MUP-08-TLN-200
MUP-08-TLN-200-L1

noble MIDSTREAM SERVICES

CRYSTAL GAUGE RECAP LOG DATA SHEET (C-7.b)

Project OP. Lab AFE/Work Order No. _____

Pipeline Flexsteel Line (Name) Weld Co (Location)

Testing Contractor Wood Pipeline Services

Pipe O.D. 8" Wall thickness. 0.75 Grade _____ MFG'R: _____

Test Fluid water Additive N/A

Test Location: 0+00 - 480+11 Section No. PL 5200 to PK 5500

Instrumentation: 0+00 NW Pad (Location) Barton Recorder (Type) 242-1264/40

Dead weights (Mfg'r) 1059 (S/N) _____ (Date Calibrated)

Time	Pressure PSIG	Ambient Temp.
7:30	1067	41
7:45	1061	40
8:00	1057	39
8:15	1055	38
8:30	1053	33
8:45	1052	32
9:00	1051	33
9:15	1049	32
9:30	1048	33
9:45	1047	35
10:00	1046	36

Time	Pressure PSIG	Ambient Temp.
10:15	1045	35
10:30	1044	36
10:45	1043	37
11:00	1042	36
11:15	1041	35
11:30	1041	36
11:45	1040	36
12:00	1039	34
12:15	1039	35
12:30	1038	37
12:45	1037	37

Time	Pressure PSIG	Ambient Temp.
1:00 AM	1036	37
1:15 AM	1035	35
1:30 AM	1035	34
1:45 AM	1035	34
2:00 AM	1034	34
2:15 AM	1034	33
2:30 AM	1033	33
2:45 AM	1033	33
3:00 AM	1032	33
3:15 AM	1031	33
3:30 AM	1031	33

Test Started 7:30 (Time) AM/PM 12-17-18 (Date) Test Ended 3:45 (Time) AM/PM 12-18-18 (Date)

