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GCP-04-MON-200-L2

MOP Establishment and Pressure Testing of Pipelines
TG1601.190

LIQUID PIPELINE
PRESSURE TEST REPORT

Pressure Test Number One 12-4-2018

MOP of tested facility is 720 PSIG

Company: Noble Midstream Operations Area: _____

Project: DS4 24/27 Produced water AFE: 5000154

Pipeline: _____

Section: _____

Station or Milepost From: _____ To: _____

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"> 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.
<i>Pipe Data</i>	<ul style="list-style-type: none"> 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.
<i>Test Water Data</i>	<ul style="list-style-type: none"> 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.
<i>Pressure Calculations</i>	<ul style="list-style-type: none"> Elevation or high and low points and the elevation of the test pressure measure sites is required for calculation of the target test pressures.
<i>Test Log</i>	<ul style="list-style-type: none"> Fill out the Test Log at the time of 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Remarks column, enter start of test, end of test, and any remarks concerning unusual events, such as liquid added or withdrawn, weather conditions, etc.
<i>Notes</i>	<ul style="list-style-type: none"> 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.
<i>Profile</i>	<ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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.
<i>Failure Log</i>	<ul style="list-style-type: none"> 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).
<i>Supplementary Documentation</i>	<ul style="list-style-type: none"> 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.
<i>Certification</i>	<ul style="list-style-type: none"> Signatures of the Company and Contractor representatives in charge of the test are MANDATORY.

Location of Test Point DSU 24/27 Produced Water Tie in to Main Line	Elevation of Test Point 4863 Ft. (Elevation) 4493 Ft. (Station)	High Point 4871 Ft. (Elevation) 0435 Ft. (Station) Location Name	Low Point 4863 Ft. (Elevation) 4493 Ft. (Station) Location Name
Target MOP: 720 Target Test Pressure Range 1st Min: 925 Maximum: 9100 2nd Min:	Test Duration: 8 hr High Point Low Point	Start Point 4869 Ft. (Elevation) 0400 Ft. (Station) Location Name	End Point 4863 Ft. (Elevation) 4493 Ft. (Station) Location Name

TEST LOG

DATE	TIME	PRESSURE	AMBIENT TEMP	BELOW GROUND TEMP	ABOVE GROUND TEMP	REMARKS
12-4-18	5:00 AM	0	6	42		
	5:15	0	6	42		Build to 25% - 237
	5:45	237	6	42		
	6:00	228	6	42		Build to 50% - 425
	6:13	423	6	42		
	6:28	415	7	41		Build to 75% - 712
	6:37	712	7	40		
	6:52	710	8	40		Daylight, sunny All exposed
	7:07	709	9	40		Pipe is well covered
	7:22	709	12	39		
	7:37	708	14	39		Build to Target - 950
	7:45	906	17	39		
	8:00	900	19	38		
	8:15	952	22	38		Hold one hour
	8:30	949	24	36		
	8:45	948	25	35		
	9:00	947	26	34		
	9:15	947	27	33		Build back to Target
	9:17	952	27	33		check for leaks
	9:30	952	28	33		
	9:45	952	29	33		
	10:00	952	31	33		
*	10:15	952	32	33		*BEGIN TEST*
	10:30	952	33	33		check for leaks
	10:45	952	35	32		Sunny, Wind @ 2

PRESSURE RECORDER 1:

Mfg: Barton
 Model: _____
 Serial No.: 202A-121213
 Range: 0-3000 PSI
0-150° F
 Notes: Cal on 8-8-2018

PRESSURE RECORDER 2:

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

DEADWEIGHT TESTER OR CALIBRATED TEST GAUGE:

Mfg: Crystal Engineering
 Model: XP2i
 Serial No.: 364359
 Date of Last Calibration: 11-9-2018
 Calibrated By: JMC
 Range: 0-5000 PSI
 Notes: _____

TEMPERATURE RECORDER:

Mfg: Barton
 Model: _____
 Serial No.: 242-128250
 Range: 0-150° F
 Notes: Cal on 11-16-2018

CALIBRATION OF TEMPERATURE RECORDER

Temperature recorder reading	Test mercury thermometer reading	Remarks
<u>15</u>	<u>15</u>	

CALIBRATION OF PRESSURE RECORDER 1

Pressure recorder reading	Deadweight tester reading	Remarks
<u>0</u>	<u>0</u>	
<u>425</u>	<u>424</u>	
<u>950</u>	<u>951</u>	

CALIBRATION OF PRESSURE RECORDER 2

Pressure recorder reading	Deadweight tester reading	Remarks

NOTES

1. Test Information:

Target MOP 720

Enter the desired MOP,

If less than pipe

Internal design

pressure.

