STRENGTH TESTING for ESTABLISHING MAOP GD10.1003-1

Original Issue Date: 08/01/83 Revision Date: 2/24/14 Status: REVISED

Approved By: John Hill Department: Gas Operations

Reference: CFR Title 49 Parts 192.503, 507, 509, 515, 517; 195.304, 305, 306, 308, 310; ASME B16.5;

Gas Standard: NA Gas Operations Plan: Natural Gas section 10 and Hazardous Liquid section 9

Purpose: To provide a procedure for strength testing natural gas and hazardous liquid lines prior to placing into operation or qualifying for reinstatement in order to establish their maximum allowable operating pressure (MAOP) and to confirm their structural integrity.

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1. OVERVIEW

The following guidelines shall apply to all strength testing of natural gas lines.

A. All new gas lines (service or main) that will operate at a pressure above 60 psig - Feeder Line (F/L) and Transmission Line (T/L) - and all liquid propane lines shall be strength tested before being placed in service. The test pressure, test medium, and test duration shall be determined by the Engineer, and shall be listed on the cover sheet of the “Issued Drawing” set. The limits of the test shall be shown on the construction plans.

B. Post installation strength testing **is not** required for the replacement of components other than pipe or for components where a manufacturer has certified:

1. The component was tested to at least the pressure required for the pipeline to which it is being added;

2. The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added; or

3. The component carries a pressure rating established through applicable ASME/ANSI, MSS specifications, or by unit strength calculations as described in § 192.143 or § 195.106.

Equipment that is not to be subjected to pressure testing (e.g. regulators, expansion joints, valves) shall be disconnected or blocked off during the test. Temporary spool pieces, blind flanges, or blanks installed for testing purposes must be designed to withstand the test pressure without distortion.

C. Each length of pipe manufactured to API 5L specifications is subjected to a quick hydrostatic strength test during the manufacturing process (see table below). This test is for the manufacturer’s inspection only and **is not acceptable** for the requirements of this procedure and Federal Code. Post construction testing is required to detect flaws that may have developed since the pipe was manufactured.

Grade	Size	API 5L Standard Test Duration (seconds)	API 5L Standard Test Pressure as %SMYS
A25	< 6”	5	60
A	> 2”	5	60
B	> 2”	5	60
X42 – X80	< 6”	5	60
	6” to 8”	5	75
	10” to 18”	5	85
	>= 20”	10	90

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D. Valves should be cut in and installed after strength testing. However, **full port** ball valves rated for the proposed test pressure may be installed prior to the test. Care should be taken to confirm these valves are in the open position prior to testing.

E. The test shall be suspended if a leak exceeds the pump capacity to maintain the test pressure or if the onsite company representative directs the test to be suspended. The test shall be started over after repairs are made.

F. The on-site company representative is responsible for observing and recording the test.

F. Prior to each test, the following shall be determined:

1. The extent of system to be tested and the number of individual test segments
2. The pressure rating of test fittings and valves, and their location
3. The test medium
4. The test pressure
5. The test duration
6. Elevation gradient along the test segment
7. The location of test medium injection point and air bleed points
8. Location of pressure gauges
9. Location of acceptable sources of test medium
10. Location of acceptable discharge of the test water

It may be beneficial to sketch a single line diagram showing this information before the test is started.

2. <u>SAFETY</u>

A. The on-site company representative shall take all reasonable precautions to protect the employees and the general public during the testing.

B. All radiographic and other non-destructive testing of welds shall be completed before the pressure test per procedure GD60.739 *Xray Report – Daily Completion*.

C. Pipe to be tested should be in a trench when possible. In congested areas, the pipeline shall be completely backfilled prior to testing, except at needed bell hole locations (e.g. flanged joints, valve pits, blow-offs, vents). The pre-testing of pipeline segments above-ground on the job site is discouraged, but may be necessary for certain installations (directionally drilled mains under a river, highway and railroad crossings, above ground stations, emergency repairs, and tie-ins (see GD60.162 for pre-tested pipe).

D. Notification of the Environmental Health & Safety Department must be at least two weeks before the scheduled removal of test water.

E. Testing against a live main or valve is prohibited, unless a valve paddle is utilized.

3. TEST PRESSURE

A. The Test Pressure must be at least 1.5 times the MAOP of the line (Class 4 location design) for natural gas lines.

B. The Test Pressure must be at least 1.25 times the MAOP of the line (Class 4 location design) for liquid propane lines.

C. Flanged joints, fittings, and valves may be subjected to pressure testing of 1.5 times the rated pressure at 100F with the rating rounded off to the nearest 25psi increment per ASME B16.5. Testing at higher pressures higher than those listed below requires approval from Gas Engineering.

ANSI Flange Fitting Class	Pressure Rating at 100F (psig)	Max. Recommended Test Pressure (psig)
150	285	450
300	740	1125
600	990	1500

D. The Engineer must calculate the Hoop Stress as a percentage of the pipe specified minimum yield strength (SMYS) for the proposed test pressure. If a water is used as the test medium, the %SMYS must be calculated by adding the water head of the greatest elevation gradient along the test segment to the test pressure. The Hoop Stress created by the combined pressure must not exceed 90% of SMYS. Exhibit 1 (attached) lists pressures that produce 90% of SMYS for various pipe sizes, grades, and wall thicknesses.

E. If, during the test, the segment is to be stressed to 20 percent or more of SMYS and natural gas, inert gas, or air is the test medium:

   A. A leak test must be made at a pressure between 100 p.s.i. gage and the pressure required to produce a hoop stress of 20 percent of SMYS; or

   B. The line must be walked to check for leaks while the hoop stress is held at approximately 20 percent of SMYS.

4. TEST DURATION

- For liquid propane lines that can be visually inspected during testing, the test pressure must be maintained throughout the system being tested for at least four continuous hours. If the pipeline cannot be visually inspected for leakage during the test, the test pressure for liquid propane lines must be maintained throughout the system being tested for at least eight continuous hours.

- The Engineer must calculate the Hoop Stress as a percentage of the pipe specified minimum yield strength (SMYS) for the proposed MAOP to determine the minimum test duration for natural gas lines.

- The following strength test duration requirements are required for natural gas pipelines that will operate at a hoop stress less than of 30% of SMYS:

    1. The strength test must be conducted by maintaining the pressure at or above the test pressure for at least four hours; except as stated below.

    2. For fabricated units and short sections of pipe, for which a post installation test is impractical, a pre-installation strength test must be conducted by maintaining the pressure at or above the test pressure for at least one hour.

- The following strength test durations are required for natural gas pipelines that will operate at a hoop stress of 30% or more of SMYS:

    1. The strength test must be conducted by maintaining the pressure at or above the test pressure for at least eight hours; except as stated below.

    2. For fabricated units and short sections of pipe, for which a post installation test is impractical, a pre-installation strength test must be conducted by maintaining the pressure at or above the test pressure for at least four hours.

5. PRE-CLEANING

- Before testing, wire brush and foam pigs shall be sent through the line to loosen and remove any scale inside the pipe and to remove any foreign material that may have been left in the pipe during construction. Care shall be exercised in maintaining slow "pig" travel speeds (3 to 10ft/s).

- A "pig" launcher and receiver of sufficient size to contain the "pig" shall be welded or bolted flanged at each end of the test section.

6. TEST EQUIPMENT

A. In order that reasonable interpretation of pressure variations can be made, it is important that accurate calibrated equipment be used. Test instruments shall be transported in such a manner as to minimize vibration and shock which could cause them to go out of calibration. During transportation, all gages shall be cushioned against excessive road shock. All pressure and temperature recording devices and gauges should be calibrated at least annually. Check the date on the calibration sticker attached to the device before using.

B. A chart recording pressure gauge shall be used to record test pressures in conjunction with a dead weight or digital pressure gauge. The range of the gauge shall be such that adequate interpretation of the pressure is possible, having a maximum pressure of no more than twice the test pressure. (E.g. Test pressure = 750 psig; chart pressure maximum indication 1500 psig.)The minimum diameter of all test charts shall be eight inches.

C. Dead weight tester or digital pressure gauge (accurate to at least 0.5%) shall also be used in conjunction with recording gauges. Both must be in good operating condition. The piston of the dead weight tester must move freely in the vertical direction and also rotate freely.

D. Temperature chart recorders should be used to measure ambient air temperature and pipe water temperature. The tap location for the sensor to the pipe water temperature recorder should be buried and placed at least 20’ from any exposed section of pipe so the influence of atmospheric temperature changes are minimized.

E. Fill pumps used shall be equipped with the proper strainers and filters (100 mesh screen typical) if non-potable water is used. The pumps shall be of sufficient size and capacity to fill the line in a reasonable time frame.

F. A reciprocating positive displacement pump with a stroke counter or a metering pump (oscillating positive displacement pumps) should be used for pressurizing the test segment. Positive displacement pumps are called **"constant flow machines"** because with each stroke of a cylinder a constant volume of fluid is displaced. In theory, they produce the same flow at a given speed (RPM) no matter what the discharge pressure. An electronic device can be used to count the number of revolutions. This type of pump must not be operated against a closed valve on the discharge side of the pump, because it has no shut-off head like centrifugal pumps. A positive displacement pump operating against a closed discharge valve will continue to produce flow and the pressure in the discharge line will increase, until the line bursts and/or the pump is severely damaged. Therefore, a relief or safety valve is required on the discharge side of the positive displacement pump. The relief valve can be internal or external.

G. Digital thermometer accurate to within 0.1 degree F.

H. Watch or clock.

I. Flow meter accurate to 1/10 CF

J. Air Compressor for pushing pigs to clean and drain pipe.

K. Sufficient supply of foam, rubber cupped, and wire brush pigs to clean, fill, and dewater the line. Pigs should be sized for the pipe ID.

L. Communication devices.

7. ELEVATION PROFILE & TEST SECTIONS

A. Where elevation gradients exceed one-hundred feet of difference, Gas Engineering will prepare a surveyed profile of the proposed alignment and evaluate if the line needs to be sectionalized so all parts of the test section are subjected to an optimum pressure without over-stressing the low points of the line. The maximum difference in elevation shown on the profile will also be used to select adequate equipment for filling and pressurizing the sections to be tested.

B. Lines may have to be separated into different test sections based on changes in pipe diameter, SMYS, and wall thickness.

C. The length of each test section shall be limited to a distance that would make a good leak test practicable and will vary according to the diameter of the pipe. However, it is felt that a test section of line over 10 miles in length is not practical except under special conditions.

D. Generally, the pressure recording gauge and a dead weight tester or digital pressure gauge is located at the highest elevation to insure the entire line meets the design MAOP/MOP. However, if there are drastic elevation changes, it will be necessary to insure that the 90% SMYS is not exceeded at the low point in the line due to the additional pressure caused by the weight of the water column. (For each 100 feet of elevation change, a pressure increase of ~43 psig will occur).

8. TEST MEDIUMS

A. Water is the test medium of choice for strength testing; however, air and inert gas may be used if approved by Gas Engineering. The maximum pressure allowed during a test using air or inert gas is 200psi and the Hoop Stress shall not exceed 30% SMYS in any portion of the test segment.

B. The sources, as well as the locations for disposal of the water to be used for the hydrostatic test, shall be located well in advance of the test. State and local regulations shall be checked by the Environmental Health & Safety Department prior to the test to assure that no complications occur with respect to usage of the desired volumes of water from the contemplated sources.

C. Potable water is preferred for testing. If potable water is unavailable, the water may be taken from streams or other bodies of water. It shall be taken in such a manner so as to minimize harm to the ecology, or aesthetic values of the area

D. If potable water is not used, the pH of the water shall be between 6.5 and 7.5. If the pH value of the water is outside this range, the water shall be chemically treated until the water is within this range. If the available water contains excessive solid material, it should be strained before it is pumped into the main.

E. Propylene Glycol (a low-toxic, biodegradable anti-freeze) may be added to test water when testing during or near freezing conditions. Do not use ethylene glycol. Add propylene glycol as a percentage of the total volume weight.

Percent Propylene Glycol (wt. %)	New Freezing Point (°F)
0	32
10	26
20	20
30	10
36	0
40	-5

9. MEDIUM FILL

A. The filling of air and nitrogen test medium in to a test segment shall follow the standard purging procedure GD55.1211-1.

B. The line shall be filled with water at a steady rate so as to mitigate the formation of air pockets. In order to expel air from the line, an approved rubber-cupped pig, poly pig or a sphere shall be used ahead of the fill water. Entrapped air shall be vented from appropriate high points along the line and from the discharge end of the test section during the filling operation.

C. The fill water shall be metered and checked against the estimated volume of water for the test. The cumulative water volume indicated on the meter should approximate the volume calculated using equations and tables listed in **Appendix A**. This value should be recorded on the form M-8174 (see **Appendix B**).

D. The water source shall be checked periodically to insure the fill water remains reasonably clear during the fill operation.

E. Personnel shall be stationed at air vents along the line. After the pig passes each vent filling it with water and producing a steady flow of water free of bubbling air, the vent valve can be closed. As soon as the line is completely full of water, all of the vents should be closed tightly and plugged.

10. STRENGTH TEST

A. Start the pressure and temperature recorders and make sure they are working properly and the pens have sufficient ink.

B. Slowly begin pressurizing the line with the displacement pump. A steady increase in pressure should be displayed on the pressure recording chart. Record the pump strokes and gauge pressure for every 10 to 20psi pressure increase. The pump stroke count should be relatively constant per pressure increment. If the pump stroke count deviates by 50% or more for the pressure increment, the pipe may be expanding or there may be a leak. A plot of the pressure versus pump strokes should be a straight line.

C. During the pressurizing operation, line surveillance shall be done by vehicle or walking, whichever is appropriate. Radio communication should be used if at all possible. The section to be tested shall be held at test pressure until such time that it is determined there is no leak in the pipeline. If the pipeline is sound, the rate of pressure drop between re-pressurizing intervals over the remaining test period should gradually decrease and approach a stabilized condition. A constant or increasing rate of pressure drop shall indicate leakage.

D. When the test pressure has been reached and there are no apparent leaks, the test section shall be shut-in and allowed to stand for a minimum of one (1) hour. Longer times may be necessary for larger volumes.

E. Gauge test pressure readings or dead weight tester readings shall be taken and recorded at intervals of fifteen minutes to one hour during the test (depending on the duration the test) to verify charts recorder readings. Ambient temperature readings shall also be taken and recorded. Readings shall be recorded on form M-8174 (see **Appendix B**).

F. If the shut-in pressure test results in a pressure drop in excess of that permitted, the onsite company representative responsible for the test shall make investigations as necessary to determine the source of the leakage indicated and shall make such repairs or replacement as necessary.

11. LEAKS

- When a leak is found at a flanged connection, the test pressure shall be reduced to at least 70% of the test pressure before attempting to tighten the bolts.
- After leaks have been repaired, the system can be brought back up to the test pressure and re-started from the beginning.

12. PRESSURE VARIATIONS

A. The test pressure should remain fairly constant if the test medium temperature remains constant and there are no leaks.

B. Pressure decreases can be caused by leaks and by cooling of the pipe test medium. If pressure is decreasing, check the pipe medium temperature recorder to see if the temperature is decreasing.

C. Pressure increases can be caused by the warming of the pipe test medium. If the pressure is increasing without adding water, check the pipe medium temperature recorder to see if the temperature is increasing.

D. The effects of temperature changes can be estimated using recorded data and equations in **Appendix A**.

13. MEDIUM REMOVAL

A. The removal of air and nitrogen test medium from a test segment shall follow the standard purging procedure GD55.1211-1. Although nitrogen is an inert gas (does not burn or explode), it can cause injury or death if it is in sufficiently high concentrations to displace enough air to reduce oxygen levels. Vent all nitrogen outside of any building or confined space.

B. Disposing of water may require transportation to a sanitation facility. If the water is allowed to be released to the surrounding area, it shall be done in a way that minimizes erosion. Filter bags installed at the outlet, in conjunction with directing water through straw bales, prevents most environmental concerns with the water disposal process.

C. "Squeegees" or "poly pigs" shall be used to push water from the main. This operation should be repeated until the on-site company representative is satisfied that the line has been reasonably dewatered.

D. After the line has been successfully tested, any accessories connected for use during the test shall be removed and the connections properly closed.

E. After the completion of the strength test and before the air leak test, the Contractor shall install the valves, valve connections, blow-offs and other accessories as specified on the Purchaser's "Issued Drawings."

14. POST CLEANING & DRYING

- Post cleaning may be required by the inspector if significant scale is noticed in the dewatering process. The line shall be determined clean if the dirt penetrates less than one-inch into the body of the foam pig.

- Super dry air shall be used to push foam pigs through the line until the pigs come out relatively dry.

15. TEST RECORDS

A. Records shall be kept of each pressure test and retained for as long as the pipe tested in in use. These records shall include the following:

- TEST CHARTS - The following information shall be written on the back of the recording chart:

    1. Work Order / Job Number
    2. Financial Project number
    3. Location – description of start and end points
    4. Line Designation / Name
    5. Pipe Size(s), Yield Strength(s), thickness(es), length(s)
    6. Test Pressure
    7. Test Medium
    8. Test Date
    9. Signature of Test Inspector
    10. Test duration

B. The strength test block on the cover of the issued drawing set shall be signed and dated by the individual monitoring the test.

C. Form M-8174 must be completed for each test and submitted to Gas Engineering along with the associated test chart.

D. Hydrostatic pressure test of mains and pipelines installed and/or tested by other than company forces (contractor and pressure service) shall be witnessed and certified by a Contractor Construction Management supervisor or inspector.

E. The pressure test of mains installed by company forces shall be witnessed by the on-site company representative.

F. The records of each pressure test shall be maintained by Gas Engineering for the useful life of the facility.

16. <u>REFERENCES</u>

A. CFR Title 49 Parts 192.503, 507, 509, 515, 517; 195.304, 305, 306, 308, 310

B. Gas Procedures:

- GD60.162, *Leak and Strength Testing of Short Segments of Pipe used for Tie-ins & Main Repairs*
- GD55.1211-1, *Purging Pipelines*
- GD60.739, *X-Ray Inspection*
- GD02-1203.4, *Establishing MAOP for Natural Gas Piping Systems*

C. Gas Operations Plans:

- Natural Gas Operations Plan
- Hazardous Liquid Operations Plan

D. **ASME B16.5 – Pipe Flanges and Flanged Fittings, 2009**

E. **Pipelines Rules of Thumb Handbook**, 6th Edition, by E.W. McAllister, Golf Professional Publishing, 2005.

F. **The Benefits & Limitations of Hydrostatic Testing by J.F. Kiefner and W.A. Maxey.**

G. **Periodic Hydrostatic Testing or In-Line Inspection to Prevent Failure from Pressure Cycle Induced Fatigue, by J.F. Kiefner and W.A. Maxey.**

H. **API5L**

17. REVISIONS

Date	Revised By	Approved By	Revisions Made
08/01/83	Original	Roy Daines	New procedure
03/27/12	Gary Hebbeler	Gary Hebbeler	
10/18/12	Chris Ampfer	John Hill	Amended text to allow use of digital or analog pressure gauges in addition to dead weights. Revised form M-8174 to allow pressure gauges and record line elevations. Changed formatting, Added %SMYs vs. pressure table, added equipment list, specified positive displacement pumps, added leak check criteria and formulas.
2/24/14	Barb Kaiser	John Hill	Inserted new test medium language in 3E per PUCO audit recommendation.

18. EXHIBITS

- Exhibit 1 - Test Pressures (psi) for Various Pipe Grades to Produce 90% SMYS
- Exhibit 2 – Engineering Formulas
- Exhibit 3 – Table 1 - F_{wt} - Factor to correct for the thermal change in the specific volumne of water from 60º F to the test water temperature.

Exhibit 1

Exhibit 1 - Test Pressures (psi) for Various Pipe Grades to Produce 90% SMYS							
Nominal Size	**OD (inches)**	**Wall Thickness (inches)**	**Pipe Schedule**	**Gr B**	**X42**	**X52**	**X60**
2	**2.375**	**0.154**	**40 & Std.**	4,085	4,902	6,069	7,003
	2.375	0.188		4,987	5,984	7,409	8,549
	2.375	0.218	80 & XH	5,783	6,939	8,591	9,913
3	3.500	0.188		3,384	4,061	5,028	5,801
	3.500	0.216	Sch 40 & Std.	3,888	4,666	5,776	6,665
	3.500	0.300	Sch 80 & XH	5,400	6,480	8,023	9,257
4	**4.500**	**0.188**		2,632	3,158	3,910	4,512
	4.500	0.237	Sch 40 & Std.	3,318	3,982	4,930	5,688
	4.500	0.337	Sch 80 & XH	4,718	5,662	7,010	8,088
6	**6.625**	**0.188**		1,788	2,145	2,656	3,065
	6.625	0.250		2,377	2,853	3,532	4,075
	6.625	0.280	Sch 40 & Std.	2,663	3,195	3,956	4,565
	6.625	0.432	Sch 80 & XH	4,108	4,930	6,103	7,042
8	**8.625**	**0.188**		1,373	1,648	2,040	2,354
	8.625	0.250	Sch 20	1,826	2,191	2,713	3,130
	8.625	0.322	Sch 40 & Std.	2,352	2,822	3,494	4,032
	8.625	0.500	Sch 80 & XH	3,652	4,383	5,426	6,261
12	12.750	0.188		929	1,115	1,380	1,592
	12.750	**0.219**		1,082	1,299	1,608	1,855
	12.750	**0.250**	Sch 20	1,235	1,482	1,835	2,118
	12.750	0.375	Std.	1,853	2,224	2,753	3,176
	12.750	0.500	XH	2,471	2,965	3,671	4,235
16	16.000	0.250	Sch 10	984	1,181	1,463	1,688
	16.000	0.375	Std.	1,477	1,772	2,194	2,531
	16.000	0.500	Sch 40 & XH	1,969	2,363	2,925	3,375
18	18.000	0.250		875	1,050	1,300	1,500
	18.000	0.312		1,092	1,310	1,622	1,872
20	20.000	0.250	Sch 10	788	945	1,170	1,350
	20.000	0.375	Sch 20 & Std.	1,181	1,418	1,755	2,025
	20.000	0.500	Sch 30 & XH	1,575	1,890	2,340	2,700
24	24.000	0.250	Sch 10	656	788	975	1,125
	24.000	0.375	Sch 20 & Std.	984	1,181	1,463	1,688
	24.000	0.500	XH	1,313	1,575	1,950	2,250
26	26.000	0.312	10	756	907	1,123	1,296
	26.000	0.375	Std.	909	1,090	1,350	1,558
	26.000	0.500	Sch 20 & XH	1,212	1,454	1,800	2,077

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Exhibit 2 – Engineering Formulas

Estimating Water Volume for a Test Pressure & Temperature

$V_{tp} = V \times F_{wp} \times F_{pp} \times F_{pwt}$

V_{tp} = Gallons of water contained in test section at pressure, P (psig), and temperature, T (^{o}F)

V = 0.0408 x d^2 x L = gallons of water to fill at 0psig (atmospheric pressure)
d = inside diameter of pipe [inches]
L = test section length [feet]

F_{wp} = correction factor for the compression of water at pressure, P
= $[(1 - 0.000045) \times (P / 14.73)]^{-1}$

F_{pp} = correction factor for pipe expansion due to pressure increase from 0psig to P
= $1 + [(D/t) \times (0.91 \times P / 30\text{x}10^{6})] + [(3.6\text{x}10^{-6}) \times (T - 60\ ^{o}F)]$
D = outside diameter of pipe [inches]
t = wall thickness of pipe [inches]

F_{pwt} = correction factor for pipe and water volumes due to temperature deviation from base temperature of 60 ^{o}F
= F_{pt} / F_{wt}

F_{pt} = factor to correct for change in pipe volume due to thermal expansion of pipe from base temperature of 60 ^{o}F
= $1 + [T - 60\ ^{o}F] \times (18.2 \times 10^{-6})]$

F_{wt} = factor to correct for thermal change in specific water volume from 60 ^{o}F to test water temperature (see Table 1 below)

The preceding formulas can also be throughout a hydrostatic test to estimate changes in water volumes do to pressure or temperature changes.

Exhibit 3 – Table 1

F_{wt} - Factor to correct for the thermal change in the specific volume of water from 60º F to the test water temperature.

Temp. (°F)	F_{wt}	Temp. (°F)	F_{wt}
35	0.9990777	70	1.0010364
36	0.9990590	71	1.0011696
37	0.9990458	72	1.0012832
38	0.9990375	73	1.0014229
39	0.9990340	74	1.0015420
40	0.9990357	75	1.0016883
41	0.9990421	76	1.0018130
42	0.9990536	77	1.0019657
43	0.9990694	78	1.0021222
44	0.9990903	79	1.0022552
45	0.9991150	80	1.0024178
46	0.9991451	81	1.0025561
47	0.9991791	82	1.0027251
48	0.9992168	83	1.0028684
49	0.9992599	84	1.0030435
50	0.9993061	85	1.0031919
51	0.9993615	86	1.0033730
52	0.9994112	87	1.0035573
53	0.9994715	88	1.0037133
54	0.9995322	89	1.0039034
55	0.9996046	90	1.0040642
56	0.9996683	91	1.0042601
57	0.9997488	92	1.0044357
58	0.9998191	93	1.0046271
59	0.9999074	94	1.0047972
60	1.0000000	95	1.0050043
61	1.0000803	96	1.0052142
62	1.0001805	97	1.0053915
63	1.0002671	98	1.0056067
64	1.0003746	99	1.0057884
65	1.0004674	100	1.0060090
66	1.0005823	101	1.0061949
67	1.0006811	102	1.0064207
68	1.0008031	103	1.0066108
69	1.0009290	104	1.0068417

AIR TESTING FOR LEAKS ON MAINS AND TIE-INS **GD10.1003-5**

Original Issued Date: 08/01/83 Revision Date: 12/16/14 Status: Revised

Subject Matter Expert: Steve Farley Revised by: B. Kaiser

Approved By: Gary Hebbeler & John Hill Department: Gas Operations

OQ Tasks: 412, 413, 415 & L919 Gas Standard: N/A

Reference: CFR Title 49 Parts 192.503, .505, .507, .509, .511, .517, .619; 195.305, 310; Procedures GD10.1003-1; GD60.162

Gas Operations Plan: Natural Gas section 10; Hazardous Liquids section 9

Purpose: To provide the requirements for air pressure testing Natural Gas Transmission (TL), Feeder Line (FL) and Distribution or Hazardous Liquid (HL) pipelines, and insure the new pipelines are free from leaks after installation.