Remarks: _____

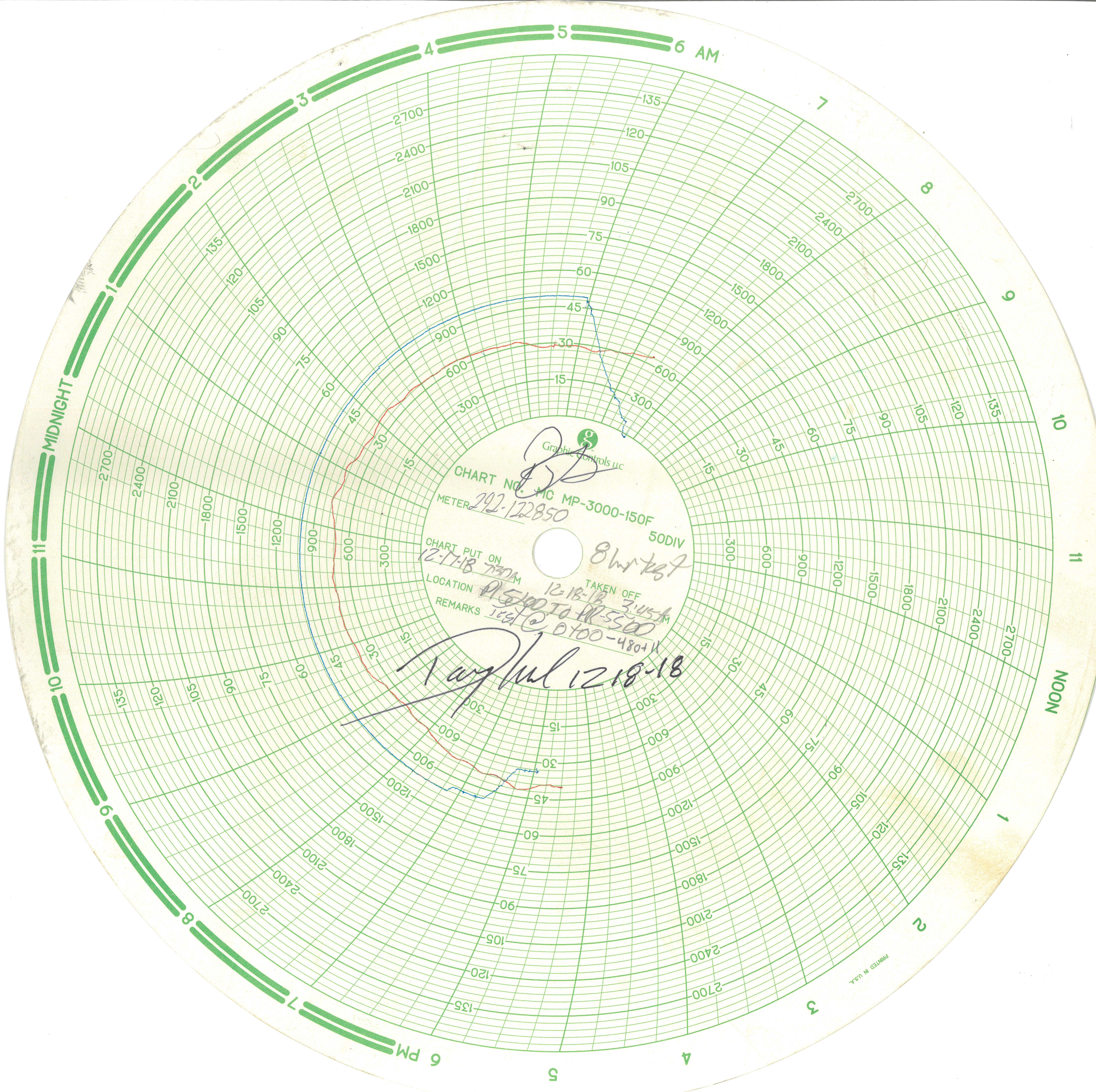
Weather: _____

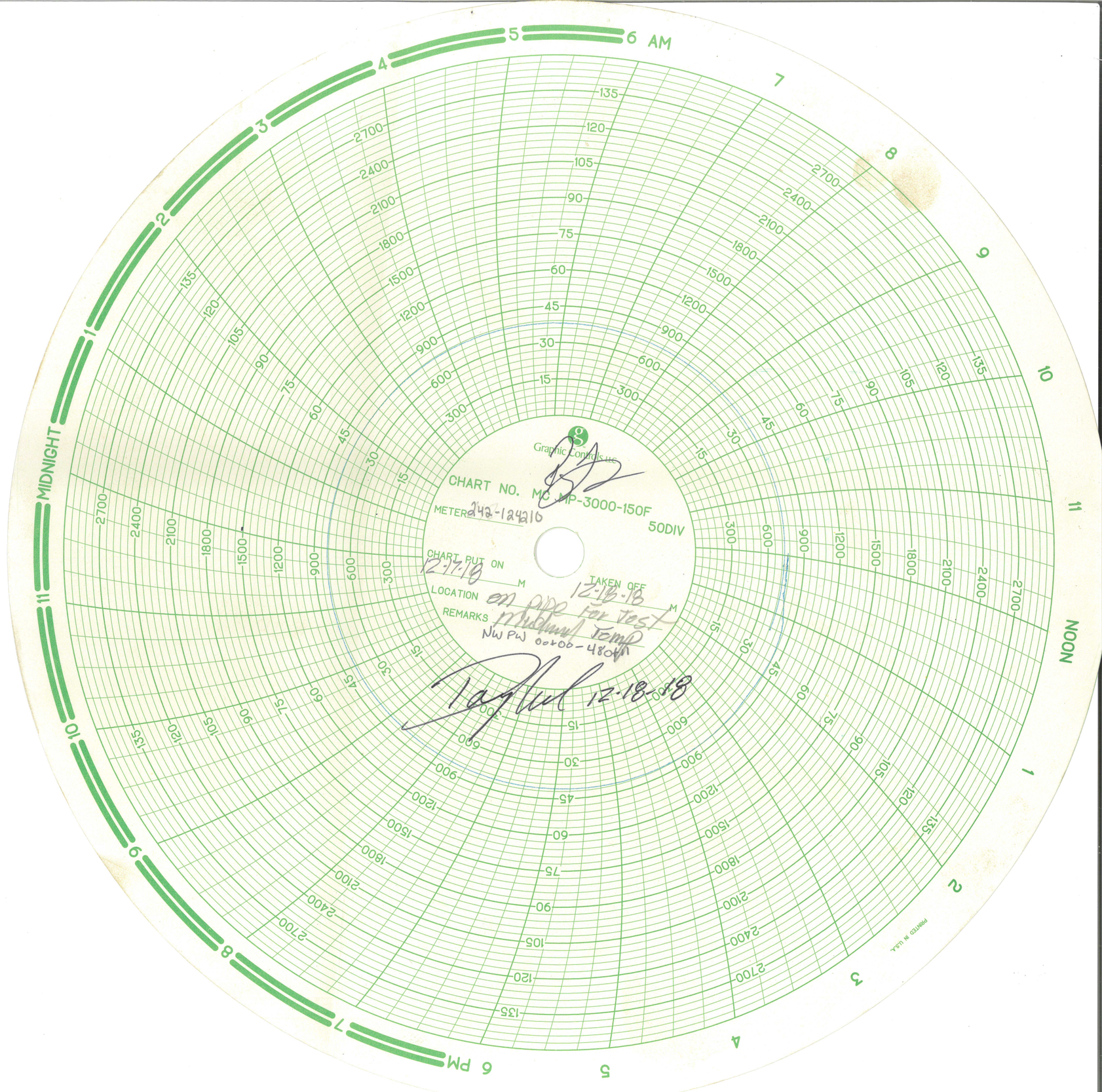
Testing Contractor's Representative _____ (Name) _____ (Title) _____ (Signature) 12-18-18 (Date)