Date 12-4-2018 Time 5:00 Am

Test Point Location DSU 24/27 Launcher

Test Medium Water Test Duration 8 hr

Specific Gravity of Test Medium 8.3

Min. Test Press. At test site 125% of min. MOP + elv. 925 PSI

Maximum allowable % of SMYS = 150%

2. Pipe Specifications:

Manufacture Type Flexsteel

Pipe (#1) O.D. 4"

MOP 720

Grade _____ SMYS _____

Seam Joint Factor _____

Wall thickness _____

Design Factor (F) _____

Length (ft.) 493

Volume 7 bbls

Max allowable test pressure, psig

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 _____

Pipe O.D. _____

MOP _____

Grade _____ SMYS _____

Seam Joint Factor _____

Wall thickness _____

Design Factor (F) _____

Fitting Description _____

Max allowable test pressure, psig

8. Pipe Fitting Specifications:

Manufacture Type _____

Pipe O.D. _____

MOP _____

Grade _____ SMYS _____

Seam Joint Factor _____

Wall thickness _____

Design Factor (F) _____

Fitting Description _____

Max allowable test pressure, psig

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 925 psig

110% to psig

Note: Add psi to min. test range

Maximum test pressure at test site, psig

CALCULATED TARGET MOP OF PIPELINE SECTION

725 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 Charles Wallace Date: 12-4-2018
(Please print) (Signature)

Engineer

By: ~~Emmanuel Zepeda~~ ~~E Zepeda~~ Date: ~~12-4-18~~
(Please print) (Signature)

Name of Testing Contractor

North Winds of Wyoming

By: Emmanuel Zepeda E Zepeda Date: 12-4-18
(Please print) (Signature)

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
Barton	202A-121213	North Winds of Wy.	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
	69 Deg	69 Deg
	110 Deg	110 Deg
	150 Deg	150 Deg

PO Number	Sales Order Number	Date of Test
Recalibrated	Recerted	10/8/2018 3:39:50 PM

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

--

Standard Used:

Manufacturer	Model	Instrument	Calibration Date	Certification #
Perma-Cal	101FTM15B21	Pressure Gauge	08/08/2018	17-043
Tech Instrumentation	TM99A	Thermometer	08/18/2018	59448

Don F.

Signature

Don F.rick 10-8-18

PSS-COMPANIES



9700 E. 104TH AVE, UNIT F- HENDERSON, CO 80640 - Phone (303)857-7986 - Fax (303)389-4945

CALIBRATION CERTIFICATE

CERTIFICATE NUMBER: CO

Details +/-: 1.0% ACCURACY

DATE CALIBRATED: 11/16/2018
DUE DATE: 11/16/2019

INDICATED TEMPERATURE RANGE: # 0 – 150°F
INDICATED PRESSURE RANGE: #0 – 3000 PSI
SERIAL NO: 242-128250 TagNo: 012965
MANUFACTURER: BARTON/ 12" RECORDER
TYPE OF INSTRUMENT CALIBRATED: TEMPERATURE / PRESSURE RECORDER

INSTRUMENT FINDINGS/STATUS: UNIT IS IN TOLERANCE/ INSTRUMENT MEETS OR EXCEEDS SPECIFICATIONS.

BASED ON INTERNATIONAL STANDARDS OF GRAVITY: (980.665 cm./sq.).

TYPE OF STANDARD USED TO CALIBRATE: REFINERY DEADWEIGHT TEST UNIT SPT.
(35225-3) SERIAL No. 5268: KESSLER TEST THERMOMETERS: SERIAL NO. CALIBRATION

ALL STANDARD DIRECTLY TRACEABLE TO NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGIES TEST NO: (N.I.S.T.) 2.6/172490 & 6.6/139577.