TABLE OF CONTENTS

1. GENERAL

   A. **New or return to service segments of pipeline (relocated or replaced pipeline), cannot be operated until** (§192.503):

      1) It has been tested in accordance with Part 192 Subpart J—Test Requirements and §192.619 to substantiate the maximum allowable operating pressure; and

      2) Each potentially hazardous leak has been located and eliminated.

   B. The test medium must be liquid, air, natural gas, or inert gas that is:

      1) Compatible with the material of which the pipeline is constructed;

2) Relatively free of sedimentary materials; and

3) Except for natural gas, nonflammable.

C. Except as provided in §192.505(a), if air, natural gas, or inert gas is used as the test medium, the following maximum hoop stress limitations apply:

Class Location	Maximum Hoop Stress Allowed as Percentage of SMYS	
	Natural Gas	Air or Inert Gas
1	80	80
2	30	75
3	30	50
4	30	40

D. Each joint used to tie in a test segment of pipeline is excepted from the specific test requirements of Part 192 Subpart J, but each non-welded joint must be leak tested at not less than its operating pressure (§192.503d).

E. Gas Operations insures a pressure tight pipeline after the installation for all Natural Gas Transmission (TL), Feeder Line (FL), Distribution or Hazardous Liquid (HL) facilities. Air Pressure Tests are performed:

1) For TL, FL and HL steel coated pipelines after the installation of valves/fittings following a successful hydrostatic strength test;

2) To insure a new natural gas distribution plastic or steel coated main is free from leaks before introducing gas; and

3) To insure the associated pipeline tie-in sections are free from leaks before installation.

F. The Hydrostatic Pressure and Leak Chart (Exhibit A) provides designers with the minimum requirements necessary to perform strength and leak tests on Duke Energy gas facilities. The test pressure listed on the “Issued Construction Drawings is the value to be used for the actual tests in the field.

2. <u>RESPONSIBILITY</u>

A. Gas Engineering is responsible for determining the minimum requirements for strength and leak testing for pipelines, and placing all air test pressure requirements on all Construction Drawings,

B. Project Control's Mapping and Records group is responsible for receiving and maintaining all pressure test documentation related to leak and strength testing reported on the following documents:

1) As-Built Construction Drawings,

- Field Pressure Test
- Direct Field Pressure Test
- Insertion Field Pressure Test

2) Pressure Test Charts

- Leak & Strength Test Record - Pre-Tested Pipe
- Leak & Strength Test Record (Field Tested Pipe)

3) Job Control Form (JCF) (form M7602)

4) Field Pressure Test Data Sheet (form M8174)

B. Gas & Field Systems is responsible for the following items as specified in this procedure:

1) Performing and witnessing air pressure tests on installed pipelines and pre-tested pipe;

2) Completely and accurately documenting air testing information on the As-Built Construction Drawing and/or the Pressure Test Chart; and

3) Insuring air test equipment used during testing is calibrated properly, and recording test equipment calibrations on the Gas Operations network drive.

3. AIR LEAK TEST

A. All new mains must be leak tested at a pressure between 90 to 100 psig with either air or compressed nitrogen as directed and approved by Gas Engineering (Exhibit A).

B. The temperature of the plastic pipe must not exceed 100° Fahrenheit during any point in the test. The hydrostatic design basis (HDB- strength) of polyethylene pipe decreases as the temperature increases. Ambient temperature changes will affect the measured test pressure.

C. An acceptable leak test shall result in no indicated pressure loss between the "final test pressure" and the "initial test pressure." It is imperative that the pen on the chart recorder line up with pressure at the start of the test to be considered a successful air test.

D. For plastic mains, the compressor must have an after-cooler to minimize the outlet air temperature that is introduced to the main.

E. The air must be run through a moisture separator to eliminate moisture and oil vapor before it is sent to the main.

F. The recording pressure gauge shall be started and allowed to run while pressurizing the main. The air is introduced to the new main up to the test pressure listed on the "Issued Construction Drawing". A steady increase is desired for display on the recording chart.

Pipeline sections under the air test shall "not" be re-pressurized with make-up air during the air test.

G. The Contractor shall furnish the labor and equipment, including the calibrated pressure-recorder and charts, to successfully leak test all piping with air at 90-100 psig. The duration of the leak test shall be at least 24 hours unless specified differently by Gas Engineering. The Contractor shall locate and repair all leaks at their expense.

A successful leak test will be required after all leaks have been repaired.

H. The test chart from a newly tested main shall be witnessed and removed by a Duke Energy employee responsible for the test.

I. Pressure test of mains and pipelines installed by Company forces shall be witnessed by the on-site supervisor responsible for the test.

J. If the new main is to sit idle for an extended period before tying it in, it is recommended that the air pressure remains on the main. The purpose is to inform and confirm with the tie-in crew there are no existing leaks on the new main, including third party damage that may occur before placing gas in the main.

4. TEST GAUGES

A. The recording pressure gauge used to record test pressures must possess the following:

1) A minimum diameter of each test charts is 8".

2) The maximum pressure range printed on the pressure chart shall not exceed more than half the test pressure.

3) All recording gages must have been calibrated within a one year period of the actual leak test. All calibration records must be traceable to the National Bureau of Weights and Measures. The original calibration sheet, or copy, must be submitted to the Duke Energy Inspector for documentation purposes.

   a) Test instruments shall be transported in such a manner as to minimize vibration and shock which could cause them to go out of calibration. During transportation, all gauges shall be cushioned against excessive road shock.

5. TEST RECORDS

A. As-Built Construction Drawings

1) The following information shall be placed on the cover sheet of Duke Energy gas pipeline Construction Drawings:

   - Company Name (Duke Energy), and
   - eMax (work management system) work order number

2) The Field Pressure Test section of the cover sheet will document Gas Engineering's required test pressure range (minimum psig to maximum psig) as well as duration of test if different than standard 24 hour requirement.

3) The Inspector will document:

   a) Hours – the duration of the test in hours
   b) Medium – record either Air or Inert Gas that was used for the test
   c) Tested By & Date – Signature of the Inspector who is responsible for the test and the month, day and year the test was performed.

Sample Construction Drawing - Field Pressure Test Box

FIELD PRESSURE TEST

ALL PIPELINES REQUIRED TESTING BEFORE PLACING INTO SERVICE. PRESSURE CHARTS AND FORMS SHOULD BE FORWARDED TO GAS ENGINEERING AND PLANNING

REQUIRED TEST PRESSURE RANGE:

MIN.______ PSIG TO MAX ______ PSIG

HOURS ________ MEDIUM ________

TESTED BY__________________ DATE ________

4) Subsequent pages of the construction drawing are used to record pressure test information for inserted and/or direct bury piping

B. **Pressure Test Charts**

1) **Leak & Strength Test Record - Pre-Tested Pipe**

a) Pipe kept on-hand at district locations for emergency and other uses may be pre-tested.

b) A copy of the associated Pre-Tested pressure test chart will remain with the pipe when it is installed. The Pre-Tested Pipe pressure chart stamp will be placed on the back of the pressure chart and completed by the installation Crew/Inspector when the pre-tested pipe is installed.

c) Each pipe that is pre-tested at the District locations shall have the following information recorded on the Leak & Strength Test Record stamp on the back of the pressure chart.

Pre-tested Pipe Pressure Chart Stamp

DUKE ENERGY LEAK & STRENGTH TEST RECORD - PRE-TESTED PIPE

Test LIR #________________ District: ☐ E ☐ N ☐ S ☐ W ☐ V

Size __________ Kind_______________ Length____________

Test Pressure ______________ Medium ☐ Air ☐ Gas ☐ Water

Gauge Serial #__________________ Calibrated Date____/___/____

Tested By Name ______________________ Date ____/____/____

Tested By Signature_____________________________________

Date STARTED _____/_____/______ Time ___________________

Date FINISHED _____/_____/______ Time___________________

PIPE INSTALLED INFO. Length __________ Date ____/____/_____

eMax WO # ___________________ Acct # ___________________

Location ____

____

Line Pressure ☐ SP ☐ IP ☐ HP ☐ FL ☐ TL Designation_________

Inspector Name____

i. **Pre-Test Pipe Section** – this top section of the stamp will be completed when the pipe is pressure tested in advance of field installation. The following definitions apply to this section:

Field Title	Description
Test LIR#	Record the number from the LIR form that is attached to the pressure chart. This number is the unique tracking number for the pre-tested pipe.
District	Select one of the Districts for the location where the pre-tested pipe is located: E = Riverside Dr. N = Todhunter S = Kentucky W = Monfort Heights V = Valley View
Size	Record the diameter of the pipe
Kind	Record the type of pipe (PE/plastic or SPC/ Steel Protective Coated)
Length	Record the amount of pre-tested pipe in feet
Test Pressure	Record the amount of pounds per square inch pressure at which the pipe was tested
Medium	Check the medium used for the test: Air, Gas or Water
Gauge Serial #	Record the serial number for the Pressure Gauge utilized for the pressure test
Calibrated Date	Record the most recent calibration date for the Pressure Gauge used.
Tested By Name & Date	Print the name of the person who performed the test, and the month, day and year of the test.
Tested By Signature	The Duke Energy employee who performed and witnessed the test will sign their name
Date STARTED & Time	Record the month, day and year when the pressure test began
Date FINISHED & Time	Record the month, day and year when the pressure test ended

ii. **Pipe Installed Section –** this bottom section of the stamp will be completed when the pre-tested pipe is installed in the ground. The following definitions apply to this section:

Field Title	Description
Length	Record the amount of the pre-tested pipe in feet, that was installed
Date	Record the month, day and year when the pre-tested pipe was installed
eMax WO #	Record the number for the eMax work order associated to the pipe installation
Acct #	Record the accounting number for the job
Location	Record a description or address for the place where the pipe was installed
Line Pressure	Select one of the pressure categories for the pipeline where the pre-tested pipe was installed ○ SP = Standard Pressure (measured in Water Column – WC) – Ohio 4" WC to 12" WC – Kentucky = 3.5" WC to 10.5" WC) ○ IP = Intermediate Pressure (<35 psig) ○ HP = High Pressure (>5psig to 35 psig) ○ FL = Feeder Line Pressure (15 psig to 60 psig) ○ TL = Transmission Line Pressure (>60 psig)
Designation	Record the pipeline name i.e. GC10, A000, as applies
Inspector Name	Print the Duke Energy Inspector name assigned to the pipe installation and who witnessed the pressure test.

2) **Leak & Strength Test Record Field Tested Pipe –** Pipe installed and pressure tested shall have the following information placed on the Leak & Strength Test Record stamp on the back of the pressure recording chart:

Leak & Strength Test Record Stamp

DUKE ENERGY – LEAK & STRENGTH TEST RECORD

eMax WO #________________________ Segment #__________

Location ____

____

Line Pressure ☐SP ☐IP ☐HP ☐FL ☐TL Designation_______

Size ___________ Kind_____________ Length _______________

Test Pressure ______________ Medium ☐ Air ☐Gas ☐Water

Significant Elevation Variations if Water? ☐ Yes ☐No

Gauge Serial #_________________ Calibrated Date___/___/____

Tested By Name ______________________ Date ___/____/____

Tested By Signature_____________________________________

Test Contractor____________________ Services Tested? ☐Y ☐N

Duke Inspector____

Tie-In Tested? ☐Y ☐N Tie-In Size & Length_________________

Date STARTED ____/______/______ Time ___________________

Date FINISHED ____/______/______ Time ___________________

The following definitions apply to this record stamp:

Field Title	Description
eMax WO #	Record the number for the eMax work order associated to the installation
Segment #	Record the number of the pipe segment (typically associated with large construction projects)
Location	Record a description or address for the place where the pipe was installed
Line Pressure	Select one of the pressure categories for the service where the pre-tested pipe was installed o SP = Standard Pressure (measured in Water Column – WC) – Ohio 4" WC to 12" WC – Kentucky = 3.5" WC to 10.5" WC) o IP = Intermediate Pressure (<35 psig) o HP = High Pressure (35 to 60 psig) o FL = Feeder Line Pressure (>60 psig) o TL = Transmission Line Pressure (>60 psig)
Designation	Record the pipeline name i.e. GC10, A000, as applies
Size	Record the diameter of the pipe
Kind	Record the type of pipe (PE/plastic or SPC/ Steel Protective Coated)
Length	Record the amount of the pipe in feet that is associated with the pressure test
Test Pressure	Record the amount of pounds per square inch pressure at which the pipe was tested
Medium	Check one of the substances use for the test: Air, Gas, Water
Gauge Serial #	Record the serial number for the Pressure Gauge utilized for the pressure test
Calibrated Date	Record the most recent calibration date for the Pressure Gauge used.
Significant Elevation Variations if Water?	If the pipe is pressure tested with water and the location has large elevation variations place a mark in the Yes box. If not, place a mark in the No box.
Tested By Name & Date	Print the name of the person who performed the test and the month, day and year of the test.
Tested By Signature	The person who performed and witnessed the test will sign their name
Test Contractor	Print the name of the contractor company responsible for installing the pipe
Services Tested?	If the gas services were pressure tested with the gas main, place a mark in the Yes box. If not, place a mark in the No Box.
Duke Inspector	Print the name of the Duke Energy Inspector assigned to the installation and who witnessed the pressure test.
Tie-In Tested?	If the pipe tie-in was tested with the pipeline, mark the Yes Box. If not, mark the No box.
Tie-In Size & Length	Record the pipe size & the amount tie-in pipe included in the pressure test
District	Select one of the Districts for the location where the pre-tested pipe is located:
Date STARTED & Time	Record the month, day and year when the pressure test began.
Date FINISHED & Time	Record the month, day and year when the pressure test ended.

DUKE ENERGY

NOTE: PROPANE PIPELINES MUST have the temperature of the test medium or pipe during the test period recorded for pressure tests on the pressure chart.

c) The pressure test chart will be submitted with field paperwork to Gas Engineering's Mapping and Records group.

C. **Job Control Form (JCF) (form M7602) – Pressure Test Data**

1) On the back of the JCF in the Pressure Test Data section, gas services tested will have the following information recorded for the Main-to-Curb and./or Curb-to-Meter portions of the service (reference the Field Paperwork Manual for instructions to complete the JCF):

- PSIG
- Duration
- Media
- Tested By (signature)
- Date

D. **Hydrostatic Field Pressure Test Data (form M8174)**

1) M8174 are to be completed for each hydrostatic pressure test.

2) The Pressure Charts are to be included with form M8174 when submitting the document to Gas Mapping and Records.

6. RECORD RETENTION

A. Gas & Field Systems will forward the records of each pressure test whether on a JCF, Pressure Test Chart, As-Built Construction Drawing or M8174 to Project Controls' Work Management (Office Coordinators).

B. Work Management will review the pressure records, then forwarded to Project Controls' Mapping and Records.

C. Mapping and Records will maintain testing records during the useful life of the facility (§192.517 & 195.310).

7. EXHIBIT A - HYDROSTATIC PRESSURE AND LEAK TEST CHART

Material	Operating Pressure	Test Type	Reference	Class Locations	Acceptable Test Media	Test Pressure Minimum	Test Pressure Maximum	Minimum Test Duration	Other Test Requirements
Steel Pipe	60 psig < P < 20% SMYS	Strength	Procedure GD60.162*	All Classes	Water	1.5 x MAOP	1.7 x Design Pressure	8 hours	--
Steel Pipe	P > 30% SMYS	Strength	Procedure GD60.162*	Class 4	Water	1.5 x MAOP	1.7 x Design Pressure	8 hours	--
Steel Pipe Except Service Lines	P > 30% SMYS	Strength	CFR §192.505	1 & 2 with an Occupied Building within 300 feet	Water	1.5 x MAOP	1.7 x Design Pressure	8 hours	--
Steel Pipe	100 psig < P < 30% SMYS	Leak	CFR §192.507 & §192.619	All Classes	Air, Inert Gas, Natural Gas	90 psig	100 psig	Gas Std. 1.6.2 or 24 hours	Alternative test is to walk the line & check for leaks while pressure is held at 20% SMYS
Steel Pipe Except Service Lines	1 psig < P < 100 psig	Leak	CFR §192.509	All Classes	Air or Inert Gas	90 psig	100 psig	Gas Std. 1.6.2 or 24 hours	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Steel Pipe	P < 60 psig	Leak	CFR §192.509	All Classes	Air or Inert Gas	90 psig	100 psig	Gas Std. 1.6.2 or 24 hours	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Plastic Pipe	P < 60 psig	Leak	Procedure GD60.162*	All Classes	Air or Inert Gas	90 psig	100 psig	24 hours	--
Service Lines **Except Plastic** < or = to 1”	60 psig < P < 20% SMYS	Leak	CFR §192.511	All Classes	Air or Inert Gas or Water	750 psig	850 psig	10 minutes	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Service Lines **Except Plastic** > 1”	60 psig < P < 20% SMYS	Leak	CFR §192.511	All Classes	Air or Inert Gas or Water	750 psig	850 psig	1 Hour	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Service Lines < or = to 1”	P < 60 psig	Leak	CFR §192.511	All Classes	Air or Inert Gas	90 psig	100 psig	10 minutes	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Service Lines > 1”	P < 60 psig	Leak	CFR §192.511	All Classes	Air or Inert Gas	90 psig	100 psig	1 Hour	Test procedure must ensure discovery of all potentially hazardous leaks in the segment being tested
Compressor Regulator & Measurement Station	P > 30% SMYS	Strength	CFR §192.505 (b)	Class 1 & 2	Water or Nitrogen	1.5 x MAOP	1.7 x Design Pressure	8 Hours	--
Fab. Units & Short Units where Post Installation Test is Impractical	P > 30% SMYS	Strength Test Pre-Installation	CFR §192.505 (e)	All Classes	Water or Nitrogen	1.5 x MAOP	1.7 x Design Pressure	4 Hours	--
Component Other than Pipe if it is the Only Item Being Replaced or Added	P > 30% SMYS	No Test Required if Mfg. Cert. Operating Pressure	CFR §192.505(d)	NA	NA	NA	NA	NA	--

*Procedure GD60.162 – *Leak and Strength Testing of Short Segments of Steel Pipe used for Tie-ins and Main Repairs*

DUKE ENERGY.

MANUFACTURING SPECIFICATIONS FOR PIPE AND PIPELINE COMPONENTS	**GD10.225**

Original Issue Date: 2/27/96 Revision Date: 05/10/13 Status: Revised

Approved By: John Hill Department: Gas Engineering

Reference: CFR Title 49 Parts 192.55, .59, .63, .103, .144, .145, .147, .150, .151, .153, .155, .157,.159; 195.101, .112, .116, .118, .120; API 6D and 5L; ANSI B16.5

Gas Standard: GD210

Gas Operations Plan: Hazardous Liquid Section 5.3

Purpose: To comply with federal and state regulations, with specific requirements for the design of pipe and pipeline components.

Table of Contents

1. GENERAL

To comply with federal and state regulations, Gas Operations has adopted specific requirements for the design and installation of pipe and pipeline components as follows:

A. Each component used in the design and operation of gas mains and services must be able to withstand the internal pressure and concurrent external forces that will be imposed on the piping. Loads imposed on the piping during installation/testing shall also be considered.

B. Metallic components for natural gas pipelines must be manufactured in accordance with Appendix B of CFR Title 49 Part 192, and components for hazardous liquid pipelines will be manufactured in accordance with CFR Title 49 Part 195 Subpart C. Parts manufactured by editions other than those referenced can be used, however any part which is manufactured under a different edition must demonstrate that:

1) No defects exist which might impair the strength or tightness of the component.

2) The edition of the document under which the component was manufactured has equal or more stringent requirements for the following:

   a. Pressure testing.
   b. Materials.
   c. Pressure and temperature ratings.

C. Components for natural gas pipelines fabricated by welding will adhere to 192.153:

   1. *Except for branch connections and assemblies of standard pipe and fittings joined by circumferential welds, the design pressure of each component fabricated by welding, whose strength cannot be determined, must be established in accordance with paragraph UG–101 of section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.*

   2. *Each prefabricated unit that uses plate and longitudinal seams must be designed, constructed, and tested in accordance with section I, section VIII, Division 1, or section VIII, Division 2 of the ASME Boiler and Pressure Vessel Code, except for the following:*

      a) *Regularly manufactured butt-welding fittings.*

      b) *Pipe that has been produced and tested under a specification listed in appendix B to this part.*

      c) *Partial assemblies such as split rings or collars.*

      d) *Prefabricated units that the manufacturer certifies have been tested to at least twice the maximum pressure to which they will be subjected under the anticipated operating conditions.*

   4. *Except for flat closures designed in accordance with section VIII of the ASME Boiler and Pressure Code, flat closures and fish tails may not be used on pipe that either operates at 100 p.s.i. (689 kPa) gage, or more, or is more than 3 inches (76 millimeters) nominal diameter.*

2. RESPONSIBILITY

A. Gas Engineering is responsible for:

   1) Approval of all materials and components used for the design and installation of all gas mains.

2) Developing standards for use in the design and installation of gas mains.

3. PIPING

A. Piping for gas mains shall be either steel or plastic. All mains with a pressure greater than 60 psig or placed on a bridge exposed shall use steel piping.

1) Steel Piping

a. Steel piping shall be manufactured in accordance with API 5L or ASTM A53.

b. All steel piping used below grade shall be purchased with an approved fusion bonded epoxy coating per GD210 *Materials Specifications for Plant Applied Coating Material for Carbon Steel Pipe*.

c. Steel pipe used in high pressure distribution and transmission lines shall be PSL 2 quality.

d. Each length of pipe that has a nominal outside diameter of 4 ½” or greater must be marked on the pipe or pipe coating with:

i. The specification to which it was made
ii. The specified minimum yield strength or grade
iii. The pipe size

2) Plastic Piping

a. Plastic piping shall be manufactured in accordance with ASTM D2513.

4) VALVES

All valves used in the installation of a gas main, must satisfy Section §192.145 and §195.116.

A. Steel Mains

1) High pressure Distribution and Transmission Lines:

a. A valve may not be used under operating conditions that exceed the applicable pressure-temperature ratings of the valve.

Note: It is common practice in Gas Engineering to design all high pressure Distribution and Transmission lines to a minimum of 500 psig.

b. Valves shall be of steel construction with weld and/ or flanged ends.

c. Valves must be manufactured in accordance with API 6D (hazardous liquid section 11). API 6D 7.2 states the pressure-temperature ratings are determined in ASME B16.34. Each valve must be able to withstand the maximum pressure at which the pipeline is to be operated. The following matrix extracts data from API 6D 7.2 and assumes that the valves will not experience elevated temperatures.

CLASS	150#	300#	600#
PSIG	285	740	1480

2) Hazardous Liquid Lines

In addition, valves on hazardous liquid pipelines:

a. Each valve other than a check valve must be equipped with a means to clearly indicate the position of the valve, i.e. open, closed, etc.

b. Each valve must be marked on the body or the nameplate with at least the following:

i. Manufacture's name or trademark;

ii. Class design or the maximum working pressure to which the valve may be subjected;

iii. Body material designation (the end connection material if more than one type is used); and

iv. Nominal valve size.

3) High Pressure (HP), Intermediate Pressure (IP), Medium Pressure (MP) and Standard Pressure (SP) Systems

a. Valves shall be of cast iron, steel, or plastic construction. Cast iron valves shall have flanged ends.

B. Plastic Mains.

1) HP, IP, MP, SP Systems

a. Valves installed in plastic pipe systems shall be an approved plastic valve.

i. The valve must have a maximum service rating for temperatures that equal or exceed the maximum service temperature.

5) FLANGES AND FLANGE ACCESSORIES

All flanges and flange accessories used in the installation of a natural gas main, must satisfy §192.147 and for hazardous liquid pipelines must satisfy §195.126.

Flanges and flange accessories must be manufactured in accordance with ANSI B.16.5, MSS SP 44. Each flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated. The following matrix assumes that the flanges will not experience elevated temperatures.

CLASS	150#	300#	600#
PSIG	275	720	1440

A. Transmission Lines/ High Pressure Distribution Systems

Note: It is common practice in Gas Engineering to design all high pressure Distribution and Transmission lines to a minimum of 500 psig. (See above matrix.)

B. HP, IP, MP, SP Systems

1. 150# class designation or a minimum pressure rating of 275 psig is required for any new steel components used in existing or new systems.

6. STANDARD FITTINGS

A. The minimum thickness of the threaded fittings may not be less than specified for the pressures and temperatures in applicable standards.

B. Steel Butt Welded Fitting should comply with ANSI B16.9 or MSS. SP-75 and have temperatures and pressure ratings equivalent to stresses for the pipe material being used.

C. Plastic fittings shall be manufactured per ASTM D2513.

7. TAPPING

A. All tapping performed on an active gas mains must satisfy Section §192.151.

B. Mechanical fittings used for tapping must be designed for at least the operating pressure of the pipeline during the tapping process.

C. Threaded taps in cast iron or ductile iron pipe may not exceed 25% of nominal diameter of pipe unless reinforced. Refer to Standard 3.5.1.

   1) A 1 ¼" tap may be used on 4" C.I. without reinforcement.