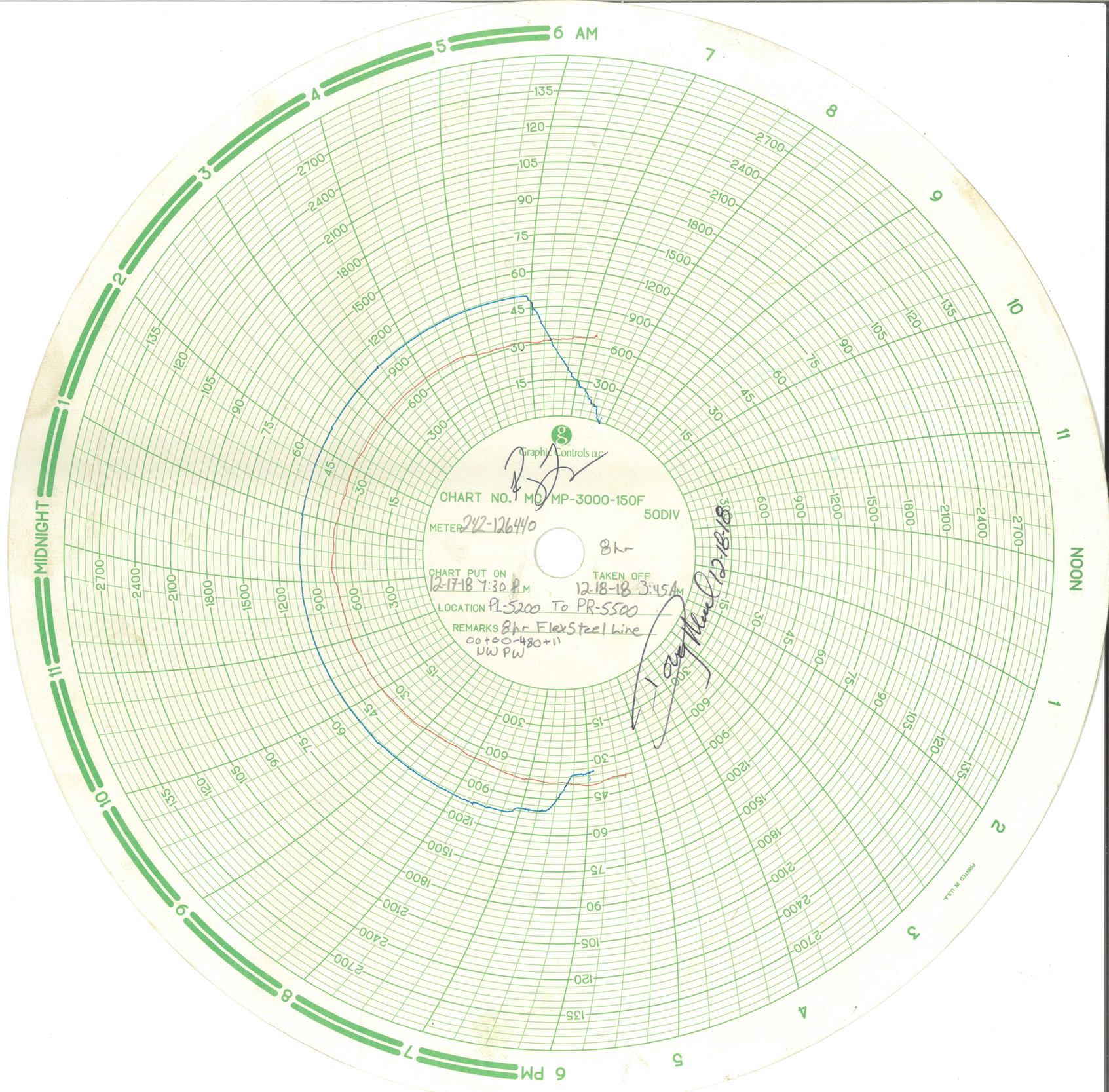
Constr. Contractor's Representative Gabe O'Keefe (Name) QAQC (Title) _____ (Signature) 12-18-18 (Date)