CALCULATED USING MASS VALUES, AREA, AO, AND STATED GRAVITY.
ROOM TEMPERATURE/HUMIDITY (AT TIME OF TEST): 73°F / 31%.

CALIBRATED BY: NICK BEDFORD


SIGNATURE



9829 E. Easter Ave. • Centennial, CO 80112
303.794.8833 • Fax 303.730.1220
Toll Free 1.800.327.7257
www.jmcinstruments.com

CR-2

CERTIFIED CALIBRATION

CUSTOMER Cross Country ORDER NO. _____

ITEM Digital Gauge RANGE 0-5000PSIG ITEM NO. 4840-1

TRUE VALUE PSIG	INDICATED VALUE	
	INCREASING READINGS	DECREASING READINGS
0.00	0	0
500.00	499.4	499.9
1000.00	999.3	999.5
1500.00	1499.0	1499.1
2000.00	1998.4	1998.7
2500.00	2498.3	2498.3
3000.00	2996.3	2997.7
3500.00	3494.3	3496.8
4000.00	3996.2	3996.0
4500.00	4497.3	4495.3
5000.00	4995.3	4995.3

Tested On: Deadweight Tester S/N# 1GA4474

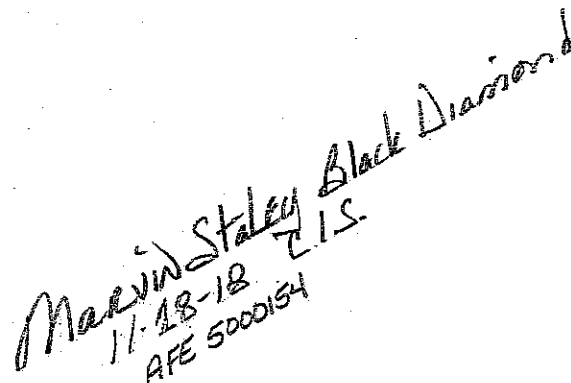
Traceable to National Institute of Standards and Technology certificate
17-043

Tested By: BDM Date 9 November 2018

Remarks:

Crystal	mod XP2i	SN 364359
Accuracy is +/- 0.025 % of Full Scale or Better		
Test Conditions 65 °F; mmHg Atm. Pressure		

