

|  |                  |                    |
|--|------------------|--------------------|
| <br><b>BLACK DIAMOND</b><br>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 1 8-15-2018

MOP of tested facility is 1460 PSIG

Company: Black Diamond Operations Area: \_\_\_\_\_

Project: \_\_\_\_\_ AFE: 5000283

Pipeline: Stillroven Gas and Stillroven Crude Oil

Section: \_\_\_\_\_

Station or Milepost From: 0+00 To: 3+49



In this worksheet, cells containing formulas are protected against input.

Cells with **BLUE** text labels allow or require input.

|                                    |   |
|------------------------------------|---|
| <i>General Information</i>         | <ul style="list-style-type: none"> <li>• Complete this Report and attached necessary exhibits for all BDM installed pipelines or pipeline segments or those re-qualified for service.</li> <li>• Fill in all applicable Information. If information is not applicable, write NA in the corresponding space on the Report.</li> </ul>  |
| <i>Pipe Data</i>                   | <ul style="list-style-type: none"> <li>• Record the details for each pipe section tested, including lengths, line fill, pipe fittings, etc.</li> <li>• Add together pipe section lengths and line fill for a total pipe section length and line fill.</li> </ul>  |
| <i>Test Water Data</i>             | <ul style="list-style-type: none"> <li>• Enter water source information (i.e., from municipal supply, well, river, lake, pond) in the Test Log or notes section of the Report.</li> <li>• Source water temperature compared to ground temperature can assist with understanding the time for the water to stabilize.</li> </ul>   |
| <i>Pressure Calculations</i>       | <ul style="list-style-type: none"> <li>• Elevation or high and low points and the elevation of the test pressure measure sites is required for calculation of the target test pressures.</li> </ul>   |
| <i>Test Log</i>                    | <ul style="list-style-type: none"> <li>• Fill out the Test Log at the time or the test. This is the actual log of the test.</li> <li>• From the start of filling the test section, record pressure readings from the calibrated test gauge or deadweight tester used in the test.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> </ul> |
| <i>Notes</i>                       | <ul style="list-style-type: none"> <li>• 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.</li> </ul>   |
| <i>Profile</i>                     | <ul style="list-style-type: none"> <li>• An elevation profile is required for any test section where the elevation varies more than 100 feet.<br/>The following should be noted on the profile:             <ul style="list-style-type: none"> <li>- Location and elevation where test pressure measurements are taken</li> <li>- High and low points</li> <li>- Stationing or mileposts</li> <li>- Horizontal and vertical scale of the drawing</li> </ul> </li> <li>• Elevation data is available in electronic format from the KPL mapping system</li> <li>• If electronic elevation data is not available, take profile elevations from survey information or from U.S. Geological Service 7 ½ minute topographical maps.</li> </ul>  |
| <i>Failure Log</i>                 | <ul style="list-style-type: none"> <li>• Record each failure event that causes the line to be taken "off test".</li> <li>• Enter the date, time, and pressure at the time of failure.</li> <li>• 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.</li> <li>• Describe the repair method (i.e., changed-out pipe or tightened flange).</li> </ul>   |
| <i>Supplementary Documentation</i> | <ul style="list-style-type: none"> <li>• Check each supplementary documentation attached as part of this test record (i.e., test charts and/or equipment certifications).</li> </ul>  |
| <i>Certification</i>               | <ul style="list-style-type: none"> <li>• Write the corresponding Exhibit Number on the attached supplementary documentation.</li> <li>• Signatures of the Company and Contractor representatives in charge of the test are MANDATORY.</li> </ul>  |



### PRESSURE CALCULATIONS

|  |   |   |   |
|--|---|---|---|
| <b>Location of Test Point</b><br><u>West End</u><br><u>LACT UNIT</u>   | <b>Elevation of Test Point</b><br>_____ Ft. (Elevation)<br>_____ Ft. (Station)      | <b>High Point</b><br>_____ Ft. (Elevation)<br>_____ Ft. (Station)<br>_____ Location Name  | <b>Low Point</b><br>_____ Ft. (Elevation)<br>_____ Ft. (Station)<br>_____ Location Name |
| <b>Target MOP:</b> <u>1480</u><br><b>Target Test Pressure Range</b><br>1st Min: <u>1876</u> Maximum: <u>1926</u><br>2nd Min: _____ | <b>Test Duration:</b> <u>4</u> hr<br><b>High Point</b> _____ <b>Low Point</b> _____ | <b>Start Point</b><br>_____ Ft. (Elevation)<br>_____ Ft. (Station)<br>_____ Location Name | <b>End Point</b><br>_____ Ft. (Elevation)<br>_____ Ft. (Station)<br>_____ Location Name |