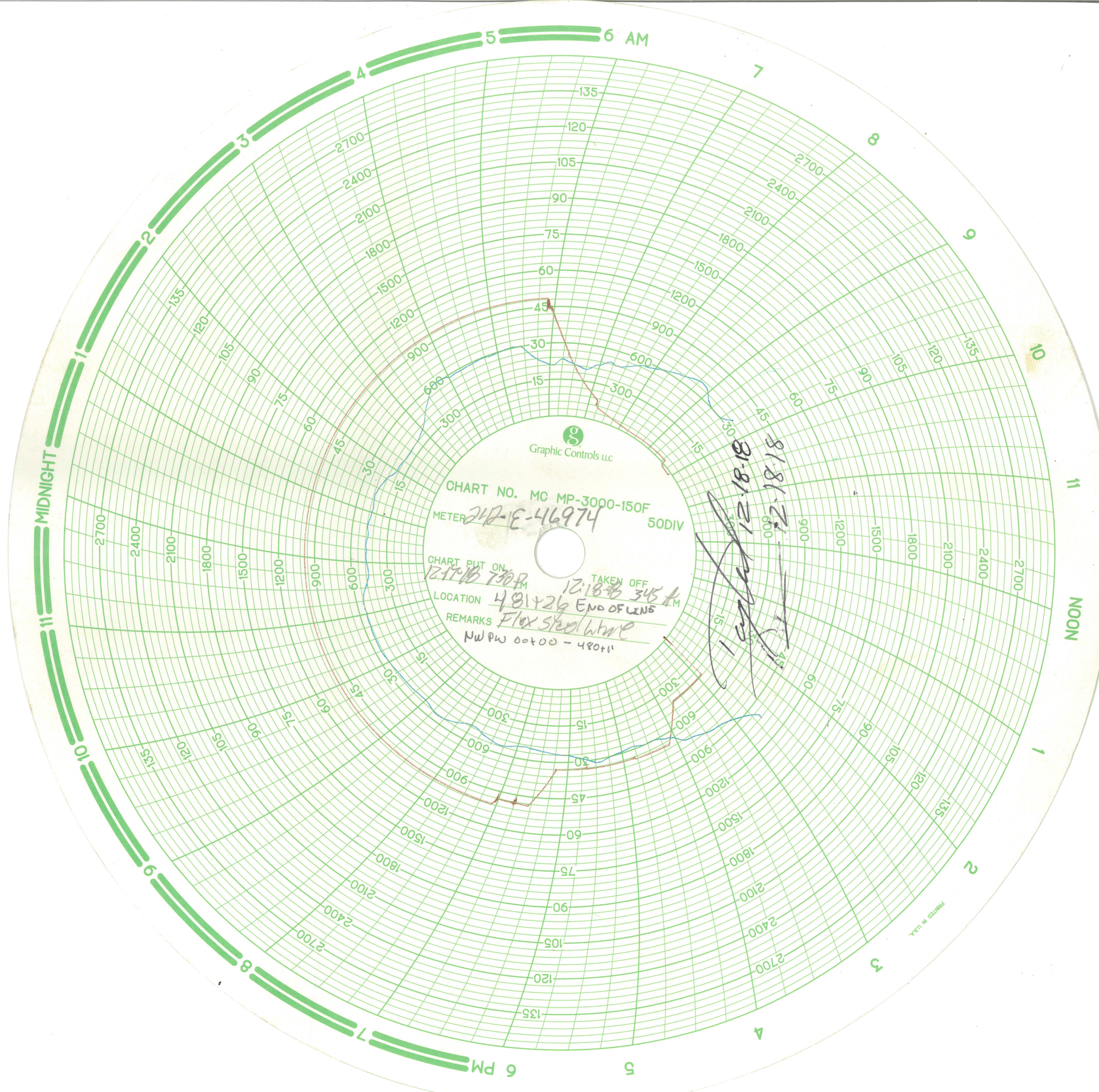
Company Representative Roger Luco (Name) CM (Title) _____ (Signature) 12/19/18 (Date)

Construction Superintendent Richard Reyes (Name) Super (Title) _____ (Signature) 12/18/18 (Date)


Graphic Controls LLC
CHART NO. MC MP-3000-150F
50DIV
METER 292-122850
CHART PUT ON 12-17-18 7:30 AM
TAKEN OFF 12-18-18 3:45 PM
LOCATION
REMARKS
8 hr test
12-18-18
MIDNIGHT
NOON
6 AM
6 PM
PRINTED IN U.S.A.


MIDNIGHT
1
2
3
4
5
6 AM
7
8
9
10
11
NOON
1
2
3
4
5
6 PM
7
8
9
10
11
Graphic Controls LLC
CHART NO. MC MP-3000-150F
METER 242-124216
50DIV
CHART PUT ON 12-14-18 M
TAKEN OFF 12-18-18 M
LOCATION on PIPE for test
REMARKS Medium Temp
NW PW 00100-4804M
12-18-18
PRINTED IN U.S.A.


6 AM
7
8
9
10
11
NOON
1
2
3
4
5
6 PM
7
8
9
10
11
MIDNIGHT
Graphic Controls LLC
CHART NO. MC MP-3000-150F
50DIV
METER 242-126440
8hr
CHART PUT ON 12-17-18 7:30 PM
TAKEN OFF 12-18-18 3:45AM
LOCATION PL-5200 To PR-5500
REMARKS 8hr FlexSteel Line
00+00-480+11
NW PW
242-18218
PRINTED IN U.S.A.