North

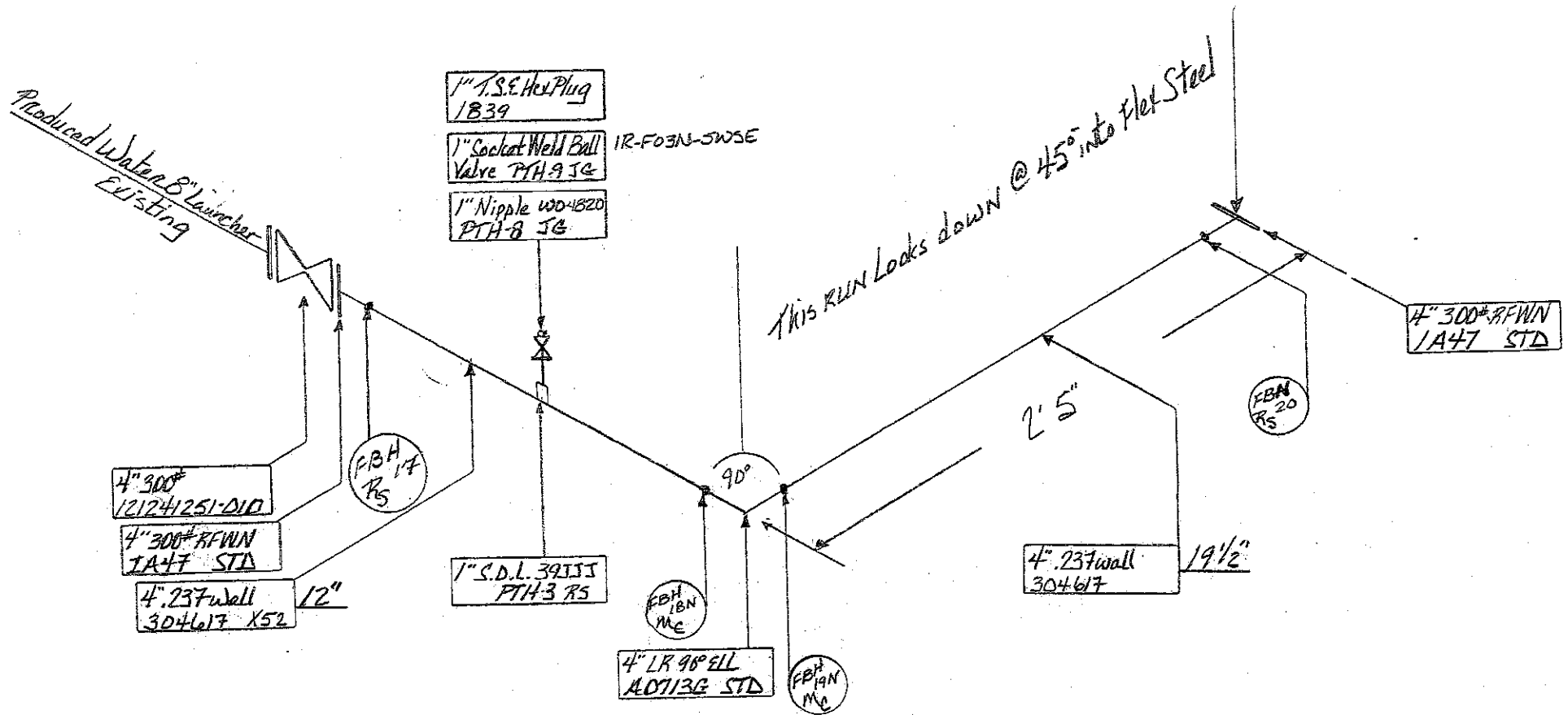


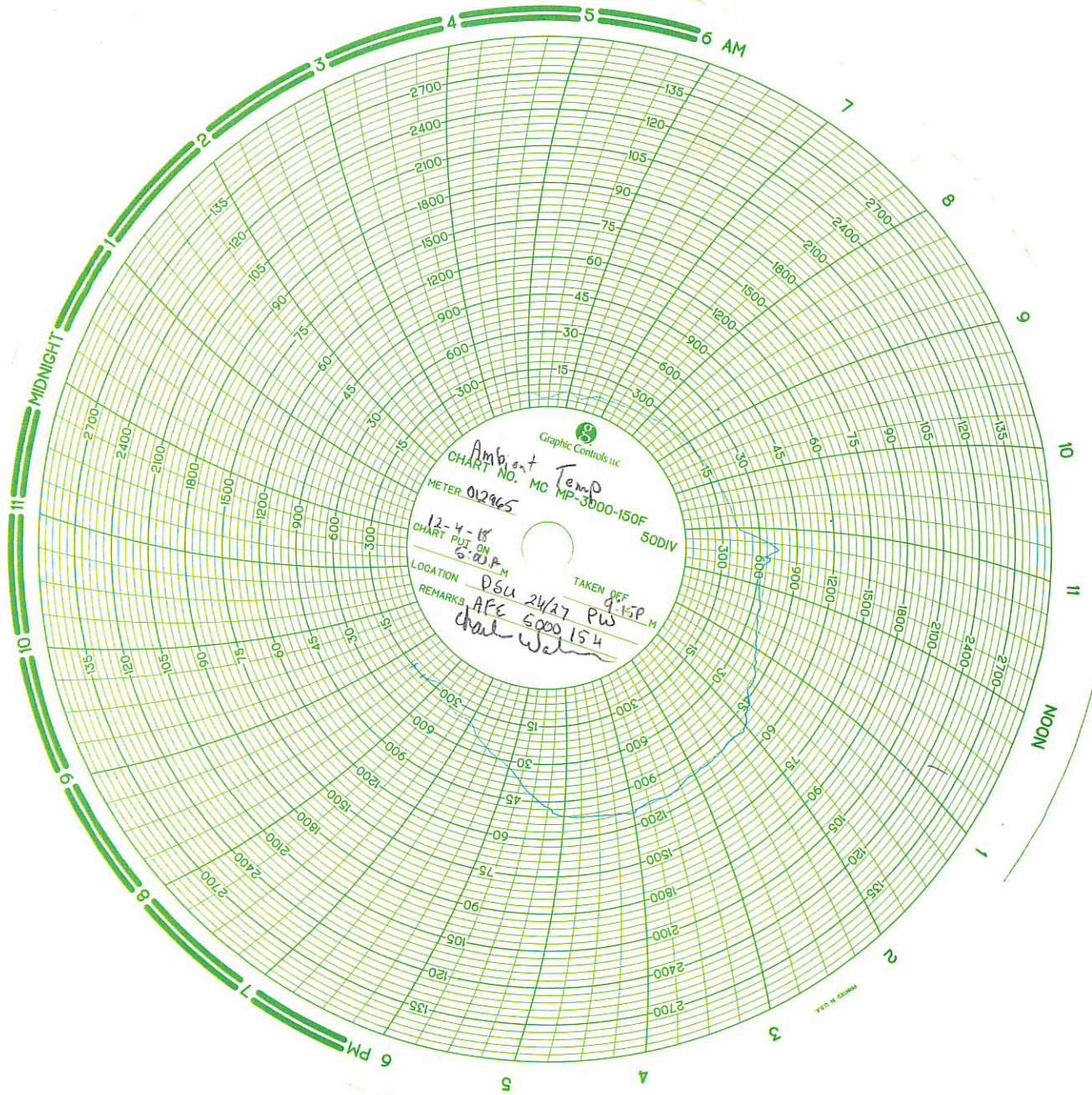
4" Valve & Fabrication off Produced Water Launcher-Existing