### TEST LOG

| DATE      | TIME    | PRESSURE | AMBIENT TEMP | BELOW GROUND TEMP | ABOVE GROUND TEMP | REMARKS                          |
|-----------|---------|----------|--------------|-------------------|-------------------|----------------------------------|
| 8-16-2018 | 7:45A   | 0        | 58           |                   |                   | Pipe has 500 PSI on it from      |
|           | 8:00    | 500      | 59           |                   |                   | Last night / Build to 80% = 1520 |
|           | 9:45    | 1521     | 63           |                   |                   |                                  |
|           | 9:50    | 1532     | 63           |                   |                   | Build to target pressure = 1901  |
|           | 10:25   | 1904     | 67           |                   |                   |                                  |
|           | * 10:30 | 1919     | 67           |                   |                   | * BEGIN TEST * Sunny, ALL        |
|           | 10:50   | 1924     | 68           |                   |                   | pipe is exposed to sun           |
|           | 11:00   | 1906     | 69           |                   |                   | Bleed to 1901 = 502              |
|           | 11:30   | 1925     | 69           |                   |                   | Bleed to 1901 = 502              |
|           | 12:00   | 1923     | 72           |                   |                   | Bleed to 1901 = 502              |
|           | 12:30   | 1922     | 75           |                   |                   | Bleed to 1901 = 502              |
|           | 12:54   | 1925     | 75           |                   |                   | Bleed to 1901 = 502              |
|           | 1:12    | 1925     | 75           |                   |                   | Bleed to 1901 = 502              |
|           | 1:30    | 1915     | 76           |                   |                   |                                  |
|           | 1:45    | 1925     | 78           |                   |                   | Bleed to 1901 = 502              |
|           | 2:10    | 1924     | 79           |                   |                   | Bleed to 1901 = 502              |
|           | * 2:30  | 1924     | 81           |                   |                   | * END TEST *                     |
|           | 2:45    | 1915     | 81           |                   |                   | Bleed down to 80% = 1521         |
|           | 2:46    | 1521     | 81           |                   |                   |                                  |
|           | 2:52    | 1522     | 81           |                   |                   | Bleed down to 0                  |
|           | 2:57    | 0        | 79           |                   |                   |                                  |
|           | 3:10    | 0        | 80           |                   |                   |                                  |
|           |         |          |              |                   |                   |                                  |
|           |         |          |              |                   |                   |                                  |
|           |         |          |              |                   |                   |                                  |
|           |         |          |              |                   |                   |                                  |







**PRESSURE RECORDER 1:**

Mfg: Barton

Model: \_\_\_\_\_

Serial No.: 202A-141894

Range: 0-3000 PSI  
0-1500 F

Notes: Cal on 7-16-2018

**PRESSURE RECORDER 2:**

Mfg: \_\_\_\_\_

Model: \_\_\_\_\_

Serial No.: \_\_\_\_\_

Range: \_\_\_\_\_

Notes: \_\_\_\_\_

**DEADWEIGHT TESTER OR CALIBRATED TEST GAUGE:**

Mfg: Crystal Engineering

Model: XP2

Serial No.: 364359

Date of Last Calibration: 4-18-2018

Calibrated By: APEX

Range: 0-5000 PSI

Notes: \_\_\_\_\_

**TEMPERATURE RECORDER:**

Mfg: \_\_\_\_\_

Model: \_\_\_\_\_

Serial No.: \_\_\_\_\_

Range: \_\_\_\_\_

Notes: \_\_\_\_\_

**CALIBRATION OF TEMPERATURE RECORDER**

| Temperature recorder reading | Test mercury thermometer reading | Remarks |
|------------------------------|----------------------------------|---------|
|                              |                                  |         |
|                              |                                  |         |
|                              |                                  |         |