MIDNIGHT
1
2
3
4
5
6 AM
7
8
9
10
11
NOON
1
2
3
4
5
6 PM
7
8
9
10
11
Graphic Controls LLC
CHART NO. MC MP-3000-150F
METER 248-E-46974
50DIV
CHART PUT ON 12-17-18 7:30 AM
TAKEN OFF 12-18-18 3:45 PM
LOCATION 481+26 END OF LINE
REMARKS Flex steel hose
NW PW 00400 - 48011
12-18-18
12-18-18
PRINTED IN U.S.A.

P-S-S-COMPANIES

WASATCH SUPPLY

PSS PIPELINE SUPPLY & SERVICE

NORTH STATE SUPPLY NS

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: 10/04/2018
DUE DATE: 10/04/2019

INDICATED TEMPERATURE RANGE: # 0 – 150°F
INDICATED PRESSURE RANGE: #0 – 3000 PSI
SERIAL NO: 242-122850
MANUFACTURER: BARTON/ 12" RECORDER

TYPE OF INSTRUMENT CALIBRATED: TEMPERATURE / PRESSURE RECORDER

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

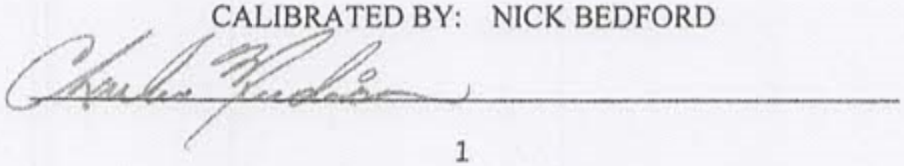
BASED ON INTERNATIONAL STANDARDS OF GRAVITY: (980.665 cm./sq.).

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): 68°F / 40%.

CALIBRATED BY: NICK BEDFORD



P-S-S-COMPANIES

WASATCH SUPPLY

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NORTH STATE SUPPLY NS

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: 09/26/2018
DUE DATE: 09/26/2019

INDICATED TEMPERATURE RANGE: # 0 – 150°F
INDICATED PRESSURE RANGE: #0 – 3000 PSI
SERIAL NO: 242-124210 / **ID:** 008861
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): 66°F / 25%.

CALIBRATED BY: NICK BEDFORD

SIGNATURE

P-SS-SS-COMPANIES

WASATCH SUPPLY

PSS PIPELINE SUPPLY & SERVICE

NORTH STATE SUPPLY NS

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: 07/05/2018
DUE DATE: 07/05/2019

INDICATED TEMPERATURE RANGE: # 0 – 150°F
INDICATED PRESSURE RANGE: #0 – 3000 PSI
SERIAL NO: 242-126440
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): 66°F / 25%.

CALIBRATED BY: NICK BEDFORD

P-S-S-COMPANIES

WASATCH SUPPLY | PSS PIPELINE SUPPLY & SERVICE | NORTH STATE SUPPLY

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: 09/19/2018
DUE DATE: 09/19/2019

INDICATED TEMPERATURE RANGE: # 0 – 150°F
INDICATED PRESSURE RANGE: #0 – 3000 PSI
SERIAL NO: 242E-46974
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): 66°F / 25%.

CALIBRATED BY: NICK BEDFORD

SIGNATURE

DP408 WEST

GAS SK-5300
GAS SK-5301
PL-5300 16" PIG LAUNCHER
LACT SK-5100
PL-5100 6" PIG LAUNCHER
PW SK-5200
PW SK-5201
PL-5200 8" PIG LAUNCHER
SDV

FRICO DITCH

2

MUG-16-TLN-200-L1
MUO-08-TAM-100-L1
MUP-08-TLN-200

WCR 49

ROAN
PR-5400 6" PIG RECEIVER
TO ROAN TIE-POINT

3 WAY INTERSECTION
PR-5300 16" PIG RECEIVER
TO 3 WAY INTERSECTION TIE-POINT

BOX ELDER CREEK

8" 8" FUTURE

6" DP410

20" DCP TIE-IN
8" 8" FUTURE

8" 8" RW
8" 8" RW

DP408 JUNCTION
PR-5600 12" PIG RECEIVER
PR-5100 6" PIG RECEIVER
PR-5200 8" PIG RECEIVER

DP408 EAST
GAS SK-5600
GAS SK-5601
PL-5600 12" PIG LAUNCHER
LACT SK-5400
PL-5400 6" PIG LAUNCHER
PW SK-5502
PW SK-5503
PL-5500 8" PIG LAUNCHER