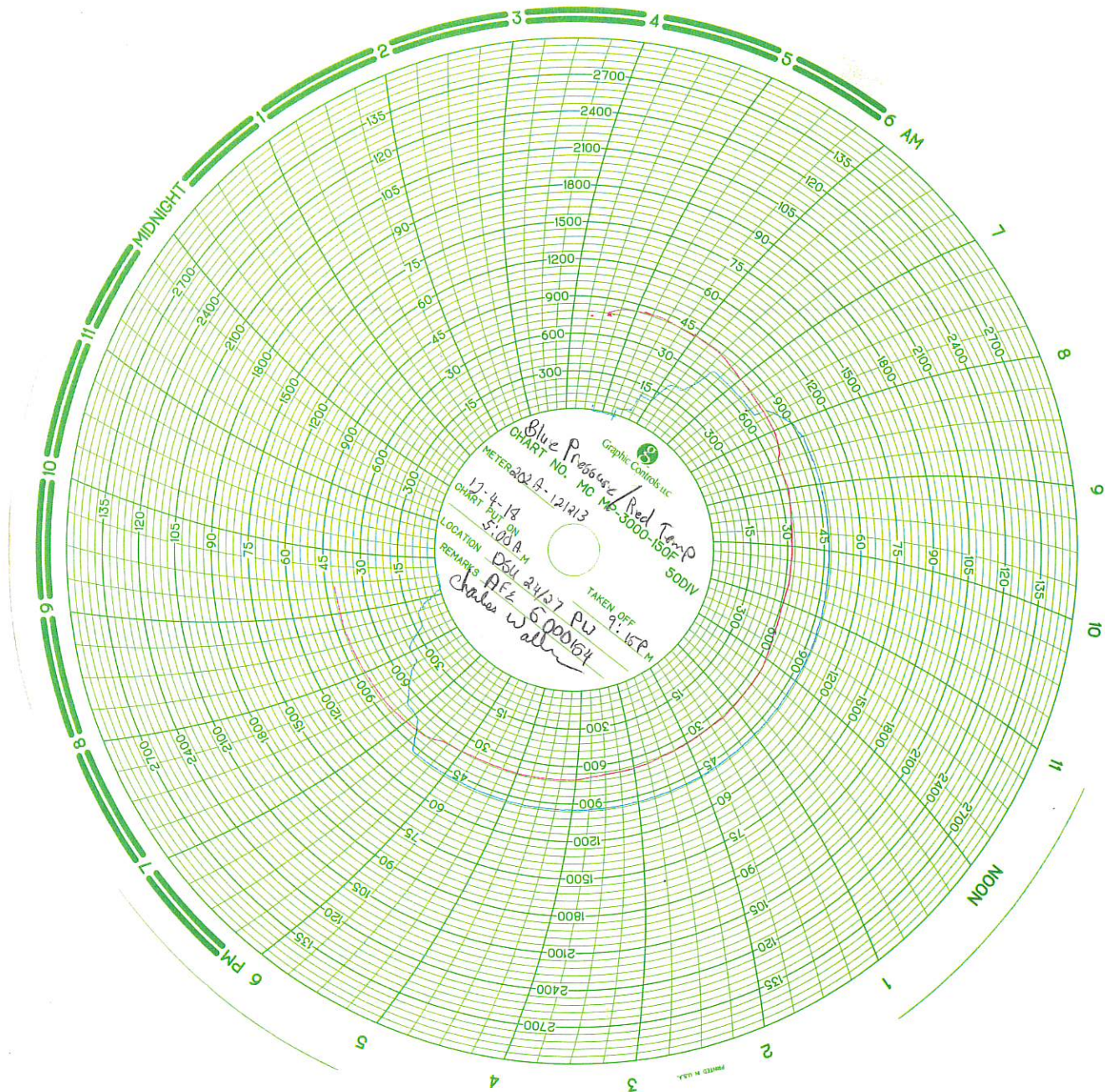
DSU-24-27

AFE 5000154

North









	Hydrostatic Pressure Test Procedure DSU 24/27 – 4” PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	

TABLE OF CONTENTS

1	EXECUTIVE SUMMARY	3
2	PRE-TEST CONSIDERATIONS	3
2.1	TEST PRESSURE.....	3
2.2	TEST DURATION.....	4
2.3	SAFETY PRECAUTIONS.....	4
2.4	TEST EQUIPMENT AND MATERIALS.....	4
2.5	QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL	6
2.6	PERMIT TO WORK.....	6
3	TEST PROCEDURE	6
3.1	SOURCE WATER	6
3.2	EQUIPMENT INSTALLATION	7
3.3	LINE FILL	7
3.4	INITIAL PRESSURIZATION	8
3.5	PIPE CONDITIONING	9
3.6	THE TEST PERIOD	10
3.7	SEARCHING FOR LEAKS	11
3.8	PRESSURE TEST FAILURES	11
3.9	DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF TEST WATER	11
3.10	DRYING OPERATIONS	12
4	RECORDS	12
5	REFERENCES.....	13

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW 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 **DSU 24/27 – 4" FlexSteel Produced Water Pipeline**. The piping and components to be tested using this procedure meet or exceed the pressure requirements of the ASME Class 300 flange rating for Type 2.2 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*, *49 CFR Part 195*, and the *FlexSteel Technical Manual*.

2.1 TEST PRESSURE


The **DSU 24/27 – 4" Flexsteel Produced Water Pipeline** shall be tested at a minimum test pressure of **900 PSIG** (125% the internal pressure rating) and a maximum test pressure of **1,100 PSIG** (150% the internal design pressure rounded to the next highest 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 **DSU 24/27 – 4" Flexsteel Produced Water Pipeline** internal design pressure is **720 PSIG**, limited by the stainless-steel flange rating.

The **DSU 24/27 – 4" Flexsteel Produced Water Pipeline** final hydrostatic test pressure shall be either **950 PSIG** or **953 PSIG**, at the point of filling, depending on where the operator chooses to fill the pipeline. See the table in **Section 3.4** for the two possible locations.

Table 1: Upper and Lower Bound Test Pressures

ASME Flange Class	Pipeline Wall Thickness (in)	Pipe Design Pressure – DP (psig)	Flange Pressure Rating – PR (psig)	Minimum Test Pressure 125% PR (psig)	Maximum Test Pressure 150% DP (psig)
300	0.4535	750	720	900	1,100

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	

2.2 TEST DURATION

The hydrostatic test pressure shall be maintained for **8 hours** after final test pressure has stabilized, and the pipe has been conditioned properly in the field. With pipe conditioning, accounted for, the test commonly takes **16 – 20 hours**. This is dependent, however on how well the pipe responds to the conditioning procedure (**times up to 24 hours may be required**).

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

2.3 SAFETY PRECAUTIONS

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

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

2.4 TEST EQUIPMENT AND MATERIALS

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

2.4.1 FILL PUMP

The 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.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

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.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	

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 **1,100 PSIG**, maximum test pressure.

