained using a measurement standard certfied to ISO 17025 and that is traceable to the National Institute of Standards and Technology (NIST) or natural physical constants, by immersing the probe in a constant temperature bath with our standard which determined the actual test temperature. The results stated on this report relate only to the items specifically noted. This report may not be reproduced except in full, without approval.

Test Procedure Used: TM99A Uncertainty Estimate: ± 0.096 F°

Acceptance Criteria: Manufacturer's Specifications

	Degrees F	Degrees C
Probe Model	1075	
Probe S/N	051418021	
Bath Temp	99.855	37.70
Probe Temp	99.8	37.7

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

	Degrees F	Degrees C
Probe Model		
Probe S/N		
Bath Temp		
Probe Temp		

Authorized Signature: J Pinnell
Jennifer Pinnell

Ambient Temperature: 72°F
Ambient RH: 20%

Comments:

Important Note: Normally we specify a one year re-calibration interval which is a typical industry norm. Due to circumstances beyond our control, we can only guarantee the accuracy of your meter at the time of shipment. Your specific application, depending on the potential consequences which could result from de-calibration of this instrument may warrant a shorter than specified calibration interval. It is up to the user to determine the appropriate re-calibration interval for your specific needs. Regardless of the calibration time frame specified, if there is ever any question regarding the accuracy of this instrument, we recommend sending your meter in for re-calibration.

Cross Country Pipeline Supply CO. Inc
Sales and Service
2251 Rifle Street - Aurora, Colorado 80011
Phone 303.361.6797 Fax 303.361.6836

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NIST CALIBRATION DATA

Model Number	Serial Number	Customer	Range	Accuracy
Barton	265-3312	North Winds of Wyo.	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
	67 Deg	67 Deg
	120 Deg	120 Deg
	150 Deg	150 Deg

PO Number	Sales Order Number	Date of Test
Recalibrated	Recerted	7/16/2018 11:10:34 AM

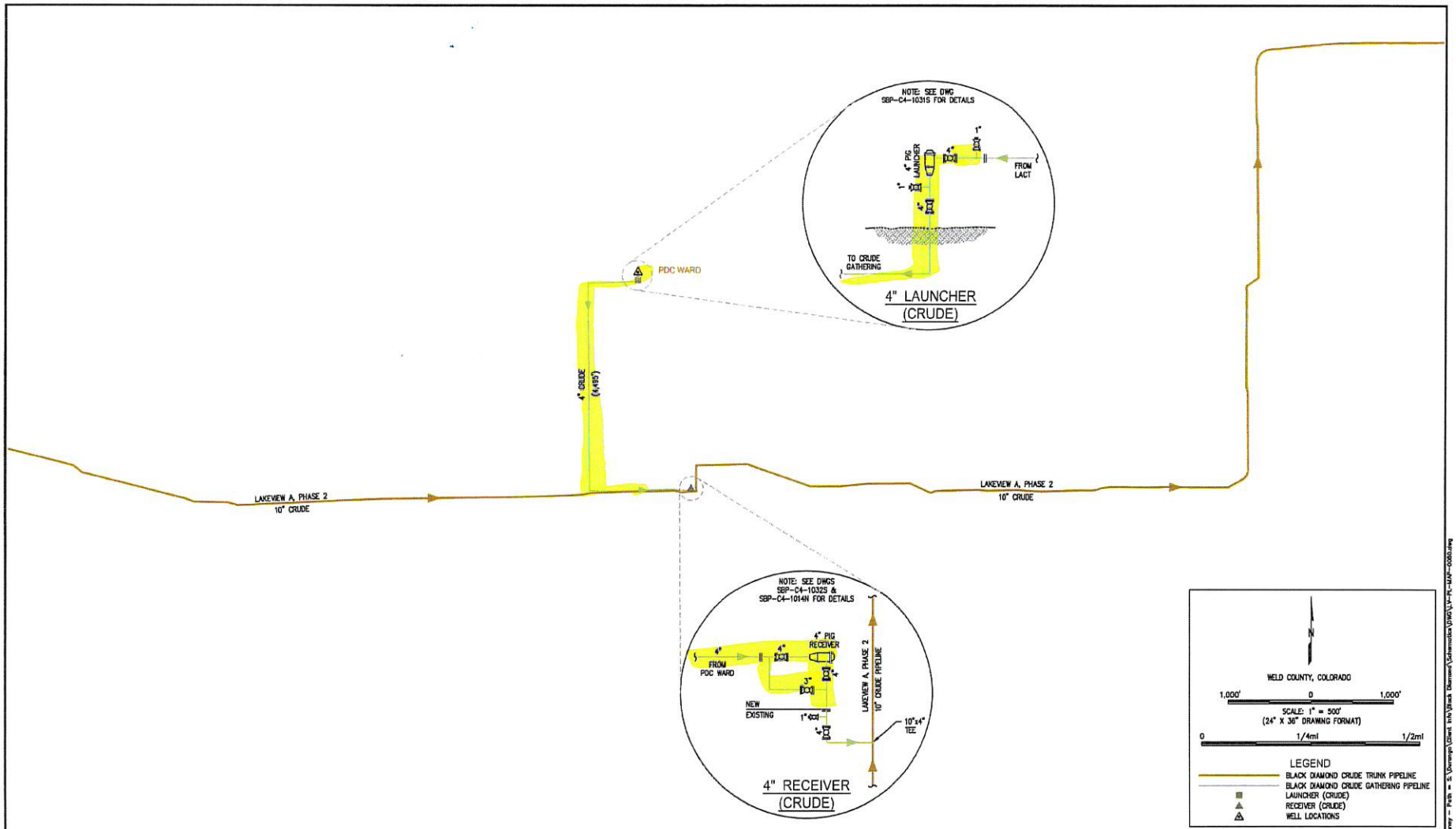
Remarks: ALL CALIBRATIONS ARE GOOD FOR ONE YEAR FROM DATE OF TEST