MUG-12-TLN-200-L1-1
MUO-06-TAM-100-L1-1
MUP-08-TLN-200-L1

DP9 SW ROW
PR-5500 8" PIG RECEIVER
FUTURE BOOSTER PUMP CONNECTION

N

PLOT STYLE:

LAST SAVED: 10/8/2018 BY: SBARTSCH

FILE LOCATION: C:\pw_workdir\den003\ch2m\ill_abartsch\d0231551\MP2-JAC-PR-PFD-0001.dwg

REFERENCE DRAWINGS

DWG NO.	DESCRIPTION
MP2-JAC-PR-PID-0003	MUSTANG JUNCTION / DELIVERY POINTS P&ID
MP2-JAC-PR-PID-0002	MUSTANG DP408 NORTHEAST P&ID
MP2-JAC-PR-PID-0001	MUSTANG DP408 NORTHWEST P&ID

REVISIONS

REV	DESCRIPTION	BY	DATE	CHK BY	CHK DATE	APR BY	APR DATE
3							
2							
1							
0	ISSUED FOR CONSTRUCTION	SJM	10/08/2018	SH	10/08/2018	BE	10/08/2018
0	ISSUED FOR CONSTRUCTION	AJB	08/8/2018	LK	08/8/2018	BE	08/8/2018
0	ISSUED FOR CONSTRUCTION	NMR	06/27/2018	DM	06/27/2018	BE	06/27/2018

APPROVALS

	SIGNATURE	DATE
DRAWN/DESIGNED	AB	4/19/18
CHECKED	JL	4/27/18
APPROVED	BE	4/27/18

CLIENT APPROVAL

	SIGNATURE	DATE
OPERATIONS		
ENGINEERING		
PROJ. MGR.		

noble MIDSTREAM SERVICES

PROCESS FLOW DIAGRAM
MUSTANG DP408 PIPELINE FLOW DIAGRAM

SCALE: NONE
DRAWING: MP2-JAC-PR-PFD-0001
SHEET No. 1 or 1
2

Mustang Gathering System

Noble Midstream Partners

Hydrostatic Pressure Test Procedure for Produced Water FlexSteel Pipelines

MP2-JAC-PI-RPT-0002 | A

October 11, 2018

Mustang Gathering System

Project No:	704161
Document Title:	Hydrostatic Pressure Test Procedure for Produced Water FlexSteel Pipelines
Document No.:	MP2-JAC-PI-RPT-0003
Revision:	A
Date:	October 11, 2018
Client Name:	Noble Midstream Partners
Project Manager:	Blake Evans
Author:	Shawn Heath
File Name:	MP2-JAC-PI-RPT-0003

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Document history and status

Revision	Date	Description	By	Review	Approved
A		Issued for Review	SH	BE	BE

Contents

EXECUTIVE SUMMARY

This general procedure defines the minimum requirements for hydrostatic pressure testing of FlexSteel pipelines. This document is intended to be used in conjunction with site-specific testing information to be provided in Appendix A.

1. REFERENCES

Testing procedures shall comply with the latest editions of the following industry standards:

- Title 49 CFR DOT Part 195 – Transportation of Hazardous Liquids by Pipeline
- API RP 1110 – Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide
- ASME B31.4 – Pipeline Transportation Systems for Liquids and Slurries
- ASME B16.5 – Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard
- FlexSteel Technical manual
- FlexSteel Commissioning Field Notes

2. PRE-TEST PRECAUTIONS

2.1 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.

2.2 TEST PRESSURE AND DURATION

2.2.1 TEST PRESSURE

Pipelines shall be tested at a minimum test pressure of 125% of the internal design pressure.

A site-specific pressure test range calculated based on pipeline elevation, pipeline material, corrosion allowance, and minimum code requirements for each test section shall be included in Appendix A of this procedure.

2.2.2 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 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 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.

2.3.1 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.

2.3.2 SUPPLY WATER FILTER

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

2.3.3 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.

2.3.4 CALIBRATION DEVICES

2.3.4.1 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.

2.3.4.2 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.

2.3.5 RECORDING DEVICES

2.3.5.1 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.

2.3.5.2 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.

2.3.6 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 the site-specific calculated maximum testing pressure to be provided in Appendix A.

2.4 QUALIFICATION OF CONTRACTOR AND OPERATOR PERSONNEL

Qualifications of contractor and operator personnel for conducting pressure tests will be based on certification requirements by 49 CFR Part 192/195, 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.

2.5 PERMIT TO WORK

Prior to commencing work, work permits shall be obtained. At a minimum, the below documents shall be provided by the contractor for submittal:

- 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 by the contractor 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. 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.

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

3.3 LINE FILL

The line fill water volume shall be calculated for each test section and be included in Appendix A of this procedure.

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. Per the *FlexSteel Commissioning Field Notes,* only polyurethane pigs are allowed to be used with FlexSteel.