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. (If Applicable)
- Biocide Safety Data Sheets (SDS). (If Applicable)
- Leak monitoring plan.
- Depressurization plan.
- Water disposal plan.
- Drying plan (If Applicable).

3 TEST PROCEDURE

As part of the work permit, a hydrostatic test plan for each section of pipe shall be developed and submitted to the appointed Noble representative prior to commencing work. The test plan shall, at a minimum, address the requirements specified in this procedure.

3.1 SOURCE WATER

The quality and source of the test water shall be determined prior to the permitting process.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4” PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

Non-potable water shall be treated with biocide prior to entering the pipeline. The SDS sheets and injection rate for the Biocide shall be submitted and approved by a Noble representative prior to work permit issuance. **Note: Biocide treatment may not always be required.**

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.

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

3.3 LINE FILL


Calculated line fill water volume: **7 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.

NOTE: Only polyurethane pigs are allowed to be used with FlexSteel. (*FlexSteel Commissioning Field Notes*)

The fill pump shall be sized for the pigs to travel at a speed that will maintain a seal with the pipeline. This will reduce the risk of introducing air behind the pigs. A travel speed of 2 – 3 mph shall be maintained. The line fill flow rate for the **DSU 24/27 – 4” Flexsteel Produced Water Pipeline** must be **97 – 145 GPM (2.30 – 3.45 BPM)** in order to maintain a 2 – 3 mph range.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	

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 **DSU 24/27 – 4" Flexsteel Produced Water Pipeline** is **494 feet** of **4.576" OD 0.454" w.t.** FlexSteel pipe. It will be pressurized to either of the following hydrostatic test pressures at the corresponding locations:

DSU 24/27 PW Skid (0+00)	950 psig
DSU 24/27" PW Tie-in Site (4+94)	953 psig

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

Pressurization up to 25% of the final test pressure shall occur at a rate of **10 PSIG/MIN**.

Once 25% of the final test pressure is reached, the pressure must be allowed to stabilize for a minimum of **15 minutes**. The pressure shall be considered stabilized after **5 minutes** without fluctuation.

This process should be repeated for pressurizing the pipe to 50% of the final test pressure. Once the pressure has stabilized for **15 minutes**, the pipe should be pressurized to 75% of the final test pressure at a rate of **10 PSIG/MIN**. Now, the pressure should be allowed to stabilize for 1 hour.

After the pressure has stabilized to 75% of the final test pressure, pressurization at a rate of **5 PSIG/MIN** shall be used to complete the pressurization process up to the final test pressure. The final test pressure shall be considered stabilized after **5 minutes** without fluctuation.

When the final test pressure is reached and has stabilized, pressurization shall cease, the pipe blocked in, and all valves and connections to the line shall be inspected for leakage.

3.5 PIPE CONDITIONING


FlexSteel must be conditioned prior to commencing a "hold" or test period. This is for the purpose of allowing the polymer liner in the FlexSteel to creep to bed into the tensile elements in the FlexSteel. (*FlexSteel Technical Manual*)

After the test pressure has stabilized in the Initial Pressurization phase, the pipe should be blocked in. Then, the pressure drop in the pipe should be monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. After that, the pipe should be re-pressurized to the test pressure, blocked in, and have its pressure monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. (*FlexSteel Technical Manual*)

The two recorded pressure drops should be compared. If the rate of pressure drop is smaller for the second run, the pipe is conditioning and not leaking. (*FlexSteel Technical Manual*)

However, if the pressure drop rate does not decrease, there is a possibility that leak exists in the pressure boundary system. These leaks are usually in the test equipment or flanges rather than the pipe. If this occurs, testing should continue for two (2) additional cycles to verify that the pressure drop rate is still not changing. If the pressure drop rate remains constant, or increases, the test fittings and flange connections should be checked for leakage. Following this, if there is still no decline in the rate of pressure drop, the pipe is leaking. A leak in the pipe is rare, and if it occurs, it could result from a faulty end fitting or end fitting installation. Thus, the end fittings should be carefully inspected and/or replaced to determine if the leak occurred at an end fitting. (*FlexSteel Technical Manual*)