Standard Used:

Manufacturer	Model	Instrument	Calibration Date	Certification #
Perma-Cal	101FTM15B21	Pressure Gauge	08/08/2017	17-043
Tech Instrumentation	TM99A	Thermometer	08/21/2017	59448

Don F.

Signature Don Frech 7-16-18



NOTES:

1) FLOW SCHEMATIC IS FOR GRAPHICAL REPRESENTATION ONLY.
2) ALL GAS, WATER AND UTILITY LINES SHOULD BE LOCATED PRIOR TO ANY EXCAVATING, DIGGING, OR TRENCHING ANYWHERE ON OR NEAR THIS SITE.
3) CAM ENGINEERING ASSUMES NO RESPONSIBILITY FOR THE SPECIFIC LOCATION OF ANY BURIED GAS, WATER, OR UTILITY LINES THAT MAY BE PRESENT ON OR NEAR THIS SITE, NOR IS ANY LIABILITY ASSUMED FOR ANY LEGAL ACTION WHICH RESULTS FROM A DISCOVERY OF A GAS, WATER, OR UTILITY LINE IN ADDITION TO OR IN A DIFFERENT LOCATION THAN SHOWN ON THIS PLAT.
4) COORDINATE SYSTEM BASED ON NAD 83 COLORADO STATE PLANE, NORTH ZONE.
5) PROPOSED PIPELINE ROUTES FROM IMPORTED SHAPE FILES PROVIDED BY BLACK DIAMOND GATHERING.

REFERENCE DRAWINGS		REVISIONS					
DWG. NO.	TITLE	NO.	DESCRIPTION	DATE	BY	CHK.	APPR.
		1	ISSUED FOR REVIEW	05/30/18	BM	JJJ	JBK

DRAWN BY:	BM 05/30/18
CHECKED BY:	JJJ 05/30/18
REVIEWED BY:	JBK 05/30/18
APPROVED BY:	
SCALE:	SCALE:1" = 500'

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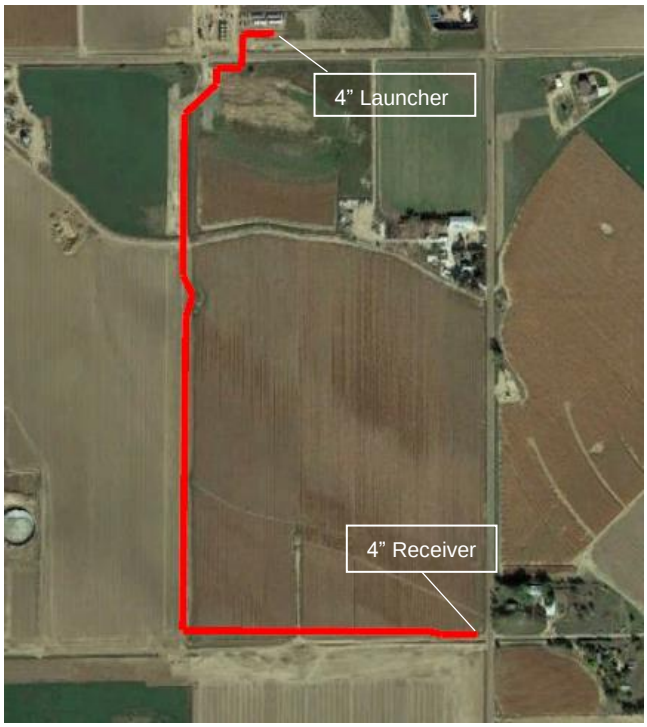
WARD – 4” Oil Pipeline (CL 600)

Hydrostatic Pressure Test Procedure



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	Noble Midstream Partners, LLC
	Hydrostatic Pressure Test Procedure
	Doc. No. N/A

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1 EXECUTIVE SUMMARY

This procedure and the accompanying site-specific Hydrostatic Test Plan define the minimum requirements for the hydrostatic pressure testing of the **WARD – 4" Class 600 Oil Pipeline**. The piping and components to be tested using this procedure meet or exceed the pressure requirements of the ASME Class 600 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.