The fill pump shall be sized for the pigs to travel at a speed that will maintain a seal with the pipeline. This will reduce the risk of introducing air behind the pigs. A travel speed of 2 – 3 mph shall be maintained.

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

Air shall be bled during the filling process to minimize the time for line pressure stabilization. The total amount of residual air shall be less than 0.2% of the volume of the test section. If it is determined that air is trapped in the pipeline, vents or traps at high elevation points may be installed to bleed the air from the pipeline. Any equipment added to the pipeline shall be removed after the pipeline has been dewatered.

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

3.4 INITIAL PRESSURIZATION

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

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

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

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

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

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

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

Pressurization up to 75% 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 which point the pressure should be allowed to stabilize for 1 hour.

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

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

3.5 PIPE CONDITIONING

FlexSteel must be conditioned prior to commencing a “hold” or test period in order to allow 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. The pressure drop in the pipe should be monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. After that, the pipe should be re-pressurized to the test pressure, blocked in, and have its pressure monitored and recorded continuously, or at least every fifteen (15) minutes for 1 hour. (*FlexSteel Technical Manual*)

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

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

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

Otherwise, the anticipated 24-hour test pressure drop shall be calculated by assuming the most recent pressure drop rate is maintained over a 24-hour test. If the predicted pressure is less than the calculated minimum test

pressure, 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 minimum 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*)

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.

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. It is also recommended that all personnel be at least 50 feet away from the pipe during the pressure test. (*FlexSteel Commissioning Field Notes*)

3.6 TEST PERIOD

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

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

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

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

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

3.7 SEARCHING FOR LEAKS

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

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

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

3.8 PRESSURE TEST FAILURES

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

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

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

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

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

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

Pressure excursions outside of the site-specific maximum and minimum test pressures as defined in Appendix A are considered test failures.

3.9 DEPRESSURIZATION, DISPLACEMENT, AND DISPOSAL OF TEST WATER

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

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

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

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

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

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

3.10 DRYING OPERATIONS

If the pipeline will not be placed into service within seven (7) days of dewatering, drying operations are required.

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

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 for 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
- Title 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

APPENDIX A. SITE SPECIFIC TESTING INFORMATION

Hydrotest Summary Page - FlexSteel

Project: **Mustang DP408**
Client: **Noble Midstream Partners**
Location: **Weld County, CO**

						Start of Line		End of Line			
	Test Segment	Process Fluid	Test Medium	Test Duration (hrs)	MOP (psig)	Min Test Pressure (psig)	Max Test Pressure (psig)	Min Test Pressure (psig)	Max Test Pressure (psig)	Max % Burst Pressure (psig)	Est. Water Volume (gal)
1	PL-5200 to PR-5500	Produced Water	Water	8	740	966	1075	925	1034	75.0%	114,160
2	PL-5500 to PR-5200	Produced Water	Water	8	740	936	1121	931	1115	75.0%	8,045
3											
4											
5											
6											
7											
8											
9											
10											

Notes:

1.) See attached calculations for specific information on each test section.