**CALIBRATION OF PRESSURE RECORDER 1**

| Pressure recorder reading | Deadweight tester reading | Remarks |
|---------------------------|---------------------------|---------|
|                           |                           |         |
|                           |                           |         |
|                           |                           |         |

**CALIBRATION OF PRESSURE RECORDER 2**

| Pressure recorder reading | Deadweight tester reading | Remarks |
|---------------------------|---------------------------|---------|
|                           |                           |         |
|                           |                           |         |
|                           |                           |         |

**NOTES**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



### EQUIPMENT CALCULATED MOP SUMMARY WORKSHEET

**1. Test Information:**

Target MOP 1480  
Enter the desired MOP,  
If less than pipe  
Internal design  
pressure.

Date 8-15-2018 Time 7:00 AM  
Test Point Location West END LACT unit  
Test Medium water Test Duration 2 hr  
Specific Gravity of Test Medium 8.3  
Min. Test Press. At test site 125% of min. MOP + elev. 1901  
Maximum allowable % of SMYS = 150%

**2. Pipe Specifications:**

Manufacture Type \_\_\_\_\_

Pipe (#1) O.D. 4.5  
Grade X52 SMYS 52,000  
Wall thickness .188  
Length (ft.) 349  
Max allowable test pressure, psig

MOP 1480  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_  
Volume 6 bbls

**3. Pipe Specifications:**

Manufacture Type \_\_\_\_\_

Pipe (#2) O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Length (ft.) \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_  
Volume \_\_\_\_\_

**4. Pipe Specifications:**

Manufacture Type \_\_\_\_\_

Pipe (#3) O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Length (ft.) \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_  
Volume \_\_\_\_\_

**5. Pipe Specifications:**

Manufacture Type \_\_\_\_\_

Pipe (#4) O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Length (ft.) \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_  
Volume \_\_\_\_\_

**6. Pipe Specifications:**

Manufacture Type \_\_\_\_\_

Pipe (#5) O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Length (ft.) \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_  
Volume \_\_\_\_\_

**7. Pipe Fitting Specifications:**

Manufacture Type \_\_\_\_\_  
Fitting Description \_\_\_\_\_

Pipe O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_

**8. Pipe Fitting Specifications:**

Manufacture Type \_\_\_\_\_  
Fitting Description \_\_\_\_\_

Pipe O.D. \_\_\_\_\_  
Grade \_\_\_\_\_ SMYS \_\_\_\_\_  
Wall thickness \_\_\_\_\_  
Max allowable test pressure, psig