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, and 49 CFR Part 195.*

2.1 TEST PRESSURE

The **WARD – 4" Class 600 Oil Pipeline** shall be tested at a minimum test pressure of **1,850 PSIG** (125% the internal design pressure) and a maximum test pressure of **2,225 PSIG** (150% the internal design pressure rounded to the next higher 25 psig increment). The upper and lower bounds of the test pressures are derived from *ASME B16.5* and *ASME B31.4 / 49 CFR Part 195* respectively.

The **WARD – 4" Class 600 Oil Pipeline** internal design pressure is **1,480 PSIG**, limited by the flange rating. The pipeline MOP is **1,480 PSIG**.

The **WARD – 4" Class 600 Oil Pipeline** final hydrostatic test pressure shall be **1,880 PSIG** or **1,877 PSIG**, at the point of filling, depending on where the operator chooses to fill the pipeline. See **Table 2** in **Section 3.4** for the two possible locations.

Table 1: Upper and Lower Bound Test Pressures

ASME Flange Classification	Pipeline Wall Thickness (in)	Pipe Pressure Rating (psig)	Minimum Test Pressure 125% DP (psig)	Maximum Test Pressure 150% DP (psig)
600	0.188	1,480	1,850	2,225

2.2 TEST DURATION

The hydrostatic test pressure shall be maintained for **8 hours** after final test pressure has stabilized.

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

2.3 SAFETY PRECAUTIONS

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

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

2.4 TEST EQUIPMENT AND MATERIALS

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

2.4.1 FILL PUMP

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

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

2.4.2 SUPPLY WATER FILTER

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

2.4.3 PRESSURIZATION PUMP

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

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

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 **2,225 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 *49 CFR Part 195*, Code, or Noble standards and procedures.

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

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

2.6 PERMIT TO WORK

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

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

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.

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.

3.3 LINE FILL

Calculated line fill water volume: **71 US Oil Barrels**

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

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

The fill pump shall be sized for the pigs to travel at a speed that will maintain a seal with the pipeline. This will reduce the risk of introducing air behind the pigs. A travel speed of 2 – 3 mph shall be maintained. The line fill flow rate for the **WARD – 4" Class 600 Oil Pipeline** must be **110 – 170 GPM (3 – 4 BPM)** in order to maintain the pig velocity in the 2 – 3 mph range.

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

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

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

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

3.4 INITIAL PRESSURIZATION

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

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

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

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

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

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

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

The **WARD – 4" Class 600 Oil Pipeline** is **4,289 feet** of **4.500" OD 0.188 w.t.** pipe. It will be pressurized to either of the following hydrostatic test pressures at the corresponding location:

Table 2: Hydrotest Fill Locations

Combined West Tie-In (0+00)	**1,880 psig**
DSU 24 Launcher Site (42+89)	**1,877 psig**

Pressurization up to 80% of the final test pressure shall occur at a rate of **10 PSIG/MIN**.

Once the pressure reaches 500 psi, the pressure must be allowed to stabilize for a minimum of **8 hours**.

Stabilization 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.

After the pressure has stabilized to 80% 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 THE TEST PERIOD

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

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

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

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

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

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

3.6 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.

3.7 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.

3.8 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.

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**.

3.9 DRYING OPERATIONS

Drying operations are required for all oil pipelines due to the delivery point’s maximum water content allowable.

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

The pipeline must be dried until the **Saturation Level** of the pig is less than **¼” penetration.**

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 as long as the pipeline is in use.

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

5 REFERENCES

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

WARD - 4" CL 600 Oil Pipeline Hydrostatic Pressure Test Plan

Start Test Location Target Parameters
- **Target Pressure:** 1,880 psig
- **Upper Bound Pressure:** 1,905 psig
- **Lower Bound Pressure:** 1,855 psig

End Test Location Target Parameters
- **Target Pressure:** 1,877 psig
- **Upper Bound Pressure:** 1,902 psig
- **Lower Bound Pressure:** 1,852 psig

Design Note:
The test conditions detailed in this exhibit shall be performed and verified in order for the system to be rated for the internal design pressure of 1,480 psig.
This test is designed to comply with hydrostatic testing standards outlined in API RP 1110, ASME B31.4, ASME B16.5, and PHMSA., DOT CFR 49 Part 195 Regulated

Pipe Spec: 4.5 in OD, 0.188 in w.t., X-52
Minimum Flange or Valve ANSI Rating: CL600 (1480 psig)
Approximate Line Length: 4,289 feet
Water Volume: 71 US Oil Barrels