8. WELDED BRANCH CONNECTIONS

A. All welded branch connections used in the installation of a natural gas main, must satisfy §192.155 and for hazardous liquid pipelines must satisfy §195.122.

B. Each welded branch connection made to the pipe in the form of a single connection, or in a manifold must be designed to ensure that the strength of the pipeline is not reduced. All stresses must be considered in the design, shear, vibration, thermal, etc.

9. EXTRUDED OUTLETS

A. All extruded outlets used in the installation of a gas main, must satisfy Section §192.157.

B. Extruded outlets must be designed to be at least equal to the design strength of the pipeline and other fittings to which they are attached. Refer to Appendix "F" of B31.8 for design criteria used on F/L's.

10. FLEXIBILITY

A. Pipeline flexibility considerations may be required in the design of gas mains and as a result must satisfy Section §192.159.

B. Flexibility should be provided by the use of bends, loops or offsets, and provisions should be made to absorb thermal changes by the use of expansion joints or couplings, of the slip joint type. If expansion joints are used, anchors or tees of sufficient strength and rigidity should be installed in the pipeline. To determine acceptable strains on elbows see ASME B31.8 833.2 and Appendix E.

C. Exposed piping is subject to greater than normal expansion/contraction due to extreme temperature swings. Temperature of the pipe during installation is a major factor in this consideration. By installing the main in a "neutral" condition the results of the temperature swing is reduced. Various designs of expansion loops or expansion joints should be considered, depending on the type of construction.

11. INTERNAL INSPECTION DEVICES

A. Each new transmission or hazardous liquid pipeline, and each line section where the line pipe, valve, fitting or other line component is replaced, must be designed and constructed to accommodate the passage of instrumented internal inspection devices.

DESIGN OF STEEL PIPING SYSTEMS GD10.302-2

Original Issue Date: 12/1/88 Revision Date: 02/03/14 Status: Revised

Approved By: John Hill Department: Gas Engineering

Reference: CFR Title 49 Parts 192.55, 103, 105, 107, 109, 111, 113, 115, 195 Subpart C ; API-5L

Gas Standard: NA

Gas Operations Plan: Hazardous Liquid section 5; Natural Gas section 3

Purpose: To specify design requirements for steel pipe.

Table of Contents

Paragraph Subject

1. GENERAL

To comply with state and federal regulations, Gas Operations has adopted specific design requirements and limitations for steel pipe.

2. RESPONSIBILITY

A. The Director of Gas Engineering is responsible for:

1. Initiating and compiling engineering design documents for new steel pipelines to be operated above 60 PSIG and confirmation of existing steel pipelines.

2. Approval of design variance in specification grade and thickness from standard materials.

3. Approval of design variance in pipeline components (valves, fittings, etc.) which incorporate materials not stocked in the company store rooms.

4. Maintaining design documents for the life of the steel pipe segment.

3. DESIGN INFORMATION

A. Steel pipe used in the construction of gas natural gas transmission, distribution, and hazardous liquid mains must be designed to withstand internal pressure and concurrent external forces and loads that will be imposed on the pipe during installation and in the course of operations after installation.

B. All transmission, feeder and hazardous liquid lines must be constructed from pipeline material certified to PSL-2 standards, per API 5L.

C. For the mechanical design of steel piping systems, Duke Energy and its subsidiaries use the design formula for steel pipe as found in the code (Exhibit A)

- population density
- location classifications
- construction type
- longitudinal joints
- temperatures

D. Design Pressure (P) - the maximum operating pressure (MOP) that can be applied to a pipeline or segment of pipeline manufactured under a specification, grade, diameter and wall thickness.

E. The Maximum Allowable Operating Pressure (MAOP) is established by certain test requirements, (CFR Part 192 Subpart J); pipeline components incorporated in the design; and/or specified by certain operating parameters. The Maximum Allowable Operating Pressure (MAOP) may equal but **never** exceed the Design Pressure (P).

F. To avoid maintaining class location records and conducting periodic class location reviews, every attempt shall be made to design the new main as if it were located in a Class 4 location. **Any exceptions to a Class 4 location design will only be permitted with the expressed written permission of the Vice-President of Gas Operations or their designate on a case-by-case determination.**

G. The design pressure for various steel piping system materials shall be in conformance with CFR Part §192 or §195.

H. Each length of steel pipe with a normal diameter of 4 ½ " or greater must be marked on the pipe or pipe coating with the specification to which it was made, the SYMS or grade and the pipe size.

4. STEEL PIPING SYSTEMS

A. Components of the system, valves, fittings, regulators, etc. must be carefully selected to match or exceed the design pressures of the system.

B. The Sponsoring Engineer need not design for internal corrosion, under normal conditions, gas received from suppliers, local producers, etc. shall be minimally corrosive as required per Company specifications.

5. PROVISIONS FOR DESIGN VARIANCES

Duke Energy's plan provides for, and recognizes the necessity for, variances to the design standards and specifications contained herein, provided:

A. The effect of such variances on the factors of design are carefully considered and are not found to be in direct violation of applicable codes and subsections thereof.

B. Engineering calculations are made when necessary and are documented to establish the variance compliance with the applicable code and subsections thereof.

C. The variance is approved by the Gas Engineering.

6. DESIGN FORMULAS FOR STEEL PIPE

A. The design pressure for steel pipe is determined in accordance with the following design formulas:

Natural Gas Equation 1 (Exhibit A)**:**

$$P = (2\,St/D) \times F \times E \times T$$

Hazardous Liquid Equation 2 (Exhibit B)**:**

$$P = (2\,St/D) \times F \times E$$

7. <u>DESIGN LIMITATIONS (NATURAL GAS PIPELINES) – Equation 1</u>

A. The yield strength (S) used in Equation 1 for determining the Design Pressure (P) shall be:

1) <u>New Pipelines</u>: The published Specified Minimum Yield Strength (SMYS) of the pipe specification and grade used (Exhibit C).

2) <u>Confirmation Calculations for Existing Pipelines</u>-<u>Manufactured prior to November 12, 1970</u>: The record SMYS when known, or 24,000 PSI if unknown.

B. The wall thickness (t) used for determining the Design Pressure (P) in Equation1 shall be:

1) <u>New Pipelines</u>: The Nominal Wall Thickness (t) for the specification and grade of pipe used.

2) <u>Confirmation Calculations for Existing Pipelines</u> – <u>Manufactured prior to November 12, 1970</u>: The record of wall thickness (t) when known, ultra sonic thickness testing or actual wall thickness of coupons removed from the pipeline measured according to the procedures described in Subpart C §192.109.

3) For new pipelines, the Nominal Wall Thickness (t) used in Equation 1 shall not be less than that shown (Exhibit D). Designers proposing use of lesser wall thickness must perform the prescribed calculations to demonstrate the competency of the design considering primary and secondary stresses on the pipe and obtain approval of the Director of the Gas Engineering.

C. The Design Factor (F) used for determining the Design Pressure (P) in Equations 1 shall be:

1) <u>New Pipelines</u>: The maximum of 0.40 based on a Class 4 location. Designers proposing a higher Design Factor (F) based on a lesser class location will require the approval of the Director of Gas Engineering.

2) <u>Confirmation Calculations for Existing Pipelines – Manufactured prior to November 12, 1970</u>: The Design Factor (F) based on the actual class location as prescribed in accordance with code.

D. The longitudinal joint factor (E) used in Equation 1 shall be:

1) <u>New Pipelines</u>: A value of 1.0 will be used in conjunction with API-5L or ASTM A-53 specifications, seamless or electric weld process piping. Pipe

manufactured using other longitudinal joint factors is prohibited. (See Subpart C §192.113) Designers proposing the use of other than standard material or designs incorporating a lesser Longitudinal Joint Factor (E) require the approval of the Director of Gas Engineering.

2) Confirmation Calculations for Existing Pipelines - Manufactured prior to November 12, 1970: The actual value prescribed by the longitudinal joint factor (E) for steel pipe based on the specification and grade of the actual pipe used of record, if known, or a maximum value of:

	(E)
a. Unknown Pipe Over 4”	0.80
b. Unknown Pipe 4” or less	0.60

E. The temperature de-rating factor (T) used for determining the design pressure (P) in Equation1 shall be:

1) New Pipelines: 1.0 for all applications. (See Subpart C §192.115)

F. The Outside Diameters (D) are used in Equation 1 for Design Pressure Calculations

8. DESIGN LIMITATIONS (HAZARDOUS LIQUID PIPELINES) – Equation 2

A. The Design Factor (F) used for determining the Design Pressure (P) in Equations 2 shall be:

1) New Pipelines: The maximum of 0.40 based on a Class 4 location. Designers proposing a higher Design Factor (F) based on a lesser class location will require the approval of the Director of Gas Engineering.

2) Confirmation Calculations for Existing Pipelines – Manufactured prior to November 12, 1970: The Design Factor (F) based on the actual class location as prescribed in accordance with code.

B. The yield strength (S) used in Equation 2 for determining the Design Pressure (P) shall be:

1) The yield strength to be used in determining the internal design pressure under §195.106(a) is the specified minimum yield strength. If the specified minimum yield strength is not known, the yield strength to be used in the design formula is one of the following:

a. The yield strength determined by performing all of the tensile tests of API Specification 5L on randomly selected specimens with the following number of tests:

Pipe size	No. of Tests
Less than 6 5/8 inch (168 mm) nominal outside diameter	One test for each 200 lengths.
6 5/8 in through 12 3/4 inch (168 mm through 324 mm) nominal outside diameter	One test for each 100 lengths.
Larger than 12 3/4 inch (324 mm) nominal outside diameter	One test for each 50 lengths.

b. If the average yield-tensile ratio exceeds 0.85, the yield strength shall be taken as 24,000 p.s.i. (165,474 kPa). If the average yield-tensile ratio is 0.85 or less, the yield strength of the pipe is taken as the lower of the following:

i. Eighty percent of the average yield strength determined by the tensile tests.
ii. The lowest yield strength determined by the tensile tests.

2) If the pipe is not tensile tested as provided in §195.106(b), the yield strength shall be taken as 24,000 p.s.i. (165,474 kPa).

B. The wall thickness (t) used for determining the Design Pressure (P) in Equation1 shall be:

1) If the nominal wall thickness to be used in determining internal design pressure under §195.106(a) is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end. However, if the pipe is of uniform grade, size, and thickness, only 10 individual lengths or 5 percent of all lengths, whichever is greater, need be measured. The thickness of the lengths that are not measured must be verified by applying a gage set to the minimum thickness found by the measurement. The nominal wall thickness to be used is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness may not be more than 1.14 times the smallest measurement taken on pipe that is less than 20 inches (508 mm) nominal outside diameter, nor more than 1.11 times the smallest measurement taken on pipe that is 20 inches (508 mm) or more in nominal outside diameter.

2) The minimum wall thickness of the pipe may not be less than 87.5 percent of the value used for nominal thickness determining the internal design pressure under §195.106(a). In addition, the anticipated external loads and external pressures that are concurrent with internal pressure must be considered in accordance with §§195.108 and 195.110 and, after determining the internal design pressure, the nominal wall thickness must be increased as necessary to compensate for these concurrent loads and pressures.

C. The seam joint factor (E) used in §195.106(a) is determined in accordance with the following table:

Specification	Pipe Class	Seam Joint Factor
ASTM A53	Seamless	1.00
	Electric resistance welded	1.00
	Furnace lap welded	0.80
	Furnace butt welded	0.60
ASTM A106	Seamless	1.00
ASTM A 333/A 333M	Seamless	1.00
	Welded	1.00
ASTM A381	Double submerged arc welded	1.00
ASTM A671	Electric-fusion-welded	1.00
ASTM A672	Electric-fusion-welded	1.00
ASTM A691	Electric-fusion-welded	1.00
API 5L	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
	Furnace lap welded	0.80
	Furnace butt welded	0.60

9. ENGINEERING RECORDS

A. New pipelines constructed of standard steel pipe materials furnished through Duke Energy’s material system shall not require specific engineering documentation as long as the stock numbers are available and they are documented on the as-built drawing or in the construction job folder.

B. New pipelines **not** constructed of regularly stocked standard materials shall require all necessary engineering documentation, such as material composition – PSL 2 for natural gas transmission, feeder, and hazardous liquid pipelines, coating specifications, etc. This information is to be forwarded to the construction job folder for record retention purposes.

C. As-built construction records will be maintained by Gas Engineering for the life of the pipe.

10. EXHIBITS

Exhibit	Name
A	Design Formula for Steel Pipe – Natural Gas Pipelines
B	Design Formula for Steel Pipe – Hazardous Liquid Pipelines
C	Specified Minimum Yield Strength (SMYS)
D	Steel Pipe – **LEAST** Nominal Wall Thickness Requirements

EXHIBIT A

DESIGN FORMULA FOR STEEL PIPE – NATURAL GAS PIPELINES

$$P = \frac{2\,St}{D} \times F \times E \times T$$

P = Design Pressure in pounds per square inch gauge

S = Yield Strength in pounds per square inch determined in accordance with §192.107

D = The Outside Diameter of the pipe in inches (Simplifying and Safe Assumption, ID is theoretically proper)

t = Nominal Wall Thickness of the pipe in inches - If this is unknown, it is determined in accordance with §192.109. Additional wall thickness required for concurrent external loads in accordance with §192.103 may not be included in computing design pressure.

F = Design Factor determined in accordance with §192.111

E = Longitudinal Joint Factor determined in accordance with §192.113

T = Temperature De-rating Factor determined in accordance with §192.115

EXHIBIT B

DESIGN FORMULA FOR STEEL PIPE – HAZARDOUS LIQUID PIPELINES

$$P = (\underline{2\,St/D}) \times E \times F$$

P = Design Pressure in pounds per square inch gauge.

S = Yield Strength in pounds per square inch determined in accordance with §195.106.

t = Nominal Wall Thickness of the pipe in inches. If this is unknown, it is determined in accordance with §195.106(c).

D = Nominal Outside Diameter of the pipe in inches. (Simplifying and Safe Assumption, ID is theoretically proper.)

E = Seam Joint Factor determined in accordance with §195.106(e)

F = Design Factor of 0.72, except that a design factor of 0.54 is used for pipe that has been subjected to cold expansion to meet the specified minimum yield strength and is subsequently heated, other than by welding or stress relieving as a part of welding, to a temperature higher than 900 °F (482 °C) for any period of time or over 600 °F (316 °C) for more than 1 hour.

EXHIBIT C

SPECIFIED MINIMUM YIELD STRENGTH (SMYS)

MIMIMUM SPECIFIED YIELD STRENGTH STANDARD STEEL PIPE MATERIALS

Specification (Grade of Steel)			Minimum Specified Strength (PSI)
ERW OR	**Seamless**	**Yield**	**Tensile**
ASTM A53	Grade A	30,000	48,000
	Grade B	35,000	60,000
API 5L	Grade A	30,000	48,000
	Grade B	35,000	60,000
API 5LX	Grade X42	42,000	60,000
	Grade X46	46,000	63,000
	Grade X52	52,000	66,000
	Grade X56	56,000	71,000
	Grade X60	60,000	75,000
	Grade X65	65,000	77,000
	Grade X70	70,000	82,000

DESIGN OF STEEL PIPING SYSTEMS GD10.302-2

EXHIBIT D

STEEL PIPE – LEAST NOMINAL WALL THICKNESS REQUIREMENTS
LEAST NOMINAL WALL THICKNESS (INCHES)
PLAIN END PIPE & THREADED PIPE

Nominal Pipe Size Inches	Outside Diameter Inches	Class 1 Location	Fabricated Assemblies Class 1 Location	Class 2 Location	Class 3 & 4 Location	All Class Locations	Compressor Stations	
1/8	0.405	.035	.065	.065	.065	.068	.095	Plain end or threaded
¼	0.540	.037	.065	.065	.065	.088	.119	
3/8	0.675	.041	.065	.065	.065	.091	.126	
1/3	0.840	.046	.065	.065	.065	.109	.147	
¾	1.050	.048	.065	.065	.065	.113	.154	
1	1.315	.053	.065	.065	.065	.133	.179	
1 ¼	1.660	.061	.065	.065	.065	.140	.191	
1 ½	1.900	.065	.065	.065	.065	.145	.200	
2	2.375	.075	.075	.075	.075	.154	.218	
2 ½	2.875	.083	.085	.085	.085	.203	.203	
3	3.500	.083	.098	.098	.098	.216	.216	
3 ½	4.000	.083	.108	.108	.108	.226	.226	
4	4.5000	.083	.116	.116	.116	.237	.237	
5	5.563	.083	.125	.125	.125	.258	.250	Plain end only
6	6.625	.083	.134	.134	.156	.280	.250	
8	8.625	.104	.134	.134	.172	.322	.250	
10	10.750	.104	.164	.164	.188	--	.250	
12	12.750	.104	.164	.164	.203	--	.250	
14	14.0	.134	.164	.164	.210	--	.250	
16	16.0	.134	.164	.164	.219	--	.250	
18	18.0	.134	.188	.188	.250	--	.250	
20	20.0	.134	.188	.188	.250	--	.250	
22, 24, 26	22, 24, 26	.164	.188	.188	.250	--	.250	
28, 30	28, 30	.164	.250	.250	.281	--	.281	
32, 34, 36	32, 34, 36	.218	.250	.250	.312	--	.312	
38, 40, 42	38, 40, 42	.250	.312	.312	.375	--	.375	

Note 1: The least nominal wall thickness of plain end steel pipe in sizes smaller than 2" nominal use for service lines where the pressure does not exceed 100 psi is not limited by the table, but shall not be less than .035 inches in any location class.

Note 2: For tubing in wall thicknesses over 0.035" the wall thickness may be obtained by interpolating between the pipe OD's listed above. Instrument, control, and sample piping are not limited by Table 841.124 but shall be governed by the requirements of 845.5}

Note: All pipe purchased by Duke Energy, both plain end (API 5L-Grade B) and threaded (ASTM_A53), meet these minimum requirements as noted in the Gas Operations Materials Catalog Inventory Class 50. Also see Gas Distribution Engineering Procedure entitled Material Design Mains.

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150

Original Issue Date: 06/01/06 Revision Date: 8/18/17

Revised By: Chris Ampfer Department: Gas Engineering

Approved By: Dave Emerick, Mgr. Gas Ops. Engineering

Reference: CFR Title 49 Parts 192 & 195

Gas Procedures: Gas Standard: Various

Gas Operations Plan: Natural Gas Plan Sections F- K & Hazardous Liquid Plan Sections D, E, G & H

Purpose: This procedure covers the general requirements and specifications for installing gas main and services.

Table of Contents

INTRODUCTION

1. GD150 covers the "general" field requirements for the various facets of installing steel welded protective coated mains, plastic mains, services and associated appurtenances under the contract proposal. For details on a specific subject it is recommended that both the Duke Energy Gas Operations Standards and Procedures are reviewed. They are available online for review.

2. Shading has been used to show those items considered "significantly" different from the previous version of GD150.

3. Where provisions of GD150 differ with the Standard Terms and Conditions, GD-150 shall govern.

4. A complete GD150 should contain those items listed in the table of contents. If more information is required, please contact Gas Engineering.

5. For those items that deal with price/pricing refer to procedure GD147 Contractor Payment Schedule.

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150

SECTION 1 - GENERAL CONDITIONS

Section A - Schedule of Work

Section B - Permits

Section C - Employees

Section D - Training

Section E - Public Relations during Construction

Section F - Responsibility of Material

Section G - Fences

Section H - Crop Damages

Section I - Right of Way

A. Schedule of Work

1. All work shall be performed in conformance with the Purchaser's drawings and specifications. The Purchaser must approve any deviation from the original route.

2. The work may be started anywhere within the limits of the project at the Contractor's discretion; however, the Purchaser reserves the right to direct the application of the work force to any portion of the work.

3. No additional work outside of the original work scope shall be completed unless it is accepted by the authorized agent of Duke Energy. The new Work must comply with the agreed to proposal and all written negotiations.

4. The Contractor shall, upon request, submit a proposed schedule for construction and an installation procedure before beginning the work.

5. The Contractor shall employ overtime at his/her own expense at any time construction fails to meet the specified schedule and conditions.

6. The Contractor shall complete all punch list items within sixty (60) days of being notified.

B. Permits

1. All work shall be in accordance with the requirements and regulations of the public authorities having jurisdiction. The Contractor shall not make street or sidewalk

openings unless the Contractor has evidence that a valid permit has been issued for the work. Construction permits will be obtained and paid for by the Purchaser with the exception of “fill” fees that may be required for dump sites.

2. Any permits required for movement of materials or equipment over highways shall be secured and paid for by the Contractor.

3. All railroad crossing permits are applied for by Duke Energy.

NOTE: If the Contractor wants to directional drill the crossing, the main typically has to be 10 feet below the tracks. If the change to directional drilling creates a problem with the original permit, the Contractor will not be reimbursed for any down time. It is the contractor’s responsibility to notify Duke Energy of their intention to directional drill the crossing and to allow adequate time to obtain a change in the railroad permit. If time does not allow for a change in the permit, the contractor shall be expected to bore the crossing.

C. Employees

1. The Purchaser shall have the right at all times, to require the removal of any supervisor or workman, who in the opinion of the Purchaser performs unsatisfactorily.

2. The Contractor shall ensure that all Federal, State and Local rules/ regulations are satisfactorily met as applicable to the work. This includes, but is not limited to, the Department of Transportation (DOT), DOT Research and Special Program Administration (RSPA) rules/regulations.

D. Training

1. Duke Energy will require polyethylene qualification on all fusion and mechanical connections. Renewal of fusion cards are the responsibility of the contractor. Adequate time must be given by the Contractor to Duke Energy so classes can be scheduled.

2. Duke Energy will require welder certification on all welds performed on Duke’s gas facilities. Renewal of welder certification cards are the responsibility of the contractor. Adequate time must be given by the contractor to Duke Energy so welder certifications can be scheduled.

3. Duke Energy will provide training to the Contractor on the renewal of services, installation of meter sets, turn off, turn on and appliance light up. Grounding procedures and a review for sizing services will also be covered in the training.

4. Contractors will be trained for free on Duke Energy policies associated with spotting unacceptable meter locations and the identification of tin meters and mercury

regulators. Only Duke Energy Service Delivery personnel shall handle mercury regulators.

E. Public Relations During Construction

1. The Contractor shall be required to hold weekly on-site meetings with the community representative and/with the Inspector to ensure immediate handling of all customer concerns. The Contractor shall be required to provide the Inspector with a proposed schedule prior to the start of work, along with weekly progress reports.

2. The Contractor shall be required to provide emergency numbers to the dispatcher to assure twenty-four (24) hour / seven (7) day week coverage. The Contractor shall also be required to leave door hangers with business cards, sewer tags and phone numbers for customer contact during and after working hours. A customer notification log must be filled out and returned to the assigned onsite Inspector prior to the start of any construction.

3. Picture ID's are required for all Contractor employees. Contract personnel are required to show their ID when asked by customers or Duke Energy personnel.

4. All primary contractor and sub-contractors vehicles must be clearly marked with either decals or magnetic stickers displaying the company name and phone number while at the work site.

5. Contractor shall respond to customer complaints within 48 hours of being notified by a Duke Energy representative.

6. The Contractor shall conduct his/her work in such a manner, as to minimize damage to sidewalks, roadways, properties, underground utilities, and structures.

7. If a block of sidewalk is to be open for more than 48 hours, class 53 temporary asphalt must be placed into the open section of sidewalk. All tripping hazards are to be avoided in sidewalk areas and, where necessary; foot traffic shall be re-routed where a sidewalk blockage is present.

8. The Contractor shall be responsible for all losses or damages to public or private property including damage to walks, driveways, drain lines, curbs, lawns, shrubs, trees and streets resulting from his/her negligent acts.

9. The Purchaser will settle and pay for all lawn damages caused by the result of the construction; however, it is expected that the Contractor shall conduct his/her work in such a manner as to minimize lawn damage.

10. The Contractor shall assume responsibility for proper surface restoration, and shall indemnify and save harmless the Purchaser from any and all claims, demands, damages, actions, causes of action and defend any and all suits instituted against

Purchaser, for property damages or personal injury to agents of the Contractor or third parties, whether caused by negligence attributable to Contractor or not, growing out of restoration or failure to restore.

11. The Contractor shall store and distribute materials and construction equipment in a manner to cause the least inconvenience to the public.

12. Pipe shall be strung in such a manner to satisfy the requirements of public authorities and involved property owners.

13. The Contractor shall be responsible for maintaining the traffic upon private or public roadways, involved within the construction limits of the project using proper signs, barrels, cones, etc.

14. The Contractor shall install and maintain temporary bridges where the trench is:

    a) opened across the street,

    b) crossing a vehicle entrance used for business purposes,

    c) located in front of a fire hydrant, or

    d) required by public authorities.

15. The Contractor shall provide and maintain footbridges with guard-railing and toe plates per OSHA guidelines for foot traffic where applicable.

16. The Contractor shall install safety shields to protect the public from injury when breaking concrete or welding/grinding.

17. Plastic rebar safety caps shall be placed on the ends of any vertically placed rebar at all times to prevent injury.

18. Adequate safety measures including caution lights, flagmen, and warning signs, shall be provided and maintained by the Contractor during construction.

19. The Contractor shall, at his/her expense, remove all excess material and debris, resulting from the construction as soon as possible, so as to permit safe passage on the roads and right-of-ways.

20. The Contractor shall provide and maintain sanitary accommodations for the use of his/her employees in a neat and satisfactory condition. The accommodations must comply with the requirements of the public authorities.

21. The Contractor shall cooperate fully with the street contractor, and cause as little interference as possible to the street improvement work.