MOP \_\_\_\_\_  
Seam Joint Factor \_\_\_\_\_  
Design Factor (F) \_\_\_\_\_



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 1926

CALCULATED TARGET MOP OF PIPELINE SECTION

PSIG



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: \_\_\_\_\_  
\_\_\_\_\_



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: 8-15-2018

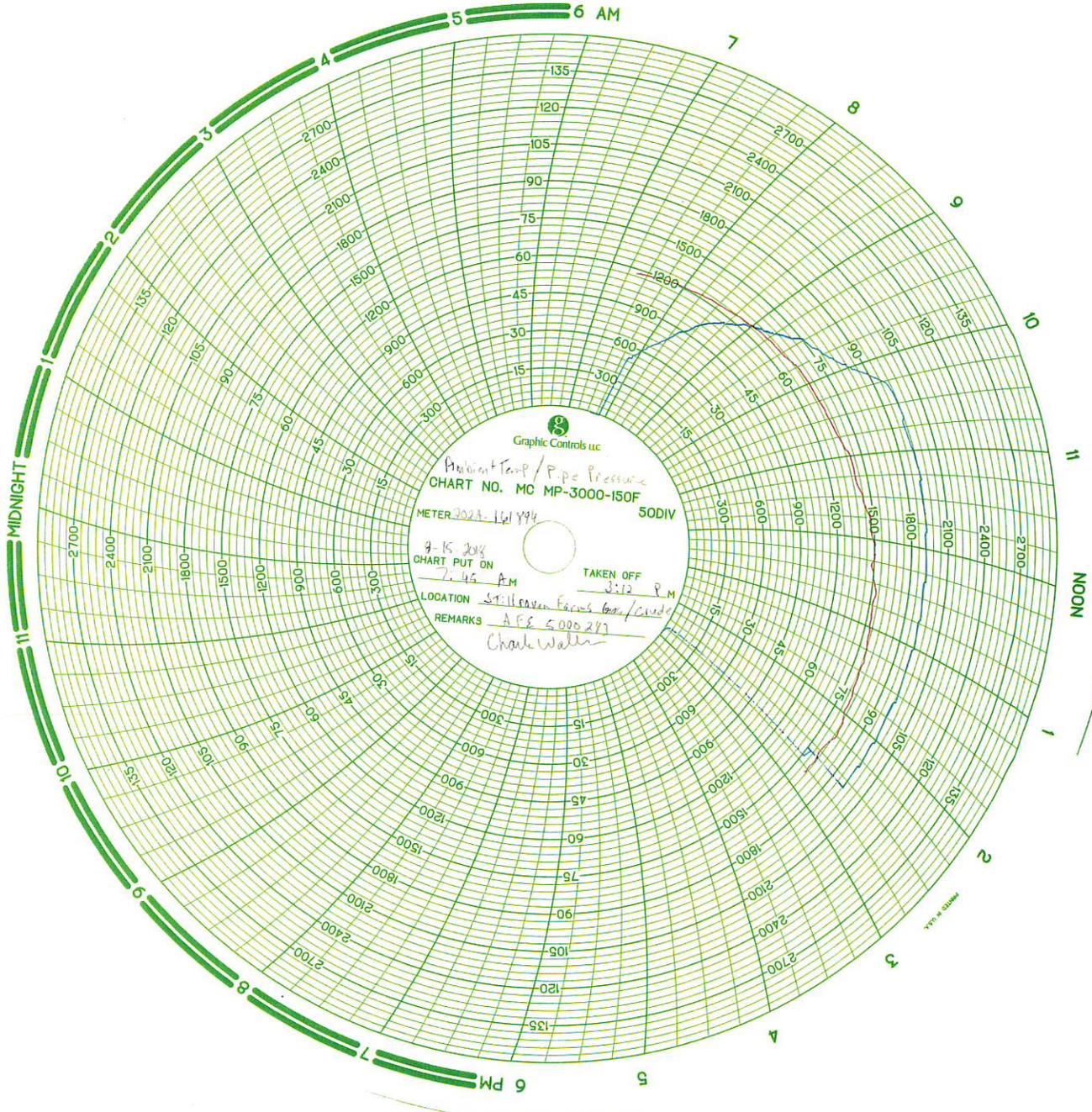
Engineer

By: \_\_\_\_\_ (Please print)      \_\_\_\_\_ (Signature)      Date: \_\_\_\_\_

Name of Testing Contractor

North Winds of Wyoming

By: Menito Espinoza (Please print)      Menito Espinoza (Signature)      Date: 8-15-2018



CR-2



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  
**Model Number:** XP2i 5000 psi  
**Serial Number:** 364359  
**Description:** Digital Test Gauge  
**Procedure:** CRY\_P\_XP2i  
**Calibrated To:** Manufacturer's Specifications  
**Technician:** Austin Molyneux

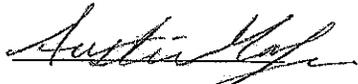
**Calibration Date:** 4/18/2018  
**Due Date:** 4/18/2019  
**As Found:** In Tolerance  
**As Left:** As Found  
**Temperature:** 73 F  
**Humidity:** 22 %

**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.

This certificate is not to be reproduced other than in full, except with prior written approval from Apex Instruments Inc.

**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 |



APX03447

# Cross Country Pipeline Supply CO. Inc

Sales and Service

2251 Rifle Street - Aurora, Colorado 80011

Phone 303.361.6797 Fax 303.361.6836

C-4

## NIST CALIBRATION DATA

| Model Number | Serial Number | Customer            | Range        | Accuracy |
|--------------|---------------|---------------------|--------------|----------|
| J-W Measure  | 202A          | North Winds of Wyo. | 3000# - 150F | 1/2%     |

| Work Performed:         | Calibration:<br>Output/Reading | Results:<br>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

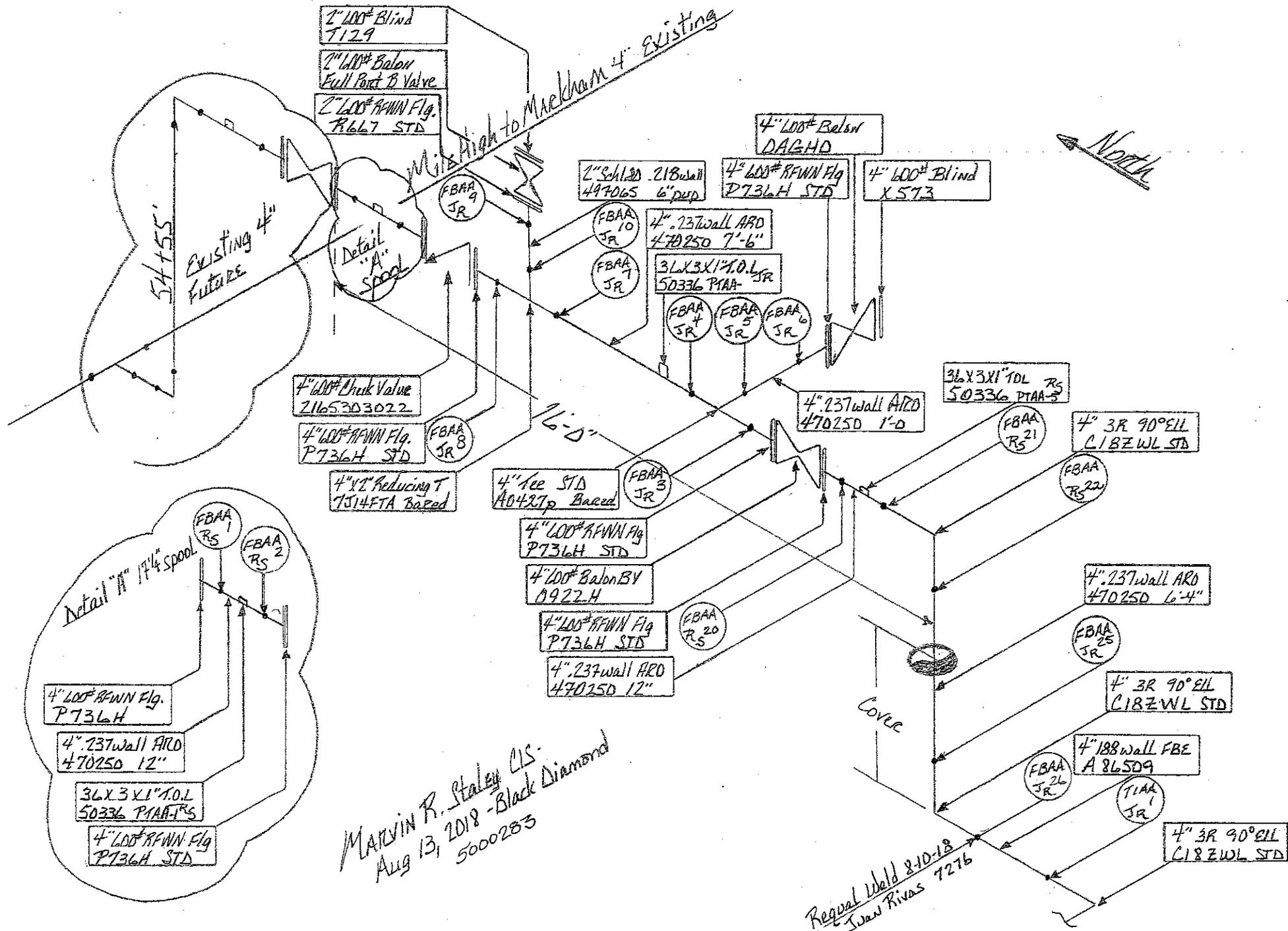
### Standard Used:

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

Don F.

Signature Don Frick 7-16-18

4" Fabrication plus 4" future @ Stillroadent WL- Leude Cr 5 & 38 SW CORNER

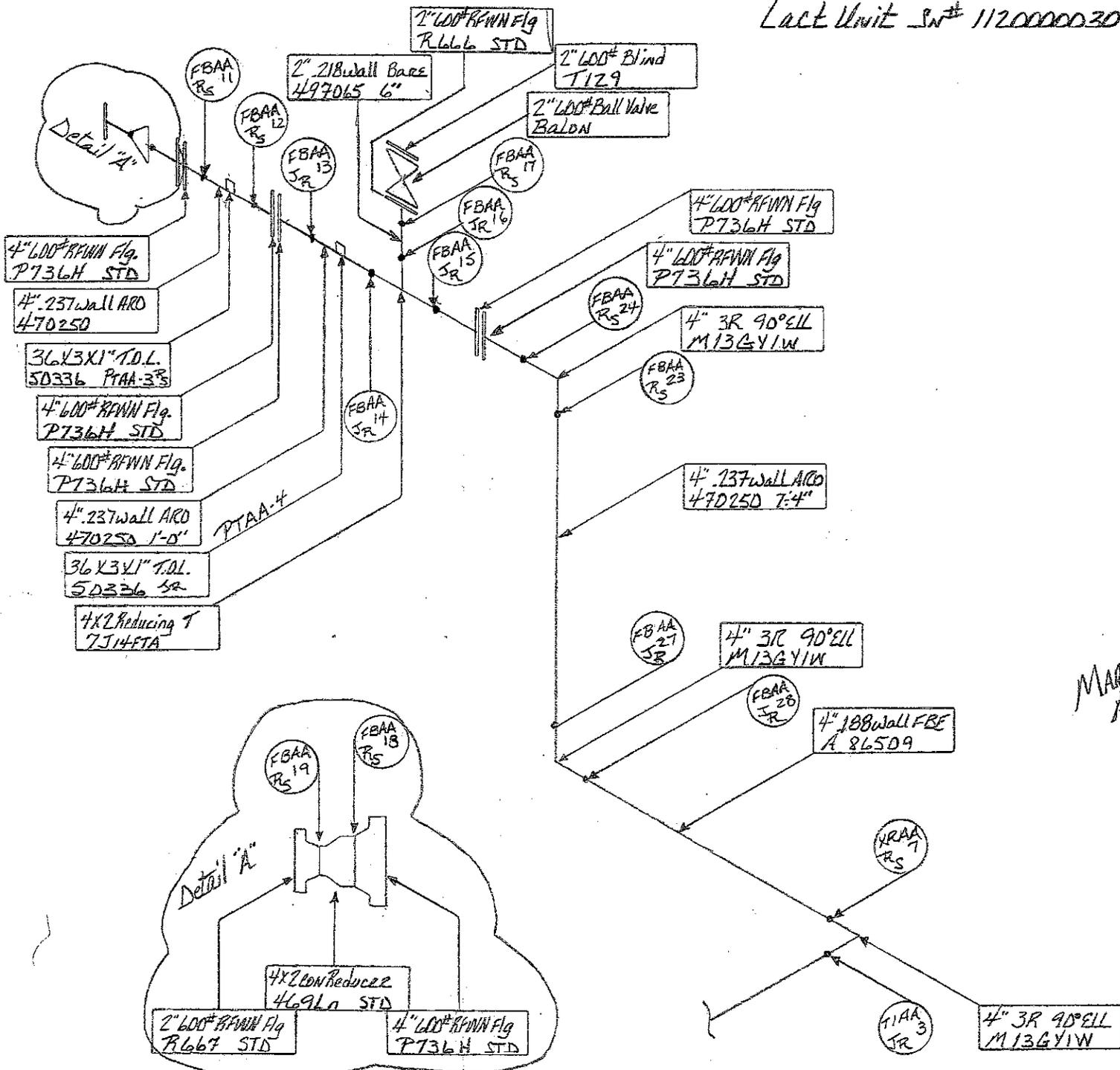


MARVIN R. STALEY C.I.S.  
 AUG 13, 2018 - Black Diamond  
 5000283



2" to 4" Fabrication off Lact Unit @ Stillroven WC Ceude Line

Lact Unit SN# 1120000030-0009-01



MARVIN R. STALEY CIS  
 Aug 13<sup>th</sup> 2018 Black Diamond  
 5000283



Hydrostatic Pressure Test Procedure  
Stillroven - 4" CL 600 Oil Pipeline

DJBU

NMP Doc.  
No.:

N/A

Rev.:

0



Stillroven – 4" CL 600 Oil Pipeline

Hydrostatic Pressure Test Procedure



|     |          |     |                                     |      |       |
|-----|----------|-----|-------------------------------------|------|-------|
|     |          |     |                                     |      |       |
| 0   | 8/6/2018 | JDL | Issued for Implementation           | DAN  |       |
| REV | DATE     | BY  | DESCRIPTION                         | CHKD | APPVD |
|     |          |     | Noble Midstream Partners, LLC       |      |       |
|     |          |     | Hydrostatic Pressure Test Procedure |      |       |
|     |          |     | Doc. No. N/A                        |      |       |

|   |  |     |         |      |
|---|--|-----|---------|------|
|  | Hydrostatic Pressure Test Procedure<br>Stillroven - 4" CL 600 Oil Pipeline |     |         | DJBU |
|   | NMP Doc. No.:  | N/A | Rev.: 0 |      |

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|---|--|-----|---------|------|
|  | Hydrostatic Pressure Test Procedure<br>Stillroven - 4" CL 600 Oil Pipeline |     |         | DJBU |
|   | NMP Doc. No.:  | N/A | Rev.: 0 |      |

## 1 EXECUTIVE SUMMARY

This procedure and the accompanying site-specific Hydrostatic Test Plan define the minimum requirements for the hydrostatic pressure testing of the **Stillroven - 4" CL 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 **Stillroven - 4" CL 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 **Stillroven - 4" CL 600 Oil Pipeline** internal design pressure is **1,480 PSIG**, limited by the flange rating. The pipeline MOP is **1,480 PSIG**.

The **Stillroven - 4" CL 600 Oil Pipeline** final hydrostatic test pressure shall be **1,900 PSIG** or **1,901 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 **4 hours** after final test pressure has stabilized.

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

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### 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.

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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**.

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## 2.5 QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL

Qualifications of contractor and operator personnel for conducting pressure tests will be based on certification requirements by *49 CFR Part 195*, Code, or Noble standards and procedures.

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**.

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### 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: **6 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 **Stillroven - 4" CL 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.

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### 3.4 INITIAL PRESSURIZATION

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

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

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

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

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

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

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

The **Stillroven - 4" CL 600 Oil Pipeline** is **336 feet** of **4" 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**

|                              |                   |
|------------------------------|-------------------|
| <b>East Tie-In (0+00)</b>    | <b>1,900 psig</b> |
| <b>West Tie-In (3+48.83)</b> | <b>1,901 psig</b> |

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 **1 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.

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### 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.

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If a rupture or a substantial leak occurs, the test shall be stopped and the pipeline depressurized. The cause of failure shall be understood, test procedures shall be reevaluated, and approval from the Noble representative shall be obtained before proceeding with repairs and starting a new hydrostatic test.

Pipe, valves, fittings, and test components that fail during a pressure test shall be investigated to determine the cause of failure and to minimize the possibility of a recurrence.

Pipe or other failed components shall be preserved for further examination and failure analysis.

If a small leak occurs, the pressure should be reduced to 80% of the final test pressure while locating the leak. After repairs are completed and authorization from the Noble representative has been obtained, the test can be restarted per the initial pressurization steps above.

Pressure excursions outside of the **Maximum and Minimum Test Pressures** as defined in **Section 2.1** of this procedure are considered test failures.

**3.8 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.

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#### 4 RECORDS

After the hydrostatic test has been completed, the following records shall be submitted as part of the Final Test Report, **which must be reviewed and accepted by an authorized Noble representative**. These records must be retained as long as the pipeline is in use.

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

#### 5 REFERENCES

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

# Stillroven - 4" CL 600 Oil Pipeline Hydrostatic Pressure Test Plan