If the rate of pressure drop did decrease without any issues, the cycle of pressurizing to the test pressure, blocking the pipe in, and monitoring and recording the test pressure for an hour should continue a few more times to get more data and demonstrate that the rate of pressure drop is decreasing with each cycle. If an issue arises, then the steps mentioned above to determine if a leak is present should be followed.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

Otherwise, the anticipated 24-hour test pressure drop shall be calculated. That is, in a hypothetical 24-hour test, the anticipated pressure drop shall be calculated assuming the most recent pressure drop rate is maintained. If the predicted pressure is less than the Lower-Bound Test pressure (see the Site-Specific Hydrostatic Test Plan), then more conditioning cycles are needed. After each cycle, the predicted pressure drop shall be calculated for a 24-hour test to see if the pressure will always stay above the Lower-Bound Test Pressure. Once this has been confirmed, the pipe has been properly conditioned. The pipe should be re-pressurized to the test pressure, blocked in, and The Test Period shall start. (*FlexSteel Technical Manual*)

NOTE: The conditioning process can take several hours (8 – 12). It may be the case that the pipe needs to be pressurized up to the final test pressure a few times to finalize the conditioning before being blocked in and starting the test period. Also, it is recommended that all personnel be at least 50 feet away from the pipe during the pressure test. (*FlexSteel Commissioning Field Notes*)

Conditioning may occur during the evening and/or in cold weather situations and precautions must be taken to eliminate the possibility of freezing in the appurtenances, such precautions may include the use of thermal blankets and heaters.

3.6 THE TEST PERIOD

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


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

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

The maximum allowable range of pressure fluctuation during the pressure test is defined by the “**Upper Bound Test Pressure**” and “**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.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4” PW Pipeline			DJBU
	NMP Doc. No.:	N/A	Rev.: 0	

3.7 SEARCHING FOR LEAKS

Prior to commencing work, the method(s) for locating leaks or failures shall be approved by the Noble representative. The operator may choose to fly, drive and/or walk the pipeline right-of-way to visually check for evidence of leaks during the pressure test. The operator should develop contingency plans for locating large and small leaks in areas of difficult terrain or in the event of inclement weather.

Acceptable methods for finding leaks during a pressure test are listed as follows:

- Sectioning or segmenting the pipeline and monitoring the pressure of each section. Closing mainline block valves will isolate the pipeline into smaller segments. Freeze plugs may also be used to isolate sections of the pipeline for evaluation.
- Acoustical monitoring equipment may be employed to narrow the search area.
- Odorants or tracers introduced into the test medium during the filling process will allow the operator to detect leaks with sensing equipment.

3.8 PRESSURE TEST FAILURES

All leaks and test failures shall be reported to the Noble representative immediately.

Any pipeline leaks or failures shall be documented in the test report.

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

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

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


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

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

3.9 DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF TEST WATER

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

Depressurization activities shall not commence without authorization from the Noble representative. Once authorization is received, depressurization should commence at a rate of **10 PSIG/MIN** in increments of 25% of the final test pressure. The pressure should be allowed to stabilize for **15 minutes** between increments.

	Hydrostatic Pressure Test Procedure DSU 24/27 – 4" PW Pipeline				DJBU
	NMP Doc. No.:	N/A	Rev.:	0	

Displacement and disposal activities shall not commence prior to Noble engineering acceptance of the hydrostatic test results.

A disposal plan for the test medium must be developed and the Noble representative shall review and approve the disposal plan.

Pigs or spheres used in the dewatering process shall be equipped with trackers for monitoring location and speed during the dewatering process.

The travel speed for the dewatering pigs shall be maintained at **2 – 3 MPH**.

3.10 DRYING OPERATIONS

Upon completion of the hydrotest the pressure should be brought down to **50 PSIG** and the water should remain in the pipeline until commissioning.


If the pipeline will not be placed into service within seven (7) days or if there is not a plan to ensure freezing will not occur, drying operations will be required.

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

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

	Hydrostatic Pressure Test Procedure				DJBU
	DSU 24/27 – 4" PW Pipeline				
	NMP Doc. No.:	N/A	Rev.:	0	

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) "FlexSteel Technical Manual"
- 6) "FlexSteel Commissioning Field Notes"
- 7) Site Specific Hydrostatic Test Plan

DSU 24/27- 4" Produced Water Pipeline (CL300) Hydrostatic Pressure Test Plan