F. Responsibility for Material

1. The Purchaser will furnish the Contractor, all required valves, fittings, accessories, prefabricated system stations, and patch coating materials, except for pipe, which will be delivered to the job site.

    a) The Contractor shall not accept any material from the Purchaser that is found to be defective.

    b) The Contractor shall be responsible to account for the material as it is unloaded.

    c) The Contractor shall be held responsible for all material that he accepts until the work is completed and accepted.

    d) The unloading, loading, and hauling of materials during these operations shall be done with care to avoid damage to the materials, to the highways and structures.

    e) There may be occasions when the Contractor shall be required to pick up material at the Purchaser's designated location. Additional movement of the pipe and materials that are to be used in construction, after delivery on the site, shall be the responsibility of the Contractor.

2. Duke Energy will provide all piping and associated pipe materials required for the pipeline work.

    a) All six (6) inch diameter and smaller polyethylene pipe will be medium density polyethylene (MDPE), colored yellow.

    b) All eight (8) inch and twelve (12) inch polyethylene pipe will be high density polyethylene (HDPE), colored black with yellow stripes.

    c) All steel pipe will be epoxy coated Grade B or stronger. Twelve (12) inch and sixteen (16) inch coated steel pipe will typically have a wall thickness of 0.219" and 0.250", respectively.

    d) Duke Energy will specify the grade and wall thickness of all steel pipes on the construction drawings.

3. The contractor shall be responsible for requesting material as it is needed.

    a) The contractor must allow a minimum of twenty-one (21) days for pipe deliveries on pipe sizes less than 8".

    b) For pipes eight (8) inch and larger, a minimum of forty-two (42) days will be required.

c) It shall be the responsibility of the Contractor to unload material at the jobsite and to provide weekly reports showing material received, material used and material remaining.

d) The material assigned to a module/project is to be used on that module/project only. At the end of the project, all surplus materials are to be returned to the storeroom or a credit requisition completed allocating the material to another job.

   i. The material must be returned or requisitioned to another job in the same condition that it was received.

e) A 10 % overrun in the quantity of pipe will be allowed for waste. All other unaccounted, damaged or material left unprotected shall be the responsibility of the Contractor.

4. Service material will be delivered to each Contractor's storage yard. Each Contractor shall be required to provide an adequate shelter area with shelves to organize all the service material.

   a) The Contractor shall provide a person to receive material, organize, and reorder material as needed.

   b) The Contractor shall accept responsibility to ensure the reorder is completed as necessary and the faxing of appropriate paperwork to 513-629-5822.

   c) At the end of each calendar year, the Contractor shall be required to inventory all service related material including material at job sites and truck inventory.

5. The Contractor must notify the Inspector of the exact location where the pipe is to be delivered. It shall be the Contractor's responsibility to determine where the staging location for the new pipe is to be. The Contractor shall have personnel available to unload the pipe when the delivery truck arrives.

6. The Contractor shall be responsible for the adequacy of supplies and materials necessary for doing the work without requiring revisions and causing delays.

7. The Contractor shall be responsible for packaging all excess material and having manpower and equipment available to load this material onto the Purchaser's trucks. There may be occasions when the Contractor may need to return material to the Purchaser's designated location.

8. Contractor Supplied Materials

a) The Gas Contractor is required to provide all materials and equipment other than as indicated on the construction drawings, which is necessary to construct the project.

b) Spray paint used by the contractor for markings must be water soluble and capable of being removed if needed.

c) All welding materials such as welding rods, grinding wheels, clamps, etc. are to be provided by the Contractor.

G. Fences

1. Fences shall be repaired at the Contractor's expense, and to the satisfaction of the property owner. Damage claims arising from livestock wandering through open or temporarily repaired fences shall be paid for by the Contractor.

H. Crop Damages

1. The Purchaser will settle and pay for all crop damages necessary for the main installation; however, it is expected that the Contractor shall conduct his/her work in such a manner as to minimize crop damage.

I. Right-of-Ways

1. On private property, the Purchaser will furnish a right-of-way, including the right of ingress and egress, and the right to use the grantor's adjacent land for construction of the main within the specified limits. The Purchaser will note any and all restrictive clauses contained in the right-of-way agreements on the construction drawings, bids, or on a separate letter. The Contractor shall conduct his/her operations in accordance with such agreements.

2. When construction involves the use of the Purchaser's easements, the Contractor shall contact each property owner, prior to entering the property. The Contractor shall be responsible for damages to and restoration of driveways and temporary roadways used for the ingress and egress.

3. The Contractor shall clear the right-of-way to such a width as required by the Purchaser and in such a manner as to permit his/her ability to work satisfactorily. Excessive damage to the land must be avoided. Brush and timber taken from the right-of-way shall be disposed of by the Contractor to the property owner's/responsible party's satisfaction.

<u>SPECIFICATION</u> FOR THE INSTALLATION OF GAS MAINS AND SERVICES

SPECIFICATION GD-150

SECTION 2 - PRIOR TO CONSTRUCTION

Section A - Preliminary Work

Section B - Surface and Subsurface Conditions

Section C - Sewer Location and Breach Prevention

A. Preliminary Work

2. The Purchaser will furnish a field Inspector for each job. The Inspector will be responsible for obtaining all necessary field measurements and notes on the installation drawing. The Contractor shall cooperate with Purchaser's field Inspector in the prosecution of the work and obtaining the necessary records.

3. Duke Energy recommends that the Contractor videotape every project prior to starting construction. This video record can be extremely important in settling disputes with governing agencies and customers. If the project is not videoed and there is a dispute between the contractor and the customer, Duke Energy will side with the customer. When videoing, addresses must be indicated verbally or pictorially.

4. The Inspector will order all material required for the job. The Contractor must provide a reasonable amount of advanced notice to allow the Inspector time to have the material ready for delivery.

5. Stockpiling of pipe on the site shall be in accordance with Gas Procedure GD02.903-2 *Coated Pipeline & Coating Materials Specification for Handling, Storage & Application*.

6. The Contractor shall have the underground utility locations marked on the streets, curbs, as required by House Bill and the Purchaser's Inspector. The Purchaser assumes no responsibility for miss-marked utilities or downtime as a result of late or incorrect marks.

7. The Contractor, together with Purchaser's representative, shall notify each property owner prior to working on, near or around the owner's property. They shall explain the nature of the work to be done, and make arrangements as necessary to minimize any inconvenience to the owner as the work progresses. Where fences, shrubbery, mailboxes, etc. are involved, there must be an agreement with the owner as to the location at which these private appurtenances are to be reinstalled. This reinstallation shall be at the Contractor's expense.

B. Surface and Subsurface Conditions

1. Because gas is usually one of the first utilities to begin work on a street improvement project, it can be assumed that trees/brush will not be cleared as indicated on the construction prints. Those incidental trees or brush that require removal for gas main installation, shall be removed by the Contractor. The cost to remove the trees/brush must be included in the "pipe installation" cost.

2. The Contractor shall be responsible for all tree damage unless directed by the Purchaser to perform work that could be detrimental to the trees. The Contractor is responsible for notifying the Purchaser of potential detriment to the trees "prior" to excavation. Otherwise, the Contractor assumes responsibility for damages.

3. The Purchaser assumes no responsibility and gives no guarantee as to what subsurface conditions will be found to exist when the work is being carried out. Locations of underground structures as shown on Purchaser's drawings are approximate only. Test holes must be dug prior to saw cutting the street to insure underground structures will not create problems with construction.

C. Sewer Location and Breach Prevention

1. See GD55.1304-9 *Specification for Sewer Inspections Where Gas Facilities Installed By Trenchless Technology*.

SECTION 3 - EXCAVATION

Section A - Route Sequence and Installation

Section B - Bracing

Section C - Installation at Specified Elevations

Appendix 3A State of Kentucky Underground Utilities Depth Requirements

A. Route Sequence and Installation

1. Prompt restoration of any interrupted gas, water, or other utility service is mandatory.

CAUTION: The Contractor is not to repair any active gas services or gas mains that may be damaged during construction. If the Contractor encounters any leaks or suspects a potentially dangerous condition, the

Duke Energy emergency contact number and the Duke Energy project inspector must be notified immediately

2. The Contractor is to maintain a minimum protected work area. All unattended open cuts in sod must be covered with ¾" plywood and barricaded with appropriate flashers, barrels, or other proper equipment. Stakes alone will not be acceptable.

3. The crossing of railroads, bridges, and streets shall be made in such a manner that will meet the specifications and requirements of the authorities having proper jurisdiction over such crossings.

4. The trench for the main shall have a maximum width as shown in Gas Standard *2.14.1: Typical Restoration Section Backfill Requirements for Steel Pipe and 2.18.1: Typical Trench Details – Polyethylene Pipe.*

5. Restoration costs will be determined based on these dimensions.

6. A minimum amount of pavement shall be removed in order to reduce the amount of restoration. Suitable equipment and methods shall be used for cutting the edges of the pavement so as not to disturb or damage the pavement or base to be salvaged.

7. The pavement shall only be removed a reasonable distance in advance of excavation, to avoid inconvenience to the public. However, it is recommended that test holes be dug enough in advance to reduce the possibility of potential unforeseen conflicts with other underground utilities.

8. The trench shall be dug so that a minimum number of vertical bends are required.

9. The trench shall be excavated to a depth to permit the necessary cover as shown on the "issued" drawing, as measured from the top of the pipe in the trench, to the average level of ground on the two sides of the trench. If the depth is not shown on the drawing, it must be assumed that a cover of 3 feet will be utilized or as directed by governing agency .Refer to Appendix 3-A "State of Kentucky Requirements".

   Except as provided in paragraphs a through c below, all transmission and feeder line mains shall have a minimum cover of thirty-six (36) inches.

   a) Where main is installed in consolidated rock the minimum cover shall be twenty-four (24) inches.

   b) Where an underground structure prevents installation of a transmission or F\L main with minimum cover, the transmission or feeder line main may be installed with less cover if it is provided with additional protection to withstand anticipated external loads.

c) All pipes installed in a navigable river or stream shall have a minimum cover of forty-eight (48) inches in soil or twenty-four (24) inches in consolidated rock. However, less than minimum cover is permitted in accordance with paragraph(c) of this subsection.

For further details, reference Kentucky Administrative Regulation 807 Part 5.022 and DOT CFR Title 49, Minimum Federal Safety Standards, Part 192.327.

10. If the Purchaser's Inspector deems it prudent, the depth of cover may be reduced or increased on street improvements with the approval from the Design Engineer.

11. Whenever the bottom of the trench has been excavated below the proposed elevation, the correct amount of **compacted** materials must be placed in the bottom of the ditch to provide the proper elevation.

12. The Contractor shall be responsible for damage resulting from failure to locate other underground utilities and structures prior to excavating, within House Bill guidelines.

13. The trench shall be cut so as to permit the main to pass under other utilities, drainage tiles, and other structures, where the minimum cover as specified is not available by going over such structures. **A minimum clearance of twelve (12) inches between the main and other structures shall be maintained if main is located under hard pavement, six (6) inches if in sod.** Where the minimum clearance between the gas main and other structures cannot be obtained, insulating spacers of an approved type, provided by the Purchaser, shall be used between the main and other structure to prevent cathodic issues. Joint trench requirements differ from this procedure (Refer to Gas Standard *2.18.3: Joint Electric, Gas, Telephone and CATV Installation).*

14. The Contractor shall be entitled to additional payment if an offset is required to avoid an unforeseen obstacle, either in the vertical or horizontal direction. One offset will be defined as the use of two (2) unplanned elbows.

15. Should the Contractor be required to excavate the trench to a depth greater than five (5) feet and two (2) feet greater than the planned depth as a result of non-contemplated obstructions (culverts, water main, etc.), a payment for "extra depth" will be considered.

16. The Purchaser assumes no responsibility for estimating the quantity or the type of rock excavation that may be encountered. Only limestone and other

hard-stratified material in a continuous volume of at least one cubic yard will be reported as rock excavation. One continuous cubic yard is not intended to mean a specific length, width, or thickness, but a combination of these three dimensions that yield a cubic yard. Length x width x thickness is equal to more than one cubic yard or twenty-seven (27) cubic feet.

NOTE: The thickness of the rock must be greater than 6” for the entire length in question in order to receive payment for rock excavation.

17. In order to eliminate potential problems for payment of rock excavation, the Contractor and the Purchaser must agree to the amount of rock, by measuring the rock located in the sides of the ditch. The actual amount of rock must be agreed upon between the Purchaser and the Contractor prior to backfilling the ditch.

18. The trench bottom shall be smooth and free from rocks, debris and/or protrusions that may damage the pipe or coating.

19. Bank run maybe required for use as padding. Padding is defined as bank run placed below and above the pipe and will be used in soils unsuitable for backfill. The Inspector will determine the use of padding. Approved bank run will be a separate pay item and will be paid by the ton.

20. Bank run gravel used for padding shall be per ODOT 703.11 Ohio Type 2 as listed in ODOT’s “Construction Material Specification” (current edition) or clean washed sand.

21. Prior to laying the pipe in trenches where imbedded rock is present, the Contractor shall be required to pad the trench bottom with a minimum of three (3) inches of finely compacted material, and/or install rock shield on the pipe, as directed by the Purchaser. Refer to Gas Standard *2.14.1: Typical Restoration Section Backfill Requirements for Steel Pipe* and 2.18.1: *Typical Trench Details – Polyethylene Pipe.*

22. There will be times it will be necessary to lower an existing, in service gas main. The Purchaser’s Engineering Department will provide the necessary information to lower the main in a safe manner. The procedure must be followed to ensure that no excessive stresses are created on the gas main.

B. Bracing

1. The Contractor must support the sides of the trench as necessary to prevent excessive damage to the sides of the pavement and creating an undermining situation. If excessive damage to the pavement occurs, the Contractor shall perform, at his/her expense, such restoration as shall be required by the Purchaser or public authorities having jurisdiction. The Inspector shall indicate

these areas on the daily work sheets. Refer to Gas Standards Section 12: *Excavations – Shoring Manual*.

2. Bracing open trenches shall be required when:

   a. Increased cover is necessary,

   a) Changes in water and moisture conditions are observed,

   b) Noticeable cracks adjacent to the ditch or within the roadway pavement,

   c) Noticeable cracking bottom heave,

   d) Trench wall deformation,

   e) Surface settlement, or

   f) As defined in the OSHA requirements.

3. Particular attention must be given to the following:

   a) Placement and removal of support system and excavated materials,

   b) Load changes in the bracing, and

   c) Physical condition of the bracing.

4. If seepage of water into the trench occurs during excavation, the following steps are to be taken:

   a) Brace the trench walls,

   b) Limit the length of the excavation to short sections and do not allow the trench to remain open overnight,
   c) Provide a drainage system along the pipeline with a proper outlet, where possible, and

   d) Provide proper compaction of the ditch per the specifications listed in Section 7 “Back-fill”.

C. Installation at Specified Elevations

2. A surveyor’s level and rod are required and must be supplied by the Contractor on projects that specify elevations for the top of the gas main.

3. The Contractor is responsible for reading the levels and installing the pipe according to the Purchaser's survey points.

4. The Purchaser will set points on the project to be used by the Contractor to determine how deep to install the main. The Contractor should notify the Purchaser at least 10 working days prior to starting the project, so that the points can be set. If set points are disturbed, the Contractor should notify the onsite Inspector immediately so that they can be reset.

5. The points typically are marked with a "C" which indicates a cut to the top of the pipe from the set point.

6. When using an offset, the cut is normally indicated on the offset stake and must be transferred to the centerline to determine proper elevation for the top of pipe.

7. A decimal measurement such as C 3.8 should be converted to feet and inches or use a decimal tape measure/decimal survey rod.

8. To convert decimal feet to inches, multiply the decimal by twelve (12) inches. (Example: .8' = 0.8 x 12" = 10")

   To determine how deep to dig the trench add the pipe diameter and depth of padding to the cut that is marked. For example if set point says C 3.5' and six (6) inch pipe with six (6) inch sand padding is being used, the ditch should be cut to a point four and one half (4.5) foot below the set point. (C = 3.5', pipe = 0.5', padding = 0.5'**;** 3.5' + 0.5' + 0.5' = 4.5')

<u>NOTE</u>: The ditch should be four and a half (4.5) feet below the set point. A surveyor's level should be used if the set point is not on the center line.

9. Services (both main-to-curb and curb-to-meter) should be installed at the same ELEVATION as the main on street improvement projects unless the cross sections sheets show a potential conflict. Contact Purchaser's Inspector or Gas Engineering if in doubt.

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES

SPECIFICATION GD-150

APPENDIX 3A

STATE OF KENTUCKY UNDERGROUND UTILITIES DEPTH REQUIREMENTS

KENTUCKY TRANSPORTATION CABINET
FRANKFORT, KENTUCKY 40622
WWW.KENTUCKY.GOV

ERNIE FLETCHER
GOVERNOR

MAXWELL C. BAILEY

RECEIVED
NOV 4 2004
DIVISION OF MAINTENANCE
PERMITS BRANCH

MEMORANDUM

TO: Chief District Engineers
District Permits Personnel
District Utilities Personnel

THRU: Maxwell C. Bailey
Secretary

Marc Williams
Commissioner of Highways

J.M. Yowell
State Highway Engineer

Charles A. Knowles
Executive Director of Traffic Operations & Maintenance

Tom Schomaker
Director of Maintenance

FROM: M. Chad LaRue
Branch Manager of Permits

DATE: October 27, 2004

SUBJECT: **Revision to Permits Policy Manual-Utility Crossings-Change to Underground Utilities Depth Requirements**

This memorandum is to notify all Kentucky Transportation Cabinet personnel of the change to the required depth for underground utilities that are located on state right-of-way. This change is being done to reduce the potential for impacting underground utilities that are located on state right-of-way. The previous policy had a variance that led to inconsistency in the depth at which underground utilities have been installed throughout the state. In addition, there have been instances where sign post installation, guardrail installation, and ditching have damaged underground utilities.

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES

SPECIFICATION GD-150

Effective the date of this memorandum, section PE 202-2, page 2 of 3, under Utilities in segment Underground, in the Permits Policy Manual shall now read, "The minimum depth for underground utilities is 42" under roadways, ramps, and ditch lines and 30" in all other areas within state right-of-way. Exceptions may be made only where the terrain is such that this requirement is proved to be impractical and where a lesser depth will not interfere with highway maintenance, safety or aesthetics. It is at the discretion of the Chief District Engineer to determine where these exceptions are to be allowed."

Section PE-202-3, page 1 of 5, in the segment Underground Utilities Installed Longitudinally, shall now read, "Requirements- These utilities must be buried a minimum of 30 inches deep..." The remaining portion of this segment shall remain the same.

Section PE-202-3, page 3 of 5, under Encasement of Utilities, in the segment Conditions Where Encasement Not Required, shall now read, "3. Pipe crossings 2" in diameter and under will not require encasement provided they are buried at least 42" below bottom of ditches, shoulders, and roadway surfaces." I have also attached an updated form TC 99-10 that reflects the above change.

This policy change will be made in the Permits Policy Manual upon its next revision.

MCL

C: Central Office Division Directors

Attachment

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES

SPECIFICATION GD-150

Kentucky Transportation Cabinet
Department of Highways
Permits Branch

EXHIBIT 8

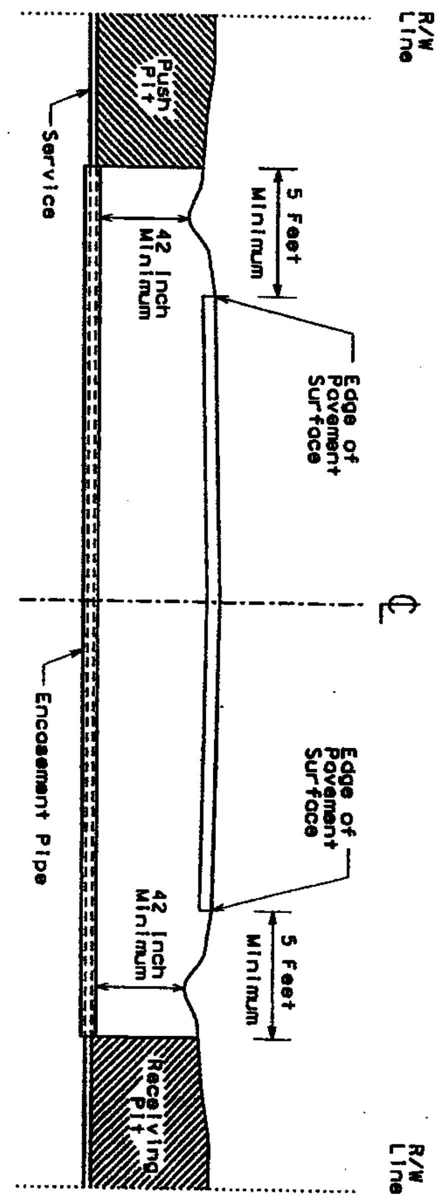
TC 99-10
Rev. 9/2004

TYPICAL HIGHWAY BORING CROSSING DETAIL

Permit No. ________

Route No. ________

Pavement Width ________



1. Push Pit and Receiving Pit shall be backfilled and thoroughly compacted.
2. All ditch lines are to remain open at all times.
3. Seed and straw all disturbed areas immediately after completing the work.
4. Provide traffic control as required to insure the safety of the traveling public in accordance with the current edition of the "Manual on Uniform Traffic Control Devices".

ALL SERVICES OVER 2" IN DIAMETER SHALL REQUIRE ENCASEMENT.

SECTION 4 - INSTALLATION OF STEEL PIPE

Section A - Handling Steel Pipe

Section B - Stringing

Section C - Welding

Section D - Valves and Other Appurtenances

Section E - Direct Bury

Section F - Boring

Section G - Horizontal Directional Drilling (HDD)

Section H - Field Bending

Section I - Pipe Defects

This specification covers the General Conditions and Technical Requirements for the storage, handling, welding and installation of steel gas mains and their associated appurtenances under contract proposal or by using Company construction forces.

A. Handling of Steel Pipe

1. Care shall be exercised during all phases of pipe handling to minimize damage to the coating as well as the beveled pipe ends.

2. If the Contractor must move the pipe, the pipe shall be loaded and secured so as to prevent undue shifting and/or flexing during transit. Stakes and chains shall be padded to prevent damage to the coating.

3. Coated pipe shall be handled with wide, non-abrasive canvas, rubber composition leather, or nylon slings. Minimum sling loads shall be as follows per 40' length of pipe:

Pipe Size	Minimum Strength Rating
12” an under	2500#
14” – 20”	5500#
24” and over	9000#

4. Slings of proper width and smoothness, as approved by the Purchaser, shall be used to prevent injury to the coating. Any slings showing signs of damage or fraying shall not be used.

5. Slings shall contain no bolts or rivets, which can come into contact with the coating. Wire rope, chains, hooks and bare cables shall not be used, except those hooks that may be used on the uncoated ends of single pipe lengths for loading and unloading purposes.

6. Skids used for supporting the coated pipe shall be free of nails or embedded rocks to insure the pipe coating is not damaged. Skids must have enough strength to safely hold the pipe in position.

B. Stringing Pipe

1. Stringing pipe shall be performed in a manner such that will not damage the ends of the pipe or the protective coating.

C. Welding

1. The joining of the steel pipe and components shall be done in accordance with the Purchaser's Qualified Welding Procedures.

2. No person shall be permitted to weld steel pipe unless they have been tested and qualified in accordance with Section 6 of API Standard 1104 (20th Edition) under the observation of a qualified Duke Energy welding supervisor. Each welder must have in his possession an up-to-date certification card. All testing will be at the Contractor's expense.

3. The contractor must have a copy of the welding specifications onsite for all steel pipeline projects, if the contractor does not have a copy, then one should be requested. F/L projects will have the welding specifications noted on the cover sheet of issued construction drawing. Contractor can question the specification if they are not in agreement with the required process.

4. Typically, pipe furnished shall be steel pipe API X-42 or X-52, Sizes 1 ¼", 2", 3", 4", 6", 8", 12", 16", 20", 24" and 30" unless otherwise specified. All pipe furnished will be double-random lengths (36'-41') mill coated with the ends beveled for welding. Fittings are Grade B unless specified otherwise. *(*Refer to Gas Standard *2.1.2 - Coated Steel Pipe Inventory).*

5. The Contractor shall be required to provide all welding materials, such as correct welding rods, grinding wheels, clamps, etc. as well as other incidental materials and equipment necessary to construct the project.

6. Immediately prior to joining the pipe, each joint shall be visually inspected and, when required or specified, brushed out internally by a method approved by the

Purchaser. The Contractor shall take positive measures to ensure that no foreign matter is sealed inside the main. Longitudinally welded pipe shall be joined with the welds staggered and located in the top segment of the pipe. The open ends of sections shall be closed by means of dead caps when no work is taking place on the main.

7. Production joints selected by the Purchaser that are removed from the line and found to be defective shall be replaced by the Contractor at the Contractor's expense. Welding the replacement back into the line shall be administered as if it was a test joint.

8. A qualified visual welding Inspector shall visually inspect all welds.

9. Miter joints shall not be permitted.

D. Valves and Other Appurtenances

- The Purchaser reserves the right to add valves and accessories not shown on the drawings. Payment will be the bid price if available; otherwise, a change order will be required.

- The Contractor must defer the installation of line valves until after the strength test has been successfully completed, if applicable, unless specified by the Purchaser.

- Valves to be welded into the line shall be installed in the closed position. The valve is to be opened when complete.

- Valve installation shall include valve, pressure stems, blow offs and valve box. Refer to Gas Standards *2.6.2: Steel Pressure Stem Installation – Distribution Systems - and 2.6.2.1: Steel Pressure Stem Installation F/L & T/L* and 2.6.1: *Valve Installation (Steel Main)*.

1. The application of cathodic protection materials and/or repairing of the coating, next to the valve, shall be included as part of the installation of the valve.

E. Direct Bury

1. The main shall be laid to the established grade with the pipe resting directly on the bottom of the trench or undisturbed soil.

2. The Contractor shall lower the main into the trench in such a fashion as not to cause any distortion or damage to the pipe, or coating. There may be some applications where the rock is so prevalent that the rock shield may have to be placed on the main prior to lowering.

3. The rock shield shall be bent to fit the curvature of the external surface of the coated pipe, and shall be secured to the pipe in such a manner as to prevent loosening or shifting during lowering-in or backfilling operations.

4. All trenches shall be visually inspected for sewer or septic facility damage. Visual inspection shall include examining both the trench and spoil for evidence of damage to sewer and septic facilities.

5. The Contractor shall remove liquids from the bottom of the trench before the main is lowered. Precautions shall be taken to prevent floating of the main, water draining into the main, and the caving of trenches.

7. In the event of excessive rainfall or subsequent bad working conditions, the Purchaser may require the Contractor to postpone operations until such time as the work can progress without excessive property damage.

6. Walking or standing on the coated pipe shall **not** be permitted.

F. Boring

1. The Contractor shall provide all necessary equipment to bore roadways and/or driveways in accordance with the Purchaser's construction drawings and specifications.

2. Where boring has been specified on the construction plans, boring will be the expected method of installation. The contractor must receive prior written approval from Gas Engineering if directional drilling is to be used in place of boring.

3. Driving of pipe will not be permitted.

4. A section of pipe will be brought beyond the exit hole and investigated for possible damage.

5. Jacking may be permitted with the agreement of the Design Engineer. All damaged main must be removed and must not be used. Any damaged coating must be repaired before acceptance. The Purchaser assumes no responsibility for failed attempts.

6. "Boring-With Casing" includes all excavation, hand or otherwise, required for placing the casing inside the bore including the bore pit. The bore is to be installed per design at the designated depth. The new casing must be positioned in such a fashion that no additional fittings will be required on the new main and that there will be no undue stress placed on the new main when installed. All casing joints must be welded per Duke Energy's welding standards to prevent water from entering the casing.

7. "Boring-With Casing" shall include the installation of all insulators, seals, and vents, if required. Refer to Gas Standard 2.12.1: *New Steel Pipeline Cased Crossings For Railroad And Highway Crossings.*

8. Tunneling shall be done only upon agreement with the Purchaser. Tunneling must be performed in a manner as specified by the Purchaser or public authorities. The Contractor shall provide all adequate shoring for trenches and boxing for tunnels where necessary upon agreement with the Purchaser. The Contractor must have a competent person on site to ensure OSHA Shoring Regulations are being followed.

9. The borehole size must be at least the next pipe diameter larger than the pipe size being installed.

10. The borehole will not be used any time that the bore causes the pavement to hump.

11. All bores shall be installed per depth listed on the "issued" drawing. If the depth is not listed, it must be assumed that a cover of 3 feet will be required.

12. All bores must be installed within +/- one (1) foot horizontally of the designed location unless specifically authorized in writing by the Purchaser.

13. Before a main/casing is installed by boring, the location and depth of all existing utilities and sewer laterals must be determined. A plan showing the location of existing sewer laterals must be submitted to the Purchaser and approved prior to the Contractor performing the bore. Acceptable methods for locating the existing sewer laterals are a camera/sonde or by physically uncovering the lateral.

G. Horizontal Directional Drilling (HDD)

1. Because the HDD of steel main is typically done to cross bodies of water, the necessity to dig pot hole is lessened; however the location of neighboring utilities must be taken into consideration when deciding on the new gas main's alignment.

2. Gas Engineering must be notified before any attempts are made to HDD a steel main that was **not** considered in the original design.

3. The main used in the HDD must be coated with an adequate thickness of Powerecrete, or equivalent, to minimize the potential destruction of the protective coating. Refer to Gas Standard 2.1.2 - *Steel Pipe - Coated*.

4. The minimum bending radius of the proposed main, as determined by Gas Engineering, must not be exceeded.

H. Field Bending

1. The Contractor shall make all necessary field bends by means of a bending machine with the appropriate mandrels and shoes to create a smooth bent pipe free of any mechanical damage, per Pipeline Safety Regulations §192.313:

   a) Each field bend in steel pipe, other than a wrinkle bend made in accordance with §192.315, must comply with the following:

      (1) A bend must not impair the serviceability of the pipe.

      (2) Each bend must have a smooth contour and be free from buckling, cracks, or any other mechanical damage.

      (3) On pipe containing a longitudinal weld, the longitudinal weld must be as near as practicable to the neutral axis of the bend unless:

         (i) The bend is made with an internal bending mandrel; or

         (ii) The pipe is 12 inches (305 millimeters) or less in outside diameter or has a diameter to wall thickness ratio less than 70.

   (b) Each circumferential weld of steel pipe which is located where the stress during bending causes a permanent deformation in the pipe must be nondestructively tested either before or after the bending process.

   (c) Wrought-steel welding elbows and transverse segments of these elbows may not be used for changes in direction on steel pipe that is 2 inches (51 millimeters) or more in diameter unless the arc length, as measured along the crotch, is at least 1 inch (25 millimeters).

   Pre-formed welding elbows, provided by Purchaser, will also be accepted.

2. Adjustments to the ditch are not acceptable to eliminate a planned field bend.

3. Wrinkle bends shall not be permitted, (Pipeline Safety Regulations §192.315). The cost for the replacement of damaged pipe, as a result of improper bending, will be charged to the Contractor.

4. A bend must not impair the serviceability of the pipe.

5. On pipe containing a longitudinal weld, the weld must be as near as practicable to the neutral axis of the bend unless:

   i. The bend is made with an internal bending mandrel.
   a) The pipe is twelve (12) inches or less in outside diameter, or has a diameter to wall thickness ratio less than seventy (70).

6. Cold bent pipe sections shall not include a circumferential weld, unless the weld is subject to radiographic examination after bending.

I. Pipe Defects

1. Should pipe defects be discovered such as sharp or deep gouges and dents and/or mill defects, they will evaluate and a repair option selected for the pipe body gouge and/or mill defect.

CAUTION: Defects such as sharp or deep gouges and dents may have cracked during service and need to be handled with caution. Lowering the pressure is recommended when evaluating and repairing.

Reference Procedure GD70.06-019 Pipeline Defect Evaluation

SECTION 5 - CATHODIC PROTECTION

Section A - Anode Installation

Section B - Insulating of Joints

Section C - Coupling Bonds

Section D - Test Connection Installation

Section E - Coating Inspection

Section F - Handling and Storage of Coating Materials

Section G - Field Coating

Section H - Hot Melt Patch (3-M Scotchkote Hot Melt Patch Compound 226P)

Section I - Heat Shrink Sleeves

Section J - Wax Tape Coating Application

Section K - Petrolatum Tape Coating Application (Densyl Tape)

Section L - Denso Protal (Epoxy)

Appendix 5A Surface Preparation Standards

The cathodic protection system shall be installed as indicated on the construction prints. The cathodic protection system installation is one of the most important aspects of the steel gas main installation because of the critical corrosion protection it provides to the gas mains.

A. Anode Installation

1. Magnesium Anodes (Sacrificial Anodes) shall be installed at the location or spaced center-to-center as indicated on the construction prints or Duke Energy Inspector. It is important to understand that when SWPC pipe is installed sacrificial anodes are a mandatory requirement unless a rectifier system is present. Refer to Gas Standard *7.5.3 - Magnesium Anode (3# To 50#) Installation For New Existing Steel Gas Pipelines*

CAUTION: Under no circumstances shall magnesium anodes be installed within 2 feet of a weld joint.

B. Insulating Joints

1. The Corrosion Engineer will determine the location of all insulated joints.

2. All insulating materials shall be cleaned and dried thoroughly before installation. Extreme care shall be exercised to insure that no electrical conducting path exists between the mating flanges.

3. The flange insulation shall be installed as shown on Gas Standard *7.6.2: Flanged Insulating Joint for Flat Face or Raised Face Flanges.*

4. Compression type insulating couplings shall be installed in accordance with the manufacturer's recommendations. Pipe ends and gaskets shall be thoroughly cleaned and dried. After installation, a thorough coating of pipe coating material, compatible with that on the adjacent pipe shall be used to protect the couplings.

5. Immediately after installation of each insulating joint, the completed joint shall be tested by a method approved by the Corrosion Engineer to ensure that no current conducting path exists across the joint.

6. The Contractor shall install a cathodic test wire on each side of the insulating joint that is to be buried. Test wires shall terminate inside the valve box or cathodic terminal box, whichever, is indicated in the construction drawings.

C. Coupling Bonds

1. Electrical shunts, known as coupling bonds, shall be installed across each compression type coupling except when armored or insulating gaskets are used to make up the joint.

2. Coupling bonds shall be formed by the Contractor from insulated copper wire. Connections to the pipe shall be made by thermite welding. Refer to Gas Standard *7.7.13 - Cathodic Protection Bonding of Coupling.*

3. After installation of the bond, the entire bond assembly shall be given two coats of an approved pipe coating for protection against galvanic action.

D. Test Connection Installations

1. The Contractor shall install test connections in accordance with Gas Standard *7.7.1 - Cathodic Protection Test Box Locations* at locations specified on the construction drawings or as indicated by the Purchaser's Inspector. The Design Engineer may specify that the loose end of the wire be placed in an existing valve or syphon box, in place of a separate box.

2. The cathodic protection test station shall be installed at the locations indicated on construction prints. It is important to understand that when SWPC pipe is installed, test stations/connections are a mandatory requirement with no exceptions. The following type of test stations/connections shall be installed in accordance with the following Duke Energy Gas Standards:

   a) Gas Standard *7.7.2 - Test Connection For Pipe Crossings*

   b) Gas Standard *7.7.4.1 - Above Grade Test Station For Transmission & Distribution Main*

   c) Gas Standard *7.7.4.2 - Grade Level in Sod Test Station for Transmission & Distribution Mains*

   d) Gas Standard *7.7.4.3 - Hard Paved Grade Test Station for Transmission & Distribution Mains*

CAUTION: Under no circumstances shall test station/connection be installed within 2 feet of a weld joint.

3. It is very important that the cad weld connection for test stations or magnesium anodes be coated. If the coating is not installed properly, the coating will disbond and create a cathodic shielding condition. The cathodic protection current is unable to penetrate the disbonded coating and corrosion shall take place even if the anode is within three (3) feet of the location. It is important to follow the manufacturer's surface preparation recommendation. Surface preparation is one of the most important factors in obtaining a great coating job.

4. The cad weld connections shall be coated in accordance with Gas Standard *7.8.3 - Installation of Handy Cap for Coating Cad Weld Connections.*

E. Coating Inspection

1. The Contractor shall furnish an approved electronic holiday detector (Jeep) for the purpose of locating defects in the pipe coating. All coating defects will be marked, repairs will be made and the pipe retested by the Contractor prior to lowering the pipe into the ditch.

2. The electronic holiday inspection should be performed in accordance with NACE RPO169-96, Section 5.22.3. Refer to the chart below for Holiday Inspection Instruments and Voltages based on pipe type.

3. Prior to lowering the pipeline, a detailed visual and electronic holiday inspection shall be performed on all construction projects where it is practical. On construction projects where it is not practical to perform an electronic holiday inspection, a detail visual inspection is satisfactory.

4. High voltage holiday detectors used for Coal Tar and Polyethylene Extruded Coat (X-Tru Coat) shall not be used for inspection of thin film coatings.

Mill Coated Pipe - Holiday Inspection Chart

Coating	Inspection	Voltage Setting	Suitable Instrument
Thin Film F.B. Epoxy	Jeep and/or Visual	1,500 – 2,000 Volts Maximum (100 Volts/Mil – 125 Volts/Mil)	Pipeline Inspection Model 700 or equal
Polyethylene Extruded Coat (X-Tru Coat)	Jeep and/or Visual	8,000 Volts	Pipeline Inspection Model 700 or equal
Wax	Jeep and/or Visual	10,000 – 12,000 Volts	Tinker Rasor Model E/P or E/4 pipeline Inspection Model 700 or equal
Coal Tar	Jeep and/or Visual	10,000 – 12,000 Volts	Tinker Rasor Model E/P or E/4 pipeline Inspection Model 700 or equal

F. Handling and Storage of Coating Materials

1. The Purchaser will supply all coating and wrapping materials, unless specified in the plans.

2. The Contractor shall supply his/her own application equipment.

3. Coating materials consigned to the job shall be properly stored and guarded against theft and damage. Pipe wrapping materials shall be protected from the elements.

4. The Contractor shall be responsible for the handling and utilization of coating materials in his/her possession, and shall reimburse the Purchaser for damaged materials. Coating and wrapping materials shall be handled in such a manner as to prevent damage to the packages. No packages shall be dropped or thrown from the trucks. The packages must not be handled with hooks. Refer to procedure GD02.903-2 *Coated Pipeline & Coating Materials Specification for Handling, Storage & Application* for handling and storing of coated pipe, and usage of coating materials.

5. All primers should be stirred before use, to prevent settlement of their components. Care must be taken to ensure that dirt or moisture does not contaminate the primer before or during application. Primers that continue to show settlement after stirring or are contaminated shall be properly discarded.

G. Field Coating

1. The Contractor shall clean the pipe and apply the pipe coating for field patching in all places on the pipe not mill coated, all places where connections have been made, and where the coating is damaged or defective. Refer to E – Coating Inspection in this section.

2. Materials used for the repair of coating defects shall include; wax compatible primer, wax tape, petrolatum tape heat shrink sleeve, hot melt patch compound, or epoxy coating.

3. Since contact of coating materials with the skin or eyes may be irritating, consideration should be given to the wearing of gloves, long sleeved shirts, and eye protection during application.

4. Prolonged breathing of fumes shall be avoided. Coatings should be applied from an upwind position. When applying coatings in poorly ventilated areas, the proper type of respirator shall be used.

5. The Contractor shall repair all coating defects found during the visual or electrical inspections.

H. Hot Melt Patch (3M Scotchkote Hot Melt Patch Compound 226P)

1. The repair of surfaces with less than two (2) square inches may be made by Hot Melt Patch Compounds, patching sticks or methods approved by Purchaser.

2. **<u>To ensure good adhesion</u>**, roughen the surface of the parent FBE coating using eighty (80) grit to one hundred twenty (120) grit sandpaper. Clean the surface and wipe away the sanding residue with a non-contaminating cloth.

3. Preheat the parent-coating surface using a non-contaminating heat source, such as portable hand-held propane torch. Heat should be applied in a manner that avoids burning or charring of the epoxy coating. Slight browning of the parent coating is

acceptable, but charring or blistering is not. Avoid heat application directly to the patchstick while prewarming the coating surface.

4. While continuing to heat the FBE surface, occasionally draw the patchstick across the repair area until it leaves a residue. Then rub the stick in a circular motion and utilize the torch to help melt it and maintain the pipe coating temperature. Continue until the patch is smooth and has a thickness of at least fifteen (15) mils greater than the parent coating.

5. Allow the patch to cool before handling.

I. Heat Shrink Sleeves

1. The joint coating over the regular butt weld pipe joints, at the option of Purchaser, shall be a heat shrinking expanded polyethylene sleeve or an epoxy coating.

2. The Contractor shall be required to furnish an approved type propane torch for the installation of heat shrinking expanded polyethylene sleeves as directed by Purchaser.

3. **The heat shrink material shall be installed in accordance with manufacturer's recommendations.** The pipe must be heated to temperature specified by manufacturer. Under no circumstances shall the heat shrink be installed on ambient temperature pipe.

J. Wax Tape Coating Application Procedure GD60.462 - *Applying Wax Tape Coatings for Below Ground Applications.*

1. Trenton #1 wax tape is now the preferred method for coating small sections of steel mains and steel fittings. Care must be given if this product is to be used in the vicinity of plastic pipe. Remove any primer that comes into contact with any plastic fitting/pipe with rag before backfilling the hole.

NOTE: **This coating is only to be used for below ground applications.**

2. Wire brush and scrape the surface clean of dirt, loose coating and loose rust. Insure proper PPE is used for this process.

3. Apply a thin film of Wax-Tape Primer. **If the surface is wet, cold or rusty, rub and press the primer to displace moisture to ensure adhesion. The temperature range for application is from 0^{0} F to 110^{0} Fahrenheit the use of gloves are recommended to reduce the possibility of cuts during installation.**

4. Wrap the Trenton #1Wax-Tape using a one (1) inch overlap. On straight pipe, apply slight tension to ensure contact with the surface. On irregular surfaces, allow slack so the tape can be molded into conformity. In either case, press and form the tape so

there are no air pockets or voids under the tape. Also, press and smooth out the lap seams to ensure they are sealed. To facilitate installation on couplings, it is recommended that small pieces of the wax tape be cut to cover the studs or bolts/nuts.

5. For below ground pipes that are located in rocky soils, the use of a rock shield or select backfill should be considered.

6. The tape does not require curing or drying time, so it can be backfilled immediately after installation.

K. Petrolatum Tape Coating Application (Densyl Tape)

1. Prepare surfaces by removing all loose scale, rust or other foreign matter in accordance to SSPC SP2 “Hand Tool Cleaning” or SP3 “Power Tool Cleaning” See Appendix “5-A”. A high pressure water wash of 3,000 - 7,000 psi is also suitable.

2. Apply a thin film of Denso Paste, which serves as a primer.

3. Wrap the tape in a spiral fashion with a minimum 1" overlap. For severely corrosive environments, a fifty-five (55) percent overlap is recommended.

4. While wrapping, press air pockets out and smooth all lap seams.

5. For additional mechanical protection, an overwrap may be used to increase impact strength and electrical resistance.

6. For irregular surfaces such as valves, flanges, use of Densyl Mastic or Denso Profiling Mastic or an approved liquid epoxy with the proper surface preparation.

L. Denso Protal (Epoxy)

1. The proper materials recommended by the manufacture must be used for blasting.

2. All surfaces to be coated shall be grit blasted to a near-white finish (SSPC SP-10 or NACE No. 2). Appendix “5-A”

NOTE: Near-white finish is interpreted to mean that all metal surfaces shall be blast cleaned to remove all dirt, mill scale, rust, corrosion products, oxides, paint and other foreign matter. Very light shadow, very light streaks or slight discolorations shall be acceptable; however, at least 95% of the surface shall have the uniform gray appearance of a white metal blast-cleaned surface.

3. Edges of the existing coating shall be roughened by power brushing or by sweep blasting the coating for a distance of one (1) inch minimum.

4. All contaminants shall be removed from the steel surface to be coated. Oil and grease should be removed in accordance with SSPC SP-1 using non-oily solvent cleaner (i.e. xylene, MEK, ethanol, etc.).

5. The Contractor shall check the surface profile depth by using a suitable surface profile gauge (e.g. Press-O-Film Gauge or equal).

6. Metal areas that develop flash rust due to exposure to rain or moisture shall be given a sweep blast to return them to their originally blasted condition before application.

   a) Application

      1) The surface shall have no condensation, precipitation or any other forms of contamination on the blasted surface prior to coating.

      2) The substrate temperature range for application of Protal is 50° to 185° Fahrenheit. The substrate temperature must be a minimum of 5°F above the dew point temperature before proceeding with the coating operation. Ambient temperature may be lower than 50°F if the substrate is heated. Preheating may be accomplished with a propane torch or induction coil prior to application.

      3) Protal shall be applied to the specified Dry Film Thickness (DFT) up to 40 mils using a brush, Denso applicator pad or roller. Wet film measurements shall be continuously performed to ensure close adherence to the thickness specification.

      4) <u>Mixing:</u> Make sure the part A (Resin) and Part B (Hardener) components match in both material and size as specified on the containers. Mix the B component first, independent of the resin. Pour the contents into the part A (Resin) component. Mix for approximately two (2) minutes until a uniform color is achieved making sure to scrape the bottom and sides of the container. Mixing should continue until there are no visible streaks showing in the mixture.

      5) <u>APPLICATION SHALL TAKE PLACE IMMEDIATELY AFTER MIXING.</u> Pour the product onto the surface and spread down and around the surface in bands beginning from the leading edge of the existing coating to as far under the pipe as can be reached. Overlap the bands onto the existing coating a minimum of one (1) inch. The person applying the mixture shall use a brush to smooth out any obvious sags or rough edges, valleys, or drips. Special attention shall be given to weld buttons and bottom surfaces.

      6) The thickness of Protal shall be checked periodically by a wet film gauge to insure the minimum wet film thickness specified. After the Protal has cured to a tack-free condition, the owner's representative and/or contractor's inspector should measure the film thickness by a magnetic gauge and notify the applicator of their acceptance. Notification to the applicator of any inadequately coated sections must be made immediately.

7) Over-coating, when necessary, shall take place within two (2) hours. The surface shall be roughed prior to application of the topcoat using 80 grit sand papers or by sand blasting.

b) Inspection/Testing For Backfill

1) The finished coating shall be generally smooth and free of protuberances or holidays. All surfaces shall have the required minimum Dry Film thickness. Inspection of hand application is best performed immediately after the application.

2) Backfill time shall be determined by the “thumb nail test.” The thumbnail test is defined when one can no longer make a permanent indentation in the coating with his or her thumbnail.

NOTE: A full and/or chemical cure may not be achieved by backfill time. Therefore, in wet soils the coating will need a full chemical cure.

3) An acceptable field-test to check to see if the coating has a full chemical cure, a solvent such as Xylen, MEK or Toluene can be rubbed on to the coating. If the gloss/sheen is removed, the coating is not fully cured.

4) Spark testing shall be performed to ensure proper film thickness and for holiday inspection.

a) The high voltage, or spark test method, can be used to test coatings up to 7.5mm (300mils) thick.

b) This method is ideal for inspecting pipelines and other protective coatings.

c) Coatings on concrete can also be tested this way.

d) This technique is suitable for locating various types of coating of flaws. **Care is required on thin coatings**.

e) A power supply generates a high DC voltage, which is connected to a suitable probe, and an earth return is connected to the substrate. As the probe is passed over the coated substrate, a flaw is indicated by a spark at the contact point which sets off the alarm.

f) The voltage used for testing weld joints and field applications shall be equal to that used for testing the mainline coating in the field not to exceed one-hundred (100) volts per mil or a maximum of two-thousand (2000) volts for the typical twenty (20) mil minimum requirements.

Appendix 5A

Surface Preparation Standards

A. Steel Structures Painting Council (SSPC)

1. SP-1 Solvent Cleaning
2. SP-2 Hand Tool Cleaning
3. SP-3 Power Tool Cleaning
4. SP-4 Flame Cleaning
5. SP-5 White Metal Blast Cleaning
6. SP-6 Commercial Blast Cleaning
7. SP-7 Brush-Off Blast Cleaning
8. SP-8 Pickling
9. SP-9 Weathering Followed By Blast Cleaning
10. SP-10 Near-White Blast Cleaning

B. National Association of Corrosion Engineers (NACE)

1. NACE 1 White Metal Blast Cleaning
2. NACE 2 Near-White Blast Cleaning
3. NACE 3 Commercial Blast Cleaning

C. Surface Preparation Standards – Definitions

<u>SSPC-SP-1</u> Solvent Cleaning - Removal of all detrimental foreign matter such as oil, grease, dirt, soil, salts, drawing and cutting compounds, and other contaminants from steel surfaces by the use of solvents, emulsions, cleaning compounds, steam or other similar materials and methods which involve a solvent or cleaning action.

<u>SSPC-SP-2</u> Hand Tool Cleaning - Removal of all rust scale, mill scale, loose rust and loose paint to the degree specified by hand wire brushing, hand sanding, hand scraping, hand chipping or other hand impact tools or by a combination of these methods. The substrate should have a faint metallic sheen and also be free of oil, grease, dust, soil, salts and other contaminants.

<u>SSPC-SP-3</u> Power Tool Cleaning - Removal of all rust scale, mill scale, loose paint, and loose rust to the degree specified by power wire brushes, power impact tools, power grinders, power sanders or by a combination of these methods. The substrate should have a pronounced metallic sheen and also be free of oil, grease, dirt, soil, salts and other contaminants. Surface should not be buffed or polished smooth.

<u>SSPC-SP-4</u> Flame Cleaning - Removal of all loose scale, rust and other detrimental foreign matter by passing high temperature, high velocity oxy-acetylene flames over the entire surface, followed by wire brushing. Surface should also be free of oil, grease, dirt, soil, salts and other contaminants.

SSPC-SP-5 (NACE 1) White Metal Blast Cleaning - Removal of all mill scale, rust, rust scale, paint or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels. A White Metal Blast Cleaned Surface Finish is defined as a surface with a gray-white, uniform metallic color, slightly roughened to form a suitable anchor pattern for coatings. The surface, when viewed without magnification, shall be free of all oil, grease, dirt, visible mill scale, rust, corrosion products, oxides, paint, or any other foreign matter.

SSPC-SP6 (NACE 3) Commercial Blast Cleaning - Removal of mill scale, rust, rust scale, paint or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree specified. A Commercial Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale and old paint have been completely removed except for slight shadows, streaks, or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain; if the surface is pitted, slight residues of rust or paint may be found in the bottom of pits; at least two-thirds of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues mentioned above.

SSPC-SP-7 Brush-Off Blast Cleaning - Removal of loose mill scale, loose rust, and loose paint, to the degree hereafter specified, by the impact of abrasives propelled through nozzles or by centrifugal wheels. It is not intended that the surface shall be free of all mill scale, rust, and paint. The remaining mill scale, rust, and paint should be tight and the surface should be sufficiently abraded to provide good adhesion and bonding of paint. A Brush-Off Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, rust scale, loose mill scale, loose rust and loose paint or coatings are removed completely but tight mill scale and tightly adhered rust, paint and coatings are permitted to remain provided that all mill scale and rust have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal fairly uniformly distributed over the entire surface.

SSPC-SP-8 Pickling - Removal of all mill scale, rust and rust scale by chemical reaction, or by electrolysis, or by both. It is intended that the pickled surface shall be completely free of all scale, rust, and foreign matter. Furthermore, the surface shall be free of unreacted or harmful acid or alkali, or smut.

SSPC-SP-9 Weathering Followed By Blast Cleaning - Weathering to remove all or part of the mill scale followed by one of the blast cleaning standards.

SSPC-SP-10 (NACE 2) Near-White Blast Cleaning - Removal of nearly all mill scale, rust, rust scale, paint, or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to the degree hereafter specified. A Near-White Blast Cleaned Surface Finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or light, tight residues of paint or coating that may remain. At least 95 percent of each square inch of surface area shall be free of all visible residues, and the remainder shall be limited to the light discoloration mentioned above.

SECTION 6 - INSTALLING PLASTIC PIPE

This specification covers the General Conditions and the Technical Requirements for the storage, handling, joining of plastic pipe and fittings, and the installation of plastic gas mains and associated appurtenances under the contract proposal or by using company construction forces. Mains and services covered by this specification will be used for the distribution of natural gas at a maximum pressure of sixty (60) psig. Piping covered by this specification is limited to a maximum nominal diameter of twelve (12) inches.

A. Materials

1. The Purchaser will furnish the plastic pipe, fittings, valves, and appurtenances.

2. The pipe and fittings will be made of polyethylene, conforming to the Duke Energy Procedure GD215 - *Specification Polyethylene Pipe & Fitting*.

3. The pipe will be made available in coils or straight lengths. Valves for use in plastic systems will be either metallic or plastic bodied. Refer to Gas Standard *2.16.1* - *Polyethylene Pipe & Tubing.*

B. Handling Plastic Pipe

1. Pipe trailers shall be required by the Contractor for handling coiled pipe.
2. The Purchaser will make every effort to have the large diameter coils delivered to the Contractor's material holding area at the start of each project. If the Purchaser is unable to make these arrangements, it shall be necessary for the large diameter coils to be picked up at Brecon by the Contractor. The Purchaser will pay the Contractor

for pickup and delivery in these cases. Refer to Gas Procedure GD60.250 - *Receiving, Handling and Storage of Polyethylene (PE) Materials.*

Coil Capacity Specifications

The coil dimensions of the current Performance Pipe (Driscopipe/Plexco) product that the trailer will need to be able to accommodate are:

Size	Coil Footage	Weight Per Coil	Minimum Coil ID	Maximum Coil OD	Width
2”	500’	315 lbs.	51”	78”	13”

3. Loading System – The trailer will need to have some form of loading mechanism in which the trailer can be field loaded from a Brecon material truck at the job site or loaded at the pipe yard at the Brecon facility. If the trailer does not have a loading mechanism, then the Contractor should make provisions to have the necessary equipment available to safely load the coils without damaging the pipe.

4. Re-rounding/Taming Equipment – The trailer will be equipped with the necessary equipment to re-round the coiled pipe and remove the curvature conditions created in the pipe by the coiling process. Pipe should be able to lie flat in a trench when straightening is complete as well as not to cause additional stresses to the pipe when inserting.

5. Polyethylene pipe can be easily handled with forklifts or hydro-cranes. When unloading or loading with a hydro-crane, use wide belly slings or a spreader bar with a fabric sling to prevent damage to the pipe. When lifting, axial bending of the pipe can be minimized by using a spreader bar, this technique also helps protect the pipe ends from damage.

6. Pipe coils or straight lengths must never be dropped or rolled from the truck or trailer bed. This is particularly important when unloading pipe in cold weather. At lower temperatures, the pipe is stiffer and more susceptible to damage from impact.

7. Polyethylene pipe, tubing, and fittings should be kept clean. They should be stored in their original packing until ready for use.

8. Care must be exercised at all times to protect polyethylene material from fire, excessive heat, or harmful chemicals. Prevent contact with cleaning solutions, solvents, alcohol, etc.

9. Storage areas will be clean, level, and free of rocks or any other object likely to damage the pipe. The polyethylene pipe and tubing will be supported in a manner as to prevent deformation of the material.

10. All fractured, kinked, buckled, deep gouged, cut pipe or pipe contaminated by exhaust, oil, or dirt will not be used. (An injurious gouge is defined as one who exceeds ten (10) percent of the minimum wall thickness for each pipe size).

C. Qualification of Joining Personnel

1. All personnel who perform joining of plastic pipe and fittings shall be qualified to federal and state code requirements, including but not limited to CFR Title 49, Subpart F: §192.285 Plastic Pipe.

2. A "Contractor Qualification Card" will be issued to the qualified applicant/contractor upon successful completion of all qualification tests. This card must be carried by the qualified applicant/contractor at all times when performing fusions for the Purchaser.

3. Only personnel trained and qualified in accordance with the Purchaser's written fusion procedures and carrying the Duke Energy's Contractor Qualification Card may perform fusions on plastic pipe and fittings. Re-qualification shall be conducted annually. Also, re-qualification is required if a person has a total of three (3) production joints that are found unacceptable during a 12 month period.

4. All qualification tests shall be performed with the fusion equipment that will be used in the construction of the future projects. All fusion equipment must be inspected and approved by the Purchaser before it can be used. All equipment must have a serial number or a tracking number stamped on it, this number shall be logged upon completion of all inspection tests.

5. The fusions required for qualification are: four (4) inch Butt Fusion, six (6) inch Butt Fusion, one (1) inch CTS Permaset Coupling, four (4) inch Electrofusion Coupling, four inch by one inch (4" X 1") CTS Electrofusion, Service Tee Fusion, one (1) inch Electrofusion Coupling, and any other plastic joining fitting as required.

6. All fusions shall be visually inspected by the qualified operator during and after joining. The new joint must be found to have the same appearance as a joint, or photographs of a joint, that is considered acceptable under that fusion process.

7. Each production joint test sample will be inspected by a destructive bend test.

8. Destructive bend testing shall be performed by a Purchaser approved qualified Inspector. Each test sample will be cut out of the pipe to be no less than one foot on each side of the fusion joint. It will be dissected longitudinally into one (1) foot wide strips. The strips will be deformed by bending. Any voids, discontinuities or failures in the fusion area will constitute a failed joint.

9. Only personnel trained and qualified in accordance with the Purchaser's written procedures may connect plastic pipe and steel using a posi-hold bolted coupling.

D. Joining Pipe, Tubing and Fittings

1. Plastic to plastic joints and the connection of plastic pipe/tubing to plastic fittings will be made by heat fusion, or polyethylene EF coupling. Only qualified personnel and equipment are permitted to join polyethylene pipe. **Connection of plastic to plastic with a metallic mechanical coupling is also prohibited.**

2. Butt fusion will be considered the primary method of joining longitudinal sections of main (See Gas Procedure GD60.776 *Joining Polyethylene Piping Systems by Butt Fusion Utilizing the MCELROY 14 & 26 Fusion Machine* & GD60.782-1 *Joining Polyethylene Pipe by Butt Fusion with McElroy No. 28 & 412 Butt Fusion Machine*). Rotary scrapers will be required when joining four (4) inch and larger pipe in the ditch. Electro-fusion may be used at the discretion of the onsite Inspector, See Gas Procedure GD60.779 *Joining Polyethylene Pipe, Tubing & Fittings by Electrofusion*.

3. Two couplings are required per Duke Energy Gas Standards when joining directionally drilled pipe. Personnel found joining pipe without the proper line up clamps and fusion equipment will have their fusion cards taken away. **NO SECOND CHANCES WILL BE GIVEN FOR TAKING SHORT CUTS WHEN JOINING PIPE.**

4. The Purchaser requires each fitting installed by a Contractor to be recorded on Duke Energy's construction print or Job Control Form. Approved electro-fusion clamps are required when making electro-fusion joints.

   Detailed procedures for joining plastic, pipe, tubing, and fittings are as follows:

   a) Butt Fusion ½" CTS-4" IPS (PE2406) *(*Refer to Gas Standard *2.17.1- Butt Fusion for Pipe, Tubing & Fittings McElroy Manual Fusion Machines (No. 14 or 4)*

   b) Electro-fusion Couplings and Reducers *(*Refer to Gas Standard *2.17.4 - Installation Of Couplings-Type Electrofusion Fittings*

   c) Electro-fusion Service Punch Tees (Refer to Gas Standard *2.17.5 - Installation & Tapping Of Saddle-Type Electrofusion Fittings*

   d) Butt Fusion 2"-8" IPS (Refer to Gas Standard *2.17.9* - *Butt Fusion for Pipe 2"-8" IPS Polyethylene Pipe and Fittings using McElroy No. 28 Fusion Unit*

6. Fusion equipment must be maintained in good condition and must be capable of producing sound joints when used in accordance with the manufacturer's instructions. Each piece of fusion equipment must be inspected and qualified by the Purchaser. Faulty equipment must be repaired or replaced.

7. Heater plates or adapters must be checked daily with a pyrometer for the correct surface temperature. The heater thermometer shall be used for reference only. Heater plates or adapters must be cleaned with a clean cotton cloth before making each joint.

8. All joints shall be inspected visually, and if there is any reason to believe that a joint is unacceptable, it shall be cut out and replaced.

   <u>IMPORTANT: WHEN IN DOUBT, CUT- IT OUT</u>

   Due to potential hazard of a failure, it is critical that all fusion joints are properly made. The Contractor's liability for any unacceptable fusion by visual examination or defect shall include the verification of the quality of all fusions on the specific project.

9. Production joints, selected by the Purchaser, may be cut out for testing by the Purchaser.

E. Transition Fittings and Mechanical Couplings

1. The connection between plastic pipe and steel pipe may be made with a Purchaser approved transition fitting *(*Reference Gas Standard *2.17.20 - Steel Pipe To Polyethylene Pipe Transition Fittings* or a posi-hold bolted coupling (reference Gas Standard *2.17.30 - Steel (S) Pipe To Polyethylene (PE Or Pl) Pipe Connection Utilizing An Ips Pull-Out Resistant Bolted Coupling.*

2. The transition fitting is a specialized mechanical fitting designed to provide a connection between plastic and steel systems. The fitting is a device consisting of a short length of coated steel pipe with a prefabricated connection to a short length of plastic pipe. The steel end is attached to the steel system by butt welding, by being welded to a flange, or prefabricated with a flange and connected to a flange. No other type of welding is allowed on the transition fitting. The plastic end is attached to the plastic system by heat fusion.

3. During the welding process, the transition connection and the plastic pipe must be protected from any excess heat generated. This is accomplished by wrapping the steel portion of the fitting with three turns of wet rags about two (2) feet from the area to be welded. Wrap additional wet cloths around the fitting. If more than three welding passes are needed to complete the joint, the weld should be allowed to cool for five minutes before continuing. **<u>DO NOT</u> <u>REMOVE</u>** the wet cloths and tape until at least ten (10) minutes after completing the weld.

4. The posi-hold bolted coupling is designed to provide for pullout resistance when properly installed. The steel pipe ends must be cleaned of the coating, oil, dirt, loose scale, and rust. On the plastic pipe end, the recommended insert stiffener must be installed. Only personnel qualified by the Purchaser may install mechanical couplings on plastic pipe.

5. Plastic pipe jointed to metallic pipe will be installed free of tension.

F. Valve Installations

1. Valve installation shall include valve, pressure stems, and valve box. *Refer to Gas Standard 2.6.5 Plastic Ball Valve Installation and 2.6.3 Plastic Main Pressure Stem Installation*.

2. All valves in plastic systems must be installed below grade and be equipped with supports and valve boxes. The valve box must not transmit traffic loads or other loads to the valve.

3. On large diameter valves, three (3) feet of cover on the main may be inadequate. Main elevation should taper down to the valve location providing clearance between the valve and valve box. This is especially critical on street improvement work where adequate clearance from the top of the valve to the bottom of the road sub-base is necessary.

4. All plastic valves that are installed will be butt fused. A minimum three (3) foot pup piece must be butt fused on each side of the valve to permit use of electro-fusion couplings. The application of cathodic protection materials and/or repairing the coating to a steel valve shall be included as part of the installation of the valve.

5. All valve assemblies must be supported on undisturbed or well compacted soil to limit stresses and strains to the plastic pipe.

6. The Purchaser reserves the right to add valves and appurtenances not shown on the drawings***. Payment will be bid price if available; otherwise, a change order will be required.***

G. Tracer Wire

Tracer wire shall be installed on all polyethylene (plastic) gas main and services to facilitate future location of the buried distribution piping. Refer to Gas Standard *2.18.20 - Tracer Wire Installation On Plastic Pipe – Main Line and Services).*

H. Installation Methods

Acceptable methods of gas main installation are direct bury, insertion, directional drilling, boring and in limited situations, pipe bursting or splitting. The main must be installed in accordance with the specified installation method as shown on the construction drawing unless an alternative method is submitted to and approved by the Duke Energy Design Engineer.

Plastic piping will **not** be installed above the ground, in a joint trench with sewer, in vaults, river crossings, near steam lines, hot water lines or any other source of heat, and under any structures such as buildings, patios, carports, or breezeways.

Plastic pipe may be installed on a bridge with Gas Engineering approval and provided that it is:

- Installed with protection from mechanical damage, such as installation in a metallic casing;
- Protected from ultraviolet radiation; and
- Not allowed to exceed the pipe temperature limits specified in §192.123.

1. Direct Bury

a) The trench bottom shall be continuous, relatively smooth, and free of rock. Plastic piping shall be installed in such a way that shear, tensile, or compressive stresses resulting from construction, backfill, thermal contraction, or external loading are minimized.

b) Sufficient clearance, not less than two (2) feet, shall be maintained between the plastic piping and any sources of heat, such as steam, hot water, and foreign direct buried primary cables, to prevent the temperature of the plastic pipe from exceeding one-hundred forty (140) degrees Fahrenheit Changes in direction will be made with fusion elbows where the minimum bending radius of the plastic pipe must be exceeded. No fittings are permitted within three (3) feet of a bend.

c) The Contractor shall remove liquids from the bottom of the trench before the main is lowered in. Precautions shall be taken to prevent floating of the main, draining of water into the main, and the caving of trenches.

d) All trenches shall be visually inspected for sewer or septic facility damage. Visual inspection shall include examining both the trench and spoil for evidence of damage to sewer and septic facilities.

e) The main shall be laid to the established grade with the pipe resting directly on the bottom of the trench or undisturbed soil.

f) In the event of excessive rainfall and subsequent bad working conditions, the Purchaser may require the Contractor to postpone all operations until such time as the work can progress without excessive property damage.

g) The width of the trench at any point below the top of the pipe shall be sufficient to provide adequate room for filling and compacting the side fills. Minimum trench width may be utilized by joining the pipe outside the trench and lowering into the trench after adequate joint strength has been obtained. Care shall be exercised to prevent gouging and strain which may buckle or over-stress the pipe or joints.

h) The plastic gas main shall be installed with the amount of cover listed on the “issued” drawing.

i) Plastic pipe is flexible and will bend to conform to the trench lines. Excessive bending must be avoided. Do not exceed the minimum bending radius for plastic pipe. Refer to Gas Standard *2.18.10 - Polyethylene Pipe Bending Specifications.*

j) Mitered joints along with cut or altered fittings are prohibited.

k) When long sections of piping that have been assembled alongside the trench are lowered, care will be taken to avoid any strains which may over stress or buckle the piping or impose excessive stress on the joints.

l) Plastic pipe shall be laid and continuously supported on undisturbed or well-compacted soil to minimize shear stresses. It shall not be supported by blocking. The side fills must be compacted to help prevent the plastic pipe from being crushed, buckled, or deflected. Branch connections will be made using butt fusion tees, or other suitable fittings, approved by the Purchaser and specifically designed for that purpose.

m) The ends of the joined pipe or tubing will be closed water tight except while work is being done on that end.

n) In existing areas, the minimum vertical separation of any foreign utility including water and sewer piping and plastic piping shall be eighteen (18) inches in Butler County, Ohio and twelve (12) inches in all other areas, unless approval from Gas Engineering is given.

o) Plastic pipe will not be used to cross streams where buoyancy or crushing is a potential problem. The pipe shall be installed five (5) feet below the firm or established bed of the stream. All stream crossings must be protected from physical damage and flotation. Refer to Gas Standard *2.18.2 - Typical Stream Crossing Detail Polyethylene Pipe.*

2. <u>Directional Drilling</u>

a) Directional drilling is an accepted method for pipe installation and must comply with all the guidelines set forth in this specification. In cases where the contractor would like to directional drill instead of direct bury or the design calls for directional drill, the approval by the Gas Engineering Sponsor will be required if any of the following occurs: rocky conditions, parallel 3rd party utility within three (3) feet, a City of Cincinnati curb is within three (3) feet, or any Metropolitan Sewer or Clermont County Water or Sewer is within five (5) feet. Refer to Gas Standard *2.18.43 - Weak Links for Pulling Polyethylene Pipe During Insertion and Boring Operations).*

b) The Gas Engineering Sponsor must approve directional drilling of any standard pressure main.

c) Directional drilling will require a profile indicating the location and depth such that appropriate data can be placed on the mapping system. The profile must be in the form of marking depths on the plan sheet approximately every fifty (50) feet.

d) Spot holes or locate holes for 3rd party utilities, under hard pavement for directional drill bores should be done with a vacuum truck to eliminate four (4) feet x two (2) feet restoration holes. The City of Cincinnati does require a one (1) foot cut back for small restoration areas.

e) The location and depth of all sewer mains, laterals and drain lines shall be determined and documented prior to drilling gas main to ensure there is no conflict between the proposed gas main and the existing sewer. A plan for locating sewer mains, laterals and drain lines must be submitted to Duke Energy and approved prior to the Contractor performing any drill work.

f) Acceptable methods for locating the mains, laterals and drain lines are using a camera or physically uncovering the mains, laterals and drain lines. If the Contractor chooses to use the camera method, it is required to:

   a) Determine the location and depth of the sewer mains, laterals and drain lines before drilling begins; and
   b) Confirm after the installation of gas facilities that no breach has occurred.

g) Sewer clean-outs may be installed on a case by case situation and acceptance will be determined by a Duke Energy representative. The Contractor must install a sewer tag on every clean out if the main or any portion of the service is installed by trenchless technology. Duke Energy will provide the tags.

h) When directionally boring on replacements or main extensions, one test hole for every one-hundred fifty (150) feet of bore will be required to verify location and depth of the facility.

3. Joint Trench

a) Plastic pipe and fittings may be installed with up to three (3) other utilities in a common trench, referred to as joint trench construction. In all cases there shall be a 6-inch separation between the plastic main and any other utility line. Refer to Gas Standard *2.18.3 - Joint Electric, Gas, Telephone And Catv Installation.*

b) The area between the gas main and other utilities shall be compacted bank run (with some rounded stone) or sand to ensure the continual required separation. Bank run, sand and spoil shall be compacted in accordance with Section 7 "Backfill" of this procedure or permitting agencies requirements. Vibratory compaction equipment is approved for use over plastic pipe. Impact compaction equipment is **not** approved for use over plastic pipe.

c) Rolling and grading shall be used to consolidate final backfill when the joint trench is outside the street rights of way.

4. <u>Boring for Casing (KDOT)</u>

a) The Contractor shall provide all necessary equipment to bore roadways and/or driveways in accordance with the Purchaser's construction drawings and specifications.

b) Jacking may be permitted with the agreement of the Design Engineer. All damaged main must be removed and must not be used. Any damaged coating must be repaired before acceptance. The Purchaser assumes no responsibility for failed attempts.

c) "Boring-With Casing" includes all excavation, hand or otherwise, required for placing the casing inside the bore including the bore pit. The bore is to be installed per design at the designated depth. The new casing must be positioned in such a fashion that no additional fittings will be required on the new main and that there will be no undue stress placed on the new main when installed. All casing joints must be welded per Duke Energy's welding standards to prevent water from entering the casing.

d) Casings:

1) In locations where metallic casings are required, the casing must be reamed and cleaned to the extent necessary to remove any sharp edges, projections, dust, welding slag, or abrasive material which could damage the plastic pipe during and after insertion.

2) Plastic pipe or tubing shall be inserted into the casing pipe in such a manner as to protect the plastic during the installation. Pushing the pipe in is preferred to pulling it in to prevent excessive tensile loading. When pulling, a weak link must be used. The leading end of the plastic must be closed water tight before insertion.

3) A protective inner sleeve will be used to prevent the plastic pipe from bearing on the end of the metallic casing. After insertion, the ends of all casings will be closed off with closed cell foam material or duct seal to prevent water and backfill material from accumulating in the casing.

4) Any portion of plastic pipe which spans disturbed earth must be protected by bridging, by compaction of the soil under the plastic pipe or by other means to prevent the settling of the backfill from shearing the plastic pipe.

5) Any portion of plastic pipe unsupported due to the removal of a section of the casing pipe must be supported with bridging or other means, so as to withstand the anticipated external soil loading.

e) Driving of pipe will not be permitted.

f) Tunneling shall be done only upon agreement with the Purchaser or where required by and in a manner as specified by the Purchaser or public authorities. The Contractor shall provide all adequate shoring for trenches and boxing for tunnels where necessary upon agreement with the Purchaser. The Contractor must have a competent person on site to ensure OSHA Shoring Regulations are being followed. Refer to Gas Standard *Section 12: Excavations*.

5. <u>Boring for Plastic Pipe</u>

a) The borehole size must be at least the next pipe diameter larger than the pipe size being installed.

b) When using a mechanical assist to pull plastic pipe through a bore hole, a “weak link” must be used between the pulling head and the pipe being pulled to protect the pipe from being over-stressed. Refer to Gas Standard *2.18.43: Weak Links for Pulling Polyethylene Pipe During Insertion And Boring Operations*. The Contractor must provide specifications to the Inspector when using a mechanical weak link.

c) A section of pipe will be brought beyond the exit hole and investigated for possible damage.

d) The borehole will not be used any time that the bore causes the pavement to hump.

e) Before a main is installed by boring or directional drilling, the location and depth of all existing utilities and sewer laterals must be determined. A plan showing the location of existing sewer laterals must be submitted to the Purchaser and approved prior to the Contractor performing any directional drill work. Acceptable methods for locating the existing sewer laterals are by camera/sonde or by physically uncovering the lateral.

f) All bores shall be installed per depth listed on the “issued” drawing. If the depth is not listed, it must be assumed that a cover of 3 feet will be required.

g) All bores must be installed within +/-one (1) foot horizontally of the designed location unless waivers are authorized in writing by the Design Engineer.

6. <u>Installation by “Insertion”</u>

a) Insertion projects will require all customers to be back in service the same day.

b) When using a mechanical assist to pull new plastic pipe through an existing main, a “weak link” must be used between the pulling head and the pipe being pulled to protect the pipe from being over-stressed. Refer to Gas Standard *2.18.43 - Pulling Plastic pipe During Insertion and Boring)*. The Contractor must provide specifications to the Inspector when using a mechanical weak link.

c. Pipelines will be leak surveyed by the on-site Inspector in accordance with the Purchaser's standards.

d. The removal of segments of pipe associated with insertion and service reconnection activities must be removed from the job site and disposed of in an approved landfill.

SECTION 7 - MAIN & SERVICE TIE-INS

Section A Contractor Responsibility

Section B Service Installations

Section C Main-to-Curb (M-C) Service

Section D Curb-to-Meter C-M) Service

Section E Curb-to-Meter Service Trenchless Technology Waiver

Section F Test & Relight

Appendix 7A One-Half Inch (½") Service Data Sheet

A. Contractor Responsibility

1. Duke Energy intends to perform all tie-ins with Duke Energy crews; however the Contractor may be required to perform tie-ins in certain situations. This shall require the installation and tapping of TD Williamson fittings, squeezing polyethylene mains and installing the appropriate saddles and making appropriate taps for connecting to cast iron mains. The Contractor shall be required to have the proper TD Williamson equipment, guillotine saws, pressure gages and pertinent equipment necessary to tie into 2 through 6 inch steel mains. All Contractors are required to have squeeze off equipment, pressure gages and pertinent equipment necessary to tie in 2 through 8 inch polyethylene and stopper bags for tying into two (2) through twelve (12) inch cast iron.

2. The tie-in shall include the preparation of any and all by-pass requirements, the installation of fittings, such as TD Williamson, excavation, preparing cast iron mains by installing appropriate saddles and making appropriate taps in accordance with the Purchaser's standards. The Contractor shall be responsible for the abandonment of

the existing facilities, including purging and sealing the ends in accordance with the Purchaser's standards.

3. It shall be the responsibility of the Contractor to meet with the Inspector, prior to scheduling any tie-in work, to discuss the equipment and personnel necessary to perform the work. The Purchaser will provide pressure crews to assist on the tie-in and purging activities.

4. The time associated with separating the existing gas facilities and reconnecting to the new main will be paid on an hourly basis. Flag-persons, arrow-boards, and plates required for tie in work will be paid on a time and material basis. Duke Energy reserves the right to allocate work to company personnel at any time to provide assistance with the tie-ins, to insure completion in a timely manner.

5. Wipe tests will be performed by Duke Energy. If the contractor sees any liquid concentrate, the onsite inspector must be notified. Removal of any gas main, service line or houseline piping must be disposed of in a designated Duke Energy container. If not disposed of immediately, it must be protected from the weather until it is disposed of in the designated Duke Energy container.

B. Service Installations

NOTE: The Gas <u>Contractor shall be required to renew customer services from the gas main to the customer's service meter, as needed</u>. Customer service lines are broken into two segments:

- The main-to-curb cock (M-C) portion, and
- The curb cock-to-gas meter (C-M) portion.

1. The Purchaser will provide training to the Contractor on the renewal of services by insertion and direct bury installation of meter sets, turn off, turn on and appliance light up. The Contractor shall be required to review company policies associated with spotting unacceptable meter locations and the identification of tin meters and mercury regulators. Safety procedures, grounding procedures and a review for sizing services will also be provided at the training session. There will be no charge to the Contractor for this training.

2. The Contractor may be required to renew services main-to-curb and curb-to-meter.

3. On all work when the main is replaced, the metallic (steel and copper) residential curb-to-meter services will be renewed.

4. Services that are polyethylene and pass the required pressure test will not be renewed and will be reconnected to the new main.

5. The minimum depth of services on customer owned property is 18 inches. The minimum depth on street right of way is the depth of the main or the local governmental requirements, whichever is greater.

6. The Gas Contractor is required to complete all associated Job Completion Forms (JCF's) with the service work. The completion of the JCF's is required within one day of the completion of the service work. JCF's which are not filled out correctly will be returned to the contractor for correction.

7. Gas meters may be relocated to the outside if the services or meters are found in an unacceptable location.

8. The Contractor may be required to rebuild the customer's meter sets associated with the renewal of curb-to-meter services along with associated meter and riser brackets.

9. The Contractor shall also be required to turn off and to re-light customer appliances in accordance with the planned replacement work and the Purchaser's approved procedures.

    a) The Contractor must contact the Inspector whenever any appliances are found to be unacceptable. Bad appliances will be referred to the Purchaser's Service Delivery Department and red tagged. The Purchaser will deal with the customer.

C. Main-to-Curb (M-C) Service

1. The main-to-curb service replacements shall include excavating at the curb valve for reconnecting to the curb-to-meter portion of the service, and installing weld-o-let, service tee, excess flow valve when required (Reference Gas Standard 3.8.1 – *Excess Flow Valves*), service piping, curb cock, cap, setting of the curb box to grade, air test, soft restoration and C-M tie-in.

2. Main-to-Curb services will be classified as either short-side M-C or long-side M-C. M-C short side services are less than fifteen (15) feet in length, regardless of the installation conditions. M-C long side services are fifteen (15) feet or longer in length and usually cross under roadways. It is possible to have all long side (crossover) services on a project. The M-C portion of the service lines must be installed at the depth of the main or as specified in street right of way or at the depth required by the local governmental agency, whichever is greater. Street improvement plans typically contain cross section sheets which should be used to determine the depth of services. If cross section sheets are not included on the available prints, it shall be the Contractor's responsibility to request the sheets from the Design Engineer before the installation of any services.

3. The use of split duck for shear protection on the electrofusion tee outlet has been discontinued. The service pipe shall be installed with a smooth, gradual transition from the service tee to the required service installation depth. Sudden elevation changes in the service pipe overstress the service tee and can cause it to fracture over time.

4. On some projects, it may be possible to reconnect the existing M-C service to the new gas main if the service is non-metallic and if the service passes the required pressure test.

5. All personnel must be trained and qualified in accordance with the Purchaser's procedures to connect service curb cocks.

6. Curb cocks should not be installed in the sidewalk without the inspectors' approval prior to installation.

7. All service holes located outside the pavement area are to be covered with three-quarter (¾) inch plywood with flasher barricades or snow fencing while left open and unattended.

8. When encountering a gas street lamp, the service to this will be considered M-C only and the actual connection to the lamp will be done by the Cincinnati Gas Light Company or other Duke Energy selected contractor.

D. Curb-to-Meter (C-M) Service

1. Curb-to-Meter service replacements shall include turning on and off appliances, separating existing facilities for testing, excavating, air testing, rebuilding of the meter set (including setting a new meter bracket and replacement of the meter as required), and re-lighting the customer appliances.

2. Renewed C-M service lines shall be installed at a minimum depth of eighteen (18) inches on customer owned property. Gas Contractors are to gas track their own service work, which includes all inside and outside meter sets in addition to soap testing. The inspection must be done by someone other than the installer. Every C-M service renewal or meter replacement must be gas tracked the same day it is installed. No leaks will be tolerated on inside meter sets, cards will be pulled as a consequence of not adhering to this requirement.

3. When renewing a C-M service by insertion, tracer wire must be attached from the curb cock to the street end of the casing and from the house end of the casing to the riser. This will facilitate locating of C-M services in the field.

   a) "Conversion" projects – where the C-M portion of the service is inserted and <u>has a metallic curb cock:</u>

      i. A tracer wire must be attached to the parent metal of the original service pipe and run up in the curb box.

      ii. At the riser, tracer wire is to be attached to the parent metal of the original service and the other end attached to the riser bracket.

b) "Conversion" projects – where the C-M portion of the service is inserted and <u>is not in a straight line with the meter and has a plastic curb cock:</u>

i. A tracer wire must be attached to the parent metal of the original service pipe and run up in the curb box.

ii. At the riser, tracer wire is to be attached to the parent metal of the original service and the other end attached to the riser bracket.

4. "Conversion" projects where gas services must be converted from standard pressure to intermediate or high pressure will require the installation of regulators, vent piping and the possible removal of orifices.

5. "Replacement" projects where gas services must be converted from standard pressure to intermediate or high pressure will require the installation of regulators and vent piping.

6. If old style regulators with three-quarter (¾) inch vents are encountered, they shall be replaced with a new regulator (one (1) inch vent). The new one (1) inch vent pipe shall not be reduced to with three-quarter (¾) inch.

7. **Curb-to-Meter services that are polyethylene and pass the required pressure test <u>will not</u> be renewed**.

8. The Gas Contractor shall be required to replace tin meters and regulators associated with the renewal of curb-to-meter services. Duke Energy will train Contractor's employees at Duke Energy's cost on the policies associated with spotting unacceptable meter and house service line locations and the identification of tin meters and mercury regulators. Only Duke Energy personnel shall handle mercury regulators. Actual removal will require a forty-eight (48) hour notice before the removal can begin.

9. If the household service lines or meters are found in an unacceptable location, the meters may be relocated to the outside.

10. When moving remote meters to the outside of a building, the Contractor must reuse the existing meter and reattach the remote reader and verify that reads of the meter and the remote are the same. In Ohio, when moving meters outside, make sure to replace any non-temperature compensated meters with a temperature compensated meter.

NOTE: In Kentucky, a temperature compensated meter will be installed during the meter age change process.

11. The only approved methods of installation for C-M's without the acquisition of a waiver are direct bury and insertion. In the event that circumstances prevent installation by one of these two pre-approved methods, a waiver requesting a variance to install all or

part of the C-M service via a trenchless technology must be requested from the Duke Energy Construction Supervisor. The contractor must obtain a signed copy of the waiver prior to renewing the service utilizing trenchless technology.

12. Large Service Renewal – The renewal of services two (2) inch and larger shall include turning on and off appliances, separating existing facilities for testing, excavating, air testing, rebuilding of the meter set (including setting a new meter bracket and replacement of the meter as directed by the Gas Inspector), and re-lighting the customer appliances.

13. Service Risers through retaining walls – Several communities have expressed concerns with service risers through walls (generally concrete retaining walls next to sidewalks). Any drilling of the C-M portion of the gas service through walls will require a waiver. All efforts should be made to install a C-M service under retaining walls. When this is not possible, contact needs to be made with the homeowner to grant permission to drill through the wall. No hole will be drilled in a retaining wall without the knowledge of the homeowner. For unusual situations, a waiver may be granted to bore under the wall. Listed below are the preferred options for walls six (6) feet and less in height:

    a) Insert a one (1) inch PL service through the existing gas service, as long as the existing service is below ground.

    b) For use on IP pressure systems and greater, insert a one-half (½) inch PL service C-M through the existing gas service, as long as the existing service is below ground. This option must be approved by the Duke Energy Gas Inspector. Refer to Appendix “7 - A” for guidelines and load requirements.

    c) Drill a 1 inch PL service C-M under the wall. This may require digging a hole two (2) feet below the ground level on the customer side of the wall and shooting a missile under the wall.

    d) As a last resort, hang the riser on the retaining wall and move the gas meter outside of the building, except in the City of Cincinnati where notification to the Job Sponsor must be made before any work is begun.

E. Curb-to-meter (C-M) Service Trenchless Technology Waiver

1. The Contractor must notify the Duke Engineering representative at least 1 day prior to requiring the waiver. All underground drains and utilities must be either exposed or traced and marked prior to the arrival of the Duke Energy Representative.

2. Those drains that were not exposed will require a pre-bore locate as well as a post-bore video camera inspection as directed by the Gas Engineering representative. The house address should be included on the video and marked on the DVD itself with light scribe. See Section 10 - <u>Sewer Location and Breach Prevention</u> for greater detail.

3. The contractor's representative, who is responsible for locating and videotaping the underground drains, shall be required to sign his/her name on Duke Engineering's inspection document indicating they did what was required to protect the property owner's sewers and underground drains.

F. Test & Relight

1. The Test & Re-Light work includes turning on and off the gas service, separating existing facilities for testing, air testing, re-connecting the meter set, and re-lighting the customer appliances according to Duke Energy approved procedures.

2. Old Normac or Rob Roy flexible risers shall be replaced with a new flexible riser before the pressure test and then relit after a successful pressure test.

APPENDIX 7A

One-Half Inch (½") SERVICE DATA SHEET

One-Half Inch (1/2") Plastic Service Renewal Intermediate Pressure (IP)

CAUTION: When using one-half (½) inch service the customer loads must be obtained in order to determine if the pipe is large enough.

The table below shows the maximum load allowable for a one-half (½) inch service at given lengths. Gas Engineering recommends that the total length of one-half (½) inch pipe not exceed 100 feet. Equivalent footage for fittings is included. The length in the table will correspond with the actual field measurement. This table reflects a slightly larger than one-half (½) psi pressure drop.

Service Length in Feet	Maximum Load in CFH	Maximum Load in BTU / Hour
20	320	320,000
30	275	275,000
40	250	250,000
50	225	225,000
60	205	205,000
70	190	190,000
80	180	180,000
90	170	170,000
100	160	160,000

<u>SPECIFICATION</u> FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150

SECTION 8 - BACKFILL

Section A - Backfill Requirements

Section B - Backfill Compaction

A. Backfill Requirements

1. Backfilling shall be done as soon as possible after the pipe has been placed in the trench **and in such a manner as not to damage the pipe or coating**.

2. The preferred method of backfilling shall be by using compacted excavated material from the trench provided such material consists of finely divided top soil, sand, or gravel. Back fill material must be free from organic matter, slag, cinders, frozen lumps, or debris; and, in the opinion of the Purchaser, is suitable for back filling.

3. The spoil removed from the excavation of a plastic main installation may be used as back fill material provided that it contains no stone greater than ½ inch in diameter. If it contains stone greater than one-half (½) inch but less than 6 inches in diameter, at least 6 inches of bank run or sand must be placed over the plastic pipe before backfilling with the spoil.

4. The trench shall be backfilled with an approved material thoroughly compacted to a depth of one (1) foot above the top of the pipe.

5. **Excavated rocks or stones with any dimension greater than 6 inches must not be returned to the trench.**

6. The backfill shall then be completed to grade, using the excavated material. Excavated material, which is not suitable for backfilling, shall be disposed of by the Contractor at the Contractor's expense and replaced with bank run, gravel or sand, at the price specified in the bid.

7. The Contractor's quoted price for main installation shall provide for back filling the trench with the material that was removed while excavating and the compaction of backfill using the proper compaction procedures. The Contractor shall be responsible for the condition of the trench and shall indemnify the Purchaser against damages resulting from improper backfill.

8. Padding shall be used at the discretion of the Inspector and/or Engineer. Padding is defined as bank run placed below and above the pipe and will be used in soils unsuitable for back fill. Bank run gravel shall be per ODOT <u>703.11</u> Ohio type 2 as listed in ODOT's "Construction Material Specification" or clean washed sand.

9. When rock, ledge, hardpan, or boulder is encountered, the trench bottom shall be undercut at least four (4) inches and the undercut refilled with a pad of clean spoil,

good-bearing bank run (with some rounded stone), or sand. Refer to Gas Standard 2.18.1 *Typical Trench Details – Polyethylene Pipe*.

10. When ledge rock or hardpan is encountered during the construction of plastic main installation, at least twelve (12) inches of bank run or sand must be placed over the plastic pipe. The side fills must be compacted to prevent the plastic pipe from being in contact with the rocky trench walls.

    a) Back filling shall be done in accordance with the rules of the governing agency responsible for the area where work is taking place, within the limits of all public or private roads and driveways.

    b) CLSM must be used as required within the hard surface areas by the appropriate governmental agency or as directed by Duke Energy. CDF, CLSM or Flash Fill must meet the specifications of the appropriate governing agency (Hamilton Co. /Cincinnati, ODOT or KDOT specifications).

11. The Contractor shall delay the back filling operations in cases where live connections will be made by the Purchaser soon after pipe installation has been completed. However, the Contractor shall be required to take the necessary measures to insure the stability of the open ditch (by shoring, etc.) until such time as the Purchaser moves on to complete the project. Should the Contractor complete all other phases of the work and leave the job site before the Purchaser's connections are made, the Purchaser will assume the responsibility of backfilling at these locations.

12. When backfilling in sod areas, the gas main, service tee and stop cock shall be covered with sand before backfilling the remainder of the excavation with the removed spoil. The service pipe shall be installed with a smooth, gradual transition from the service tee to the required service installation depth. Sudden elevation changes in the service pipe overstress the service tee and can cause it to fracture over time.

13. When backfilling in roadways on:

    a) **Two (2) inch – six (6) inch** pipe, the gas main and service tee shall be covered with sand before backfilling the remainder of the excavation with the permit required backfill material. Sand shall be placed to a height of 6" above the pipe.

    b) **Eight (8) inch and twelve (12) inch** pipe, the excavation will be filled with permit required backfill material and **<u>not</u>** padded with sand to avoid settlement. If the required backfill is CLSM and the fill is over an extended length, placing sand over the main in a few locations may be required to prevent the main from "floating".

B. Backfill Compaction

1. Backfill Compaction" shall be defined as compaction by means of air tools, hand tools or machine tamping.

2. The Contractor is responsible for the pipe or casing he damages through backfilling operations. The Contractor shall be responsible for all necessary repairs and replacement due to said damages.

3. When crossing lawns, the back fill shall be thoroughly compacted to minimize future settlement. The top twelve (12) inches of backfill shall be shredded topsoil if sand backfill is used. The backfill shall be neatly rounded over the trench to a height sufficient to allow for settlement to grade after consolidation. The Contractor shall be responsible for the condition of the trench until consolidation has occurred, and shall indemnify the Purchaser against damages resulting from improper back fill.

4. If the back fill is to be **hand tamped** it shall be compacted in horizontal layers not exceeding four inches in depth.

5. Vibratory compaction equipment is approved for use over plastic pipe. Impact compaction equipment is not approved for use over plastic pipe.

6. <u>Low Energy Compactors under four-thousand (4,000) Feet - Pounds</u>
   Back fill material shall be placed and compacted in uniform horizontal layers not exceeding six (6) inches in thickness, loose measurement. Each layer shall be compacted by means of approved mechanical tampers. Successive blows of the tamper shall overlap no less than one-fourth of the width of the tamper head. Each layer shall be dampened when necessary to ensure the maximum density obtainable, or as directed.

7. <u>High Energy Compactors Over four-thousand (4,000) to thirteen-thousand (13,000) Feet - Pounds</u>
   Back fill material shall be placed in such a manner that the first layer, loose measurement, will provide a two (2) foot – six (6) inches over above the pipe. After compaction of the first layer, each additional layer shall be compacted in uniform layers of twelve (12) inches, loose measurement.

8. Unless otherwise directed, trench compaction using select excavated spoils, shall meet the following minimum compaction requirements:

Trench Soil Compaction	
Maximum Lab. Dry Weight	**Minimum Compaction Requirements***
Pounds / Cubic Feet	**% Lab. Max**

90 - 104.9	98% of Standard
105 - 119.9	95% of Standard
120 & More	90% of Standard

Soils with a maximum dry weight of less than ninety (90) pounds per cubic foot are considered unsuitable for use as back fill materials. *Measured at one-half (½) depth of the fill.

9. Extreme care will be taken to ensure that the back fill material is adequately compacted both underneath and around gas pipe and fittings to prevent excessive stress and shearing forces. Hand tamp around fittings where mechanical compaction cannot be used.

10. In the event that subsequent settlement occurs, the Contractor shall make the necessary repairs to the ditch at his/her expense.

11. Where the pipeline passes under main line sewers or culverts, and the installation was done by tunneling, the backfill material shall be controlled density fill or as directed by the Purchaser.

12. On slopes, the Contractor may be instructed to install a silt fence, field stone, rip rap, sandbags, water diversion terraces, or other surface treatments as directed by the Purchaser, to minimize washing of the trench.

13. Granular material may act as a trench drain and attract long term seepage where glacial outwash or wet zones within bedrock are penetrated. Outlet drainage must be provided consistent with the specific topography. A four (4) inch perforated drain pipe must be installed at the direction of the Inspector with the granular material and run to daylight where practical.

14. The Contractor shall spread excess dirt across the right-of-way when requested by the landowner.

SECTION 9 - RESTORATION

Section A - Restoration Requirements

Appendix 9A - City Of Covington Restoration Ordinance

Appendix 9B - City Of Cincinnati Notes

<u>SPECIFICATION</u> FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150

A. Restoration Requirements

1. All surface, subsurface structures and improved areas shall be restored by the Contractor to a condition at least equivalent to that prior to construction.

    a) Clean up and restoration on all projects must be in compliance with local governmental agency requirements and must be approved by the Duke Energy inspector.

2. The Purchaser's Gas Standards 2.14.0 *Paving Definitions & Descriptions* through Gas Standard 2.14.23 *Restoration & Backfill Section For Excavation Made In Warren County* is a general restoration guide for the Contractors. The Contractor shall supply all labor, machinery, tools, appliances, equipment and materials necessary to restore the various types of improved surfaces.

3. Areas which do not have comprehensive rules and regulations governing the opening and restoring of public ways shall be made in accordance with the appropriate Engineering Standards as determined by the Purchaser.

4. Where permitted, all surfaces shall be permanently restored immediately after adequate consolidation of the backfill has taken place. The Contractor may be required to provide and maintain a temporary surface until permanent restoration is made. Projects requiring the reconnection of customer service lines to the new facilities (replacement projects) will require permanent restoration to be completed after the service work are completed. This work must be coordinated with the Purchaser.

5. Surface restoration shall be made to the satisfaction of the inspector/responsible government agency.

6. The Contractor shall properly dispose of all construction debris and leave the working area in a clean condition.

7. Ditches disturbed during construction shall be restored promptly and graded for proper drainage.

8. The Contractor shall grade, remove large surface rock, seed and straw the work area with a seed mixture acceptable to the property owner or public authority having jurisdiction.

9. The Contractor agrees to answer all customer restoration complaints immediately upon receiving notice from the Purchaser.

10. All final soft restoration, seed and straw, shall be included in the length of main installed. Twelve (12) inches of topsoil will be required if granular material is used as a backfill. The Contractor shall be required to hydro-seed all soft areas, except when

Duke Energy or a governing agency Inspector instructs the contractor to seed and straw based on weather conditions. Topsoil is a separate bid item.

11. Pavement marking restoration will be required after performing the hard surface restoration unless otherwise specified by the Duke Energy.

12. Traffic loop restoration shall be the responsibility of the contractor.

13. Curb ramps may be required at the intersections of streets.

14. All tie-in areas shall have permanent restoration placed within five (5) days of tie-in completion if weather and governing agency allow.

15. All final restoration of longitudinal cuts shall be rolled even if grind and pave is a requirement of the permit. Duke Energy will require all uneven restorations to be redone.

16. Grind and pave work required by permit will be done at Duke Energy's expense unless it is due to poor workmanship on the original trench restoration. In some cases, the permit required grind and pave work is waived by the permitting agency if the final restoration is considered adequately smooth.

17. When installing gas main in a brick paved street, the existing bricks shall be salvaged. Following gas main installation, the salvaged bricks must be weaved into the repair area; no straight line saw cutting of the pavement will be permitted.

18. Determination of the limits of CL 32 asphalt restoration shall be at the discretion of Duke Energy or the permitting agency.

19. The City of Covington has specific restoration requirements for brick streets. Refer to attached letter Appendix 9A.

20. The City of Cincinnati has submitted a general guideline of their traffic control requirements and usage of LSM and concrete. Refer to attached notes in Appendix 9B.

21. When pouring concrete over a multiple of days; specifically Class 33, (2) 1" diameter 12" long rebar will be inserted half way at the end of the pour each day in order to "secure" the beginning of the new pour.

APPENDIX 9A

CITY OF COVINGTON RESTORATION ORDINANCE

CITY OF COVINGTON

638 MADISON AVENUE • COVINGTON, KENTUCKY 41011-2298

August 9, 2005

Cinergy
670 W. North Bend Road
Cincinnati, OH 45224

Re: City of Covington Restoration Ordinance

Based on the recent concerns expressed by Covington residents, neighborhood committees, and various public agencies regarding restoration of streets and sidewalks, I felt it necessary to provide all the utility organizations performing work within the City a copy of our restoration requirements. Enclosed is a copy of the pertinent sections of our Code of Ordinances specifically addressing restoration of streets, alleys, sidewalks, and other passageways within the City's right-of-way.

The recent concerns have been restoration of brick streets and alleys or the lack thereof. Due to the historical significance of this particular infrastructure I am asking that you remind your field crews and contractors of the detailed requirements for restoration of brick streets and alleys. The intent insofar as possible is to carefully remove the existing brick and replace the same after utility work is completed. In cases where this is not possible, I ask that you coordinate your efforts with the Engineering Department.

To assist in the planning process, I have enclosed a map highlighting the brick streets within Covington. We are hopeful that with proper coordination we can maintain the historical appeal we are known for in the state of Kentucky.

Thank you for your continued efforts in maintaining and improving our city.

Sincerely,

Thomas H. Logan, PE
City Engineer
City of Covington

c: Jay Fossett, City Manager

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An Affirmative Action / Equal Opportunity Employer

§ 96.05 ENCROACHMENT PERMITS FOR WORK ON STREETS; REPAIRS TO STREETS.

(E) *Restoration regulations.*

(1) Each and every person who excavates, digs into, or occupies the right-of-way of any city street, alley, sidewalk, or other public way or any owner of real estate or the agent or lessee of such owner, who allows or permits such work to be done, whether under contract with the city or otherwise, has a duty, upon completion of such work, to immediately cause the street, alley, sidewalk, or other public way worked upon to be placed in reasonably close conformity to its condition before such work began. This work shall include, but not be limited to, the following:

(a) Installing, removing, or repairing any water pipe for the conveyance of water; gas pipe for the conveyance of gas; sewer pipe for the conveyance of drainage or sewerage; electric, telephone, computer, or cable type conduit of any kind; construction of any kind of sewer or other drain structure; or for the purpose of making house connections of any kind whatsoever;

(b) Installing, removing, or repairing any overhead lines or other similar facilities; and/or

(c) Opening, excavating, or occupying the right-of-way of any city street, alley, sidewalk or other public way or causing or permitting it to be opened, excavated, or occupied.

(2) Restoration work shall include the proper and thorough compacting and settling of the earth displaced, replacement of backfill, sub-base, or pavement, as required by current city standards or subdivision regulations. The top of any such opening shall be replaced or laid with the same or nearly the same kind of material(s) as composed the surface before such opening was made and in the same manner and upon the same level as it lay before such opening was made.

(a) If bricks or pavers are removed, to the extent possible, the removed bricks or pavers should be reused at the top of any such opening. If the removed bricks or pavers cannot be reused, then bricks or pavers of a like kind and material should be used. Restoration work must be completed immediately after the purpose for opening the street, alley, sidewalk, or public way is accomplished, and such work must be completed before the person or company doing the work leaves the work site, unless the City Engineer grants to said person or company a written extension of time to complete the restoration work. The street, alley, sidewalk, or other public way worked on, immediately after such work is done, shall be placed in reasonably close conformity to its original condition in every respect as it was before such work was commenced.

(b) The duty of restoring the street, alley, sidewalk, or other public way to conformity with its original condition is also imposed upon any contractor and any officer and upon any and all other persons under whose direction, supervision, or oversight such work is done or upon whose request, permission or cooperation such opening is made. It is the duty of the City Engineer to require and see that the provisions of this section are strictly, promptly, fully, and carefully carried out and enforced.

('77 Code, § 622.2, Sec. IV(a)) (Ord. O-16-82, passed 3-16-82; Am. Ord. O-17-02, passed 4-9-02) Penalty, see § 96.99

SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150

APPENDIX 9B

CITY OF CINCINNATI NOTES

Pre-Construction Meeting

Inspection

Call 352-3451 every morning between 7:30 AM & 8:30 AM with Permit Number.

No phone calls on cell phone for inspection.

All traffic control, excavations, backfill, temporary and permanent restoration must be inspected.

When field inspections are made a designated or responsible person must be on job site to take instructions.

Excavation and Restoration

Excavation – Pre-saw full-depth with wet diamond blade saw, brine from saw must be washed down so as not to be tracked by autos or pedestrians into business. Remove spoils every day, nothing left over night.

Backfill – CLSM required in all city streets, driveways, sidewalks and within 2 feet of the edge of the pavement. See approved Ham-Cin List for approved mixes.

- CDF with concrete base restoration – must wait a minimum of 12 hours before pouring concrete
- CDF with asphalt base restoration – must wait a minimum of 12 hours before placing asphalt
- Flash Fill ™ - must wait 1-4 hours before pouring concrete or asphalt base

Temporary Street Restoration – 3 options

1. 10" crushed stone or slag with a 2" cap of Hot Asphalt Mix #448
2. Bring CLSM within 2" of street and cap with 2" of Hot Asphalt Mix #448
3. Bring CLSM within 3" of street and cap with 3" of Concrete

Temporary Sidewalk Restoration – 2" of compacted Hot Asphalt Mix # 448

No Cold Mix will be allowed for any temporary restoration, street or sidewalk.

Final Street Restoration –

<u>SPECIFICATION</u> FOR THE INSTALLATION OF GAS MAINS AND SERVICES SPECIFICATION GD-150

<u>Concrete Base</u> - 9" Class C Concrete with 2" cap of Hot Asphalt Mix #448. Main arterial roads require concrete to be pinned with #5 Epoxy Coated Rebar. Rebar or keyways will be required at the end of each concrete base pour.

<u>Concrete</u>

Standard Class C Concrete – minimum setup time 5-7 days
Class MS Concrete – minimum setup time 24 hours
Class FS Concrete – minimum setup time 4 hours

Internal Vibrator
Bull Float
Hand floats
Broom finish
String all castings for grade.

<u>Asphalt</u>

All asphalt restoration must be parallel and perpendicular to the Center line or curb line
Hot Asphalt Mix #448
Tack coat per ODOT 702.04
3 to 5 ton roller
Sealer per ODOT 705.04 (except in crosswalks)

<u>Asphalt Base</u>

<u>Arterial Road</u> – 2-5" lifts of Asphalt Item 304 with a 2" cap of Asphalt Item 448
<u>Residential</u> – 2-4" lift of Asphalt Item 304 with a 2" cap of Asphalt Item 448

All Brick surface streets must be restored in kind.

Final Sidewalk and Driveway Restoration – 5" Class C Concrete for sidewalks and 7" Class C Concrete for driveways.

Any excavation through a curb ramp will require complete replacement of the curb ramp and upgraded to meet current ADA requirements.

Maintenance of Traffic

Follow all rules for maintenance of traffic. Item 614 ODOT Traffic Safety Manual

Advance warning signs for traffic pattern.

Use of a uniformed police officer with cruiser may be required when working in or within 50' of a signalized intersection. Contact the Cincinnati Police Detail Unit at 352-2583 to coordinate.

No Parking Signs – Contact appropriate police district for policy and procedure

Some streets may have restricted working hours.

Miscellaneous

Street Plates – Plates will be required to be pinned, welded and ramped as necessary. No overnight noise. Silence plates with expansion paper, tar paper or ramp plates. Also see attached memo from the City of Cincinnati dated April 4, 2008.

Contact Urban Forestry at 861-9070 when working within fifteen (15) feet of a tree in the public right-of-way.

Special circumstances to be decided / directed by the City Engineer.

April 4, 2008

To all permit holders, Contractors, Utility Companies, Public Agencies with active excavations in City streets:

As the City of Cincinnati Traffic Road and Operations Division (TROD) prepares for the ongoing construction season, they will need to know the location of trench plates in City of Cincinnati streets during this season.

As a general rule we encourage everyone to make every attempt to complete permanent restoration of your trenches as soon as possible. If this can't be done we request that you use a temporary restoration acceptable to the Department of Transportation & Engineering Inspector assigned to your work.

Trench plates in City streets, during the construction season, should only be used for emergency purposes or when materials are not available to complete a good temporary pavement restoration.

We also request that all privately owned trench plates have permanent visible markings, such as the initials, of the company placed on the plates to better help identify which utility contractor the plates belong to.

Please advise ALL private contractors under your control and all necessary agency staff to contact TROD regularly with updated utility plate locations, the date placed, what utility it is for, and an emergency contact. Also, please remind them to call back when the plates are removed. You can contact TROD (Customer Service) at (513) 591-6000, 24 hours each day, 7 days a week.

This request is effective throughout the year, not just during snow plowing operations through the winter.

Your cooperation in providing this information to staff and attention to completing your street restorations are appreciated and will help to contribute to a safe and effective construction season.

Mike Niswonger
ROW Management Section
Transportation & Engineering
City of Cincinnati
(513) 352-3463

SECTION 10 - TESTING

Section A - Internal Cleaning Prior to Testing

Section B - Testing Main

Section C - Purging

Section D - Test Equipment

A. Internal Cleaning Prior to Testing

1. The Contractor shall furnish labor, equipment, and pigs suitable for traversing all bends, for cleaning the interior of all pipes prior to the air test.

2. Under no circumstances will any water removal equipment (pigs) be allowed to remain in the line. The Contractor shall be billed for all costs associated for the removal of any equipment left in the line.

B. Testing Main

After installation, the Contractor shall furnish the labor and equipment to test the main, in accordance with the following procedure. The contractor will also be responsible for ensuring the accuracy of the test charts. The crew leader must make sure the chart is good, fill in all applicable data, sign the chart and give it to the inspector for review. The inspector will initial chart.

1. Testing Distribution Mains Operating **Less** Than sixty (60) PSIG:

   a) The Purchaser will visually inspect all welds on steel mains. The Purchaser will, at his/her option, inspect the welds by radiographic methods or by destructive testing methods. The Contractor shall conduct his/her work in a manner that permits the Purchaser and/or Radiographer to obtain a satisfactory examination of the pipeline. Welds found to be defective shall be replaced by the Contractor at his/her expense.

   b) The Purchaser will inspect the heat fusion process used to join plastic pipe, connections, and fittings. Any joint connection or fitting that is visibly inspected and found to be defective or for any other reason believed not to be satisfactorily installed will be removed for testing. Joints found to be defective shall be replaced by the Contractor at his/her expense.

c) The Contractor must complete the air test on the new main at least two (2) working days from the date of completing the installation.

d) The Contractor shall furnish labor and equipment, including the calibrated pressure-recorder and charts, to successfully leak test all piping with air at ninety to one-hundred (90-100) psig. The maximum pressure of the pressure chart shall not exceed 200 psig and must be equal to or greater than eight (8) inch in diameter. Refer to Procedure GD10.1003-5 Air Testing for Leaks on Mains and Tie-ins.

e) The duration of the leak test shall be at least twenty-four (24) hours or as indicated on the “issued set” of plans.

f) Pressure testing of plastic will not be initiated until all fusion joints have cooled to below one-hundred (100) degrees Fahrenheit.

g) Air compressors used for pressure testing shall be equipped with traps or filters on the discharge side to minimize the amount of oil contamination introduced to the system. On plastic main jobs, the air compressors shall be equipped with an after-cooler capable of limiting the outlet air temperature to maximum allowable temperature of 100 degrees Fahrenheit.

h) While conducting pressure tests, every reasonable precaution must be taken to protect personnel and the general public during the test.

i) The Contractor shall locate and repair all leaks at his/her expense. A successful retest after the repair will be required. Re-pigging the line may be required if water is suspected of entering the line.

2. <u>Testing Mains Operating Greater Than sixty (60) PSIG:</u>

a) The Purchaser will visually inspect all welds and specify the minimum percentage of welds to be radio-graphed. Refer to Gas Standard *6.2* - *<u>Inspection of Pipeline Welding.</u>*

b) The Contractor must defer the installation of line valves until after the strength test has been successfully completed unless specified by the Purchaser.

c) After the line has been properly cleaned, the Contractor shall be required to furnish labor, tools, hydrostatic testing equipment, certified dead weight tester, and certified pressure chart recorder. Clean water is required to hydrostatically strength test the line to a pressure listed on the cover sheet of the “Issued

Drawing". The pipe section being tested must have the test equipment located at the highest elevation in that section.

d) The hydrostatic test must not include any portion of the live main, service tees, etc. Testing is not permitted in these areas so as to prevent the possibility of introducing water into the system and to maintain the integrity of the existing main. The maximum pressure at any point in the test section shall not exceed one-hundred (100) percent Specified Minimum Yield Strength (SMYS) unless specified by Engineering. The duration of the strength test shall be no less than the time listed on the cover sheet of the "Issued Drawing".

e) After the completion of a successful strength test, the Contractor must supply suitable equipment and labor for removal of all water from the line. All water used for strength testing the main must be disposed of per that State's environmental guidelines.

f) After the completion of the strength test and before the air test, the Contractor shall install the valves, valve connections, blow-offs and other accessories as specified on the Purchaser's "Issued Drawings".

g) In the event others perform the hydrostatic test, the Contractor shall be required to prepare the line for testing, including the attachment and removal of end closures and other testing appurtenances.

h) The Contractor shall furnish the labor and equipment, including the calibrated pressure-recorder and charts, to successfully leak test all piping with air at ninety to one-hundred (90-100) psig. The maximum pressure of the pressure chart shall not exceed 200 psig and have a diameter greater than or equal to eight (8) inch.

i) The duration of the leak test shall be at least twenty-four (24) hours or as indicated on the "Issued Set" of plans. The Contractor shall locate and repair all leaks at his/her expense. A successful leak test will be required after all leaks have been repaired.

C. Purging

1. In most cases, the Purchaser will purge the air from the completed installation. In some cases, the Contractor may be required to purge the air from the completed installations. In those cases, the Contractor shall furnish labor and certified purging equipment (exclusive of the purging medium) to purge the main in a manner approved and supervised by the Purchaser.

2. An inert gas, supplied by the Purchaser, shall be admitted to one end of the main and vented from the other end. The quantity of inert gas will be determined by the Purchaser.

3. The vent pipe shall extend a sufficient distance above ground level and shall be equipped with a conveniently located sampling connection.

4. The Purchaser may prescribe complete screening of the vent pipe with nonferrous material having a total area of at least fifteen (15) times that of the open end of the vent pipe. The screening material shall have a maximum screen size of fifty (50) mesh. The vent pipe shall be grounded using number twelve (#12) or larger copper wire, fastened securely to a metallic rod driven into moist earth. All purging shall be done while the new installation is physically isolated from gas lines in service. Immediately after purging has been completed, the main will be tied into the gas distribution system by the Purchaser. After adequate purging, as determined by the Purchaser, the line will be pressurized with natural gas by the Purchaser.

D. Test Equipment

1. All test gages/recorders and dead weight testers shall be supplied by the Contractor.

2. The gages/recorders listed above must have been calibrated within one year's time before being used to perform any tests. All calibration records must be traceable to the National Bureau of Weights and Measures. The original calibration sheet or copy must be submitted to Gas Engineering for documentation purposes prior to use in field.

3. The dead weight testers must be in good condition. The piston must move freely in the vertical direction and also rotate freely.

4. The charts used on pressure chart recorder must have a maximum pressure listing of no more than twice the maximum pressure of the hydrostatic test, e.g., maximum pressure for the hydrostatic test is eight-hundred (800) psig; the maximum pressure listed on the chart must be sixteen-hundred (1600) psig or less.

5. The diameter of the charts used on the chart recorders must be eight (8) inch or larger.

SECTION 11 - PROCEDURE LISTING

The following list is a recommended listing of procedures developed for use in Duke Energy for the typical gas construction project. This list is not all inclusive but contains those procedures most likely required for use in the field during the installation of gas mains and services along with similar related activities.

The actual procedures can be found on the "Gas Operation's Home Page" located on the Portal. If you are unable to get this information, notify the Sponsor Engineer and request a copy of the procedure be sent to you.

Procedure Number	Procedure Title
GD02.116	New Customer Notification of Customer Owned Service Lines (Maintain Buried Natural Gas Lines)
GD02.901.2	Corrosion Control Glossary
GD02.902.1	General Policy for Corrosion Control
GD02.903.1	Corrosion Control Plan
GD02.903.2	Coated Pipeline & Coating Materials Specification for Handling, Storage & Application
GD02.904.3	Wire Connections to Pipelines
GD02.1212-4	Damage Prevention Program
GD02.1212-8	Gas Facility Location
GD10.01	Uprating of Steel Piping Systems
GD10.225	Manufacturing Specifications for Pipe and Pipeline Components
GD10.300	Free Span Limitations for Exposed Gas Mains During Excavation
GD10.302	Lowering In-Service Steel Pipelines
GD10.302-2	Design of Steel Piping Systems
GD10.1003-1	Strength Testing for Establishing MAOP
GD10.1003-5	Air Testing for Leaks on Mains and Tie-ins
GD10.1203	Medium Pressure – MAOP and MOP
GD10.1214	Procedures For Digging and Surveying Test Holes for Locating Buried Gas Main
GD20.463	Magnesium Anodes
GD40.01-01	Gas Main - Tracking & Recording Tie-In, Separation & Abandonment of Gas Mains
GD40.01-02	Gas Main - Standard Pressure - Abandonment
GD40.001	Pressure Conversion Guidelines
GD40.002	Pressure Increase Guidelines

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Procedure Number	Procedure Title
GD40.003	Pressure Decrease Guidelines
GD40.004	Pressure Uprate Guidelines
GD40.005	Pressure Downrate Guidelines
GD50.0001	Control of Hazardous Energy (Lockout/Tagout)
GD50.0002	Control Of Hazardous Energy (Lockout / Tagout) (energy isolating devices)
GD55.1210	Planned and Unplanned Interruption of Service
GD55.500	Visual and Radiographic Weld Inspection on Steel Pipelines
GD55.505-1	Welding Qualifications
GD55.512-1	Limitations of Welders and Welding Processes
GD55.1211-1	Purging Pipelines
GD55.1220-1	Locating & Temporary Marking of Natural Gas & Hazardous Liquid Facilities
GD55.1303-1	General Policy for Pipeline Markers and Navigable Waterway Pipeline Warning Signs
GD55.1304-2	Inside Piping Inspections
GD60.078	Annual Qualification For Joining Plastic Pipe By Qualified Personnel
GD60.111	Prevention of Accidental Ignition
GD60.122	Supplied Breathing Air
GD60.130	Gas Vault/Pit Access or Entry
GD60.162	Leak and Strength Testing of Short Segments of Steel Pipe used for Tie-ins and Main Repairs
GD60.200	Work Zone Safety
GD60.250	Receiving, Handling And Storage Of Polyethylene Pipe, Tubing And Fittings
GD60.383	Excess Flow Valve Installation
GD60.434	Tapping and Squeeze-off of Polyethylene Gas Mains under Pressure
GD60.444	Excavation Safety
GD60.445	Directional Drill Requirement for Locating Underground Utilities
GD60.462	Applying Wax Tape Coatings for Below Ground Applications
GD60.465-1	Insulphone Tester
GD60.465-2	Cathodic Protection Indicator
GD60.465-3	Continuity Tester
GD60.625	Gas Meter and Regulator Installations Inspection
GD60.631	Pressure Testing & Inspecting Residential Customer House Lines
GD60.632	Testing Inspecting Commercial and Industrial House lines
GD60.633	Meter Testing or Pressure Testing Customer House Lines for Leaks
GD60.636	Customer Meters: Turning Gas On to a New Residential Meter Set
GD60.637	Customer Meters: Turning Gas On (Reconnect or Succession) For A New Customer

**SPECIFICATION FOR THE INSTALLATION OF GAS MAINS AND SERVICES
SPECIFICATION GD-150**

Procedure Number	Procedure Title
GD60.658	Gas Meter Changes and Testing (Age Changes)
GD60.700	Gas Service Renewal
GD60.701	New Gas Service Installation
GD60.702	Gas Service Curb Box and Valve Box Accessibility Program
GD60.704	Flexible Service Riser Replacement
GD60.719	Joining Copper by High Temperature Soldering
GD60.720	Corrosion - Causes And Prevention
GD60.728	Tapping, Bagging and Stoppling of Metallic Gas Mains Under Pressure
GD60.730	Main Tie-ins, Cut Outs and Isolation of Main Segments
GD60.732	Grounding and Temporary Bonding of Pipelines
GD60.738	Weld Inspection - Visual
GD60.739	X-Ray Report - Daily Completion
GD60.786	Grouting Abandoned Pipe
GD60.750	Pipeline Valve Inspection - Annual and 5-Year
GD60.751	Repair of Distribution Mains
GD60.776	Joining Polyethylene Piping Systems by Butt Fusion Utilizing the McElroy 14 & 26 Machine
GD60.779	Joining PE2406 Polyethylene Pipe, Tubing & Fittings By Electrofusion
GD60.780	Joining Pipe With Mechanical Fittings
GD60.782	Joining Polyethylene Pipe By Butt Fusion Utilizing The McElroy No. 28 Fusion Unit
GD60.782-1	Joining Polyethylene Pipe by Butt Fusion with McElroy no. 412 High Velocity Fusion Unit
GD60.783	Repair of Aldyl A Service Punch Tee (SPT) and Tapping Tee
GD60.785	Abandonment or Inactivation of Facilities
GD70.06-019	Pipeline Defect Evaluation
GD60.2001	Gas Pipeline Condensate (PCB) Management
GD60.2002	Mercury Regulator Handling, Spill Response and Clean-Up
GD147	Contractor Payment Schedule
GD210	Materials Specification for Plant Applied Coating Material for Carbon Steel Pipe
GD215	Polyethylene Pipe & Fitting Specification

GAS ENGINEERING
MATERIALS SPECIFICATION FOR
PLANT APPLIED EXTERNAL COATINGS
GD 210

January 12, 2017

SPECIFICATION GD210
PLANT APPLIED EXTERNAL COATINGS

Contents

SPECIFICATION GD210
PLANT APPLIED EXTERNAL COATINGS

1. GENERAL

1.1 The following specification covers the minimum requirements for application, performance, and handling of plant applied external pipe coatings for corrosion and abrasion resistance.

1.2 The following acronyms and definitions are used in this specification:

Term	Definition
API	American Petroleum Institute
Applicator	The organization contracted by the company for the application of the coating.
ARO	Abrasion Resistant Overlay
ASTM	American Society of Testing Materials
Coating Material	The powder material before it is applied to the pipe
Coating	The cured film of coating material as applied to the metallic pipe.
Company	Duke Energy Corporation
FBE	Fusion Bonded Epoxy
NACE International	National Association of Corrosion Engineers International
SSPC	Steel Structures Painting Council
Supplier	Coating manufacturer and/or distributor

1.3 The Company's representative and the powder manufacturer's representative shall have access at all times to inspect Company work and material furnished by the Supplier in accordance with this specification.

1.4 Qualification testing shall be performed by the Company or organization chosen by the Company.

1.5 The Applicator shall notify the Company’s purchasing department and/or the Gas Engineering 48 to 72 hours in advance of any pipe-coating job that is to be performed for the Company. This will logistically facilitate onsite inspection by a Company representative or third party inspector.

SPECIFICATION GD210
PLANT APPLIED EXTERNAL COATINGS

2. RESPONSIBILITY

2.1 Gas Engineering is responsible for developing, maintaining and issuing this procedure. All revisions require the approval of the Gas Engineering's Corrosion Engineer.

2.2 T&D Supply Chain's Warehousing shall inspect all pipe shipment to verify that the pipe complies with the issuing purchase order and the specifications reference therein. T&D Supply Chain's Warehousing shall verify that all stenciling and markings complies with Section 9 of this specification.

3. MATERIAL SPECIFICATIONS & PERFORMANCE REQUIREMENTS

3.1 The material to be used for external coating shall be previously approved by the Company. Once the Company accepts a coating formulation, it shall not be changed unless the Company is notified in writing and the Company corrosion engineer gives approval. The Applicator shall provide powder manufacturer's certification at company request.

3.2 The approved coating material shall be stored at temperatures for a maximum time period recommended by the coating materials manufacturer from the date received from the Supplier. Any Powder materials that do not comply with this requirement are subject to rejection if storage conditions do not comply with manufacturers specifications.

3.3 Material qualification testing shall comply with API RP 5L7, section 3 specifications, and shall meet the following additional qualification test requirements.

3.3.1 Full cure of coating shall be achievable at temperatures below 500° Fahrenheit (260° Celsius).

3.3.2 Coating shall withstand 40 inch-pounds of impact per ASTM G14 standard.

3.3.3 Coating shall withstand bending of 2.0 degree per pipe diameter at (minus) -20° F (-29° C) per modified ASTM G10 standard.

3.3.4 Coating shall not deform deteriorate or disbond when subjected to soil stresses due to seasonal temperature changes in the Midwestern United States.

SPECIFICATION GD210
PLANT APPLIED EXTERNAL COATINGS

3.3.5 Coating shall not ignite blister or burn back more than two inches (50mm) when pipe is weld or torch cut.

3.4 The corrosion prevention FBE shall be 6233P by 3M, unless otherwise specified. The Average Nominal Coating Thickness for standard burial application will be one of the following, as denoted on the purchase order:

MINIMUM	NOMINAL	MAXIMUM
14 Mils (356 microns)	15 Mils (381 microns)	16 Mils (406 microns)

3.5 The Abrasion Resistant Overlay material, if specified, shall be Powercrete DD by Seal for Life Industries, unless otherwise specified. The Average Nominal Coating Thickness for directional drilling, thrust (slick) boring and or severe handing applications will be one of the following, as denoted on the purchase order:

MINIMUM	NOMINAL	MAXIMUM	Bore Length
30 Mils (762 microns)	40 Mils (1016 microns)	50 Mils (1270 microns)	L ≤ 2,000’
50 Mils (1270microns)	60 Mils (1524 microns)	70 Mils (1778 microns)	L > 2,000’

4. PLANT REQUIREMENTS

4.1 All plant equipment must be in good working condition.

4.2 The plant must have an operational pre-heater to remove moisture prior to final blasting.

4.3 The plant must have a mid-plant pipe rejection system so that rejects for whatever reason can be diverted from the coating line.

4.4 All runners and conveyors must be kept adequately clean to prevent contamination of pipe or damage to pipe and/or coating.

4.5 The fluidized beds must have magnets capable of removing iron and steel contamination from virgin or recycled powder.

4.6 The plant site must have a grinder (spider) or beveling machine for re-facing cutoffs or damaged bevels.

4.7 The plant site must have a laboratory equipped to perform production quality control tests according to but not limited to the following standards:

- The Society for Protective Coatings (SSPC)
- American Petroleum Institute (API)
- American Society for Testing and Materials (ASTM)
- National Association of Corrosion Engineers (NACE)

5. HANDLING AND STORAGE OF BAR PIPE

5.1 All pipes shall be inspected by Applicator upon arrival. The pipe shall be free of all abnormalities that can't be removed during the abrasive cleaning process. When damaged pipe is found, trucks or rails cars are not to be unloaded until exception is noted on the bill of lading and the load has been inspected by the transporter's representative.

5.2 After complying with section 5.1 of this specification, the Applicator shall notify the Company supplier regarding the extent of the damaged pipe and provide the associated purchase order number.

5.3 The Company supplier will then contact the transportation company to resolve the problem.

5.4 The Applicator shall not coat any damaged pipe until the Company supplier has been notified and proper documentation made.

5.5 The Applicator shall be able to unload arriving pipe to accommodate all types of transportation vehicles in a manner that would not damage the surface or structures of the pipe.

5.6 Pipe handling vehicles (particularly fork-type) shall be free of burrs or projections that could gouge or scratch pipe. The vehicle shall be free of lacquer, oil, grease and contaminates that could create coating adhesion problems if not removed during the coating process.

5.7 When the pipe is picked up from the top stack precautions must be taken so that the pipe wall and end are not damaged, and the remaining joints will not roll or be damaged by the lifting and movement of the load.

5.8 Pipe shall be properly stacked in accordance with good safety practices to a height that would not damage the pipe wall and ends.

5.9 Sufficient separators and padding shall be used to prevent damage to the bare pipe during storage per sections 12.6 and 12.7 of this specification.

6. SURFACE PREPARATION & CLEANING FOR CORROSION PREVENTION FBE

6.1 Prior to abrasive cleaning, the applicator shall clean the pipe surface in according to SSPC-SPI-63 (or current standard) to remove all organic and inorganic contaminants. Contaminants include but not limited to the list below.

6.1.1 Oils (hydraulic oils) and greases

6.1.2 Muds, soils and salts

6.1.3 Mill lacquers

6.1.4 Ethylene glycol - prevents H20 freezing during hydro testing

6.1.5 Amine glycol - soap compound present in (Mobilmet-29) cooling media during the welding of longitudinal seam

6.2 Bevel ends and lands shall be protected from grit blast and impact damage at all times.

6.3 Pipe shall be uniformly preheated to remove all moisture above dew point just prior to abrasive blast cleaning in order to prevent oxidation of cleaned surface.

6.4 The surface to be coated shall be abrasively cleaned to a "Near White Metal" finish by grit blasting in accordance with:

- NACE visual standard TM01-75, and
- SSPC-SP10 standard

6.5 The blast pattern shall be a uniform angular profile with a minimum depth of 1.5 mils (38 microns) and a maximum depth of 4.0 mils (100 microns) as measured with a replicating film and micrometer. Standard for comparison shall be made available by the Applicator.

6.6 The pipe surface profile shall be checked at least twice per eight (8) hour shift.

6.7 A consistent mixture of the working mix of steel grit (G-25 or equivalent) will be maintained by frequently adding amounts of new grit commensurable with grit consumption.

6.8 The surface must be inspected immediately after blasting and all slivers, burrs, scabs and gouges made visible by blast cleaning must be removed with a media that will maintain the proper anchor profile.

6.9 Before coating the pipe shall be inspected for cleanliness and compliance to "Near White Metal" specifications.

6.10 The total elapsed time between grit blasting and coating shall be kept to a minimum to avoid the formation of oxides on the clean surface. All visible formation of such oxides shall require that the pipe be re-blasted prior to coating.

6.11 Prior to coating, all residual metallic dust left from grit cleaning shall be removed from the pipe surface.

6.12 Prior to coating, all steel grit and/or loose contaminates must be removed from the interior surface of the pipe.

7. COATING APPLICATION FOR CORROSION PREVENTION FBE

7.1 The specified protective coating shall be applied externally to the pipe by the use of electrostatic powder spray method at a sufficient rate to result in a uniform cured film thickness as specified on the purchased order.

7.2 The pipe, which has been cleaned, shall be uniformly preheated so that the pipe temperature at the entrance of the coating station is between 450° F (232° C) and 475° F (246° C). At no time during the entire coating or recoating process shall the temperature exceed 500° F (260° C). The heat source shall not leave a residue or contaminant on the pipe surface.

7.3 Application and curing temperatures for the FBE coating systems shall be in strict conformance with the coating manufacturer's application specification.

7.4 The heat source shall not leave a residue or contaminant on the pipe surface.

7.5 Graduated "