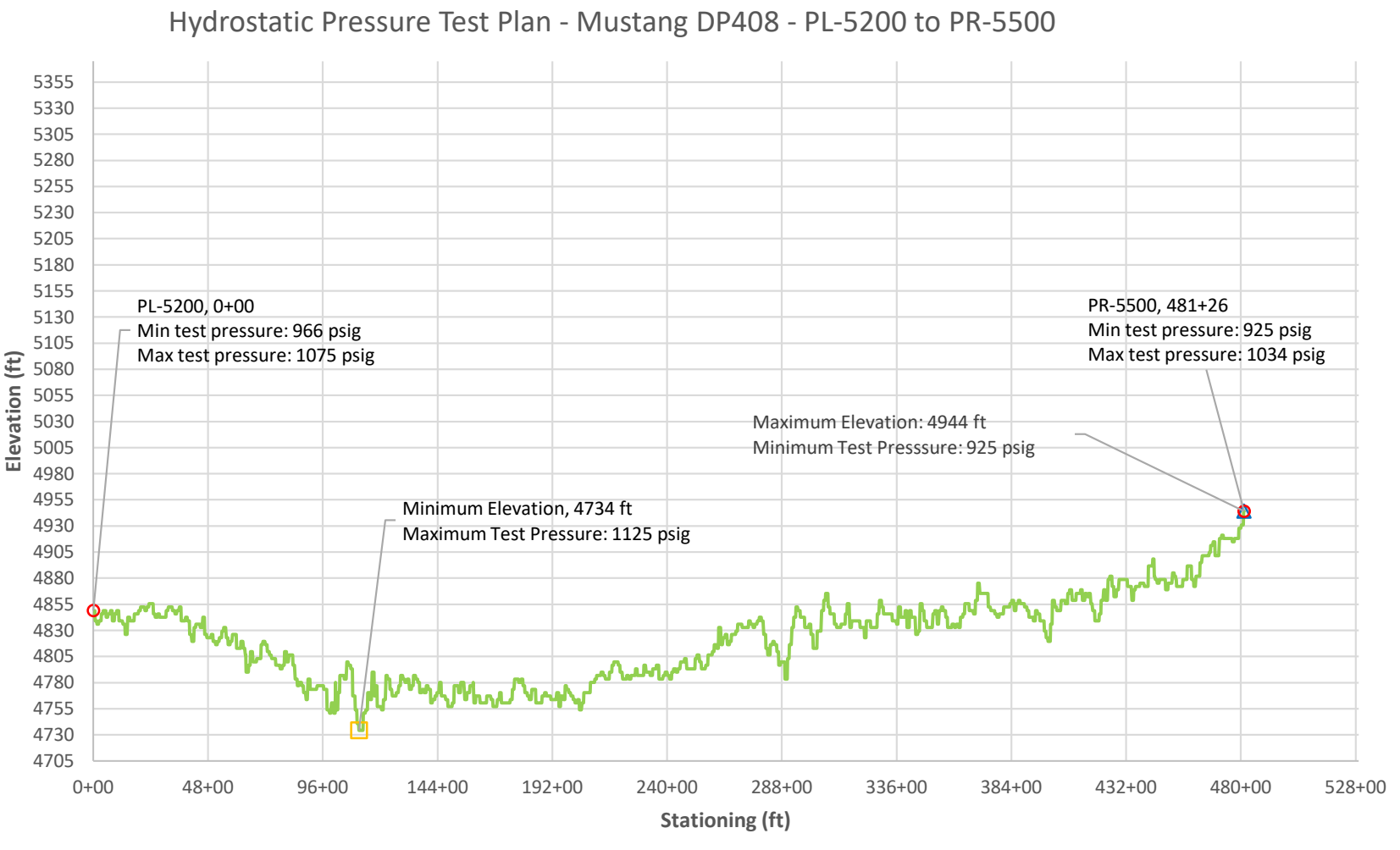
Hydrostatic Pressure Test Plan - FlexSteel

Project:	**Mustang DP408**	By:	ML
Client:	**Noble Midstream Partners**	Checked By:	SH
Location:	**Weld County, CO**	Date:	10/11/2018
Segment:	**PL-5200 to PR-5500**	Revision:	A

Design Criteria		Calculated values	
PW	Process Fluid	9.12	Outside Pipe Diameter (in)
750	FlexSteel Rating (psig)	7.63	Inside Pipe Diameter (in)
8	Pipe Nominal Diameter (in)	0.75	Wall Thickness (in)
740	MAOP (psig)	925	Min Test Pressure (psig)
1.25	Hydrotest design factor	1125	Max Allowable Test Pressure (psig)
300	ANSI Fitting Rating	1500	Burst Pressure (psig)
Water	Test Medium	2.372	Water volume, gal/ft
8	Test Duration (hours)	48,126	Test section length (ft)
		114,160	Water volume (gal)

Test Pressure Summary

			Minimum (Allowable)		Maximum (Allowable)	
	Station	Elevation	psig	% burst	psig	% burst
Begin	0+00	4849.08	966	64%	1075	72%
High	481+20	4944	925	62%	1034	69%
Low	111+20	4734	1016	68%	1125	75%
End	481+26	4944.23	925	62%	1034	69%



Hydrostatic Pressure Test Plan - FlexSteel

Project:	**Mustang DP408**	By:	ML
Client:	**Noble Midstream Partners**	Checked By:	SH
Location:	**Weld County, CO**	Date:	10/11/2018
Segment:	**PL-5500 to PR-5200**	Revision:	A

Design Criteria		Calculated values	
PW	Process Fluid	9.12	Outside Pipe Diameter (in)
750	FlexSteel Rating (psig)	7.63	Inside Pipe Diameter (in)
8	Pipe Nominal Diameter (in)	0.75	Wall Thickness (in)
740	MAOP (psig)	925	Min Test Pressure (psig)
1.25	Hydrotest design factor	1125	Max Allowable Test Pressure (psig)
300	ANSI Fitting Rating	1500	Burst Pressure (psig)
Water	Test Medium	2.372	Water volume, gal/ft
8	Test Duration (hours)	3,391	Test section length (ft)
		8,045	Water volume (gal)

Test Pressure Summary

			Minimum (Allowable)		Maximum (Allowable)	
	Station	Elevation	psig	% burst	psig	% burst
Begin	0+00	4819.55	936	62%	1121	75%
High	27+40	4846	925	62%	1109	74%
Low	0+40	4810	941	63%	1125	75%
End	33+91	4832.68	931	62%	1115	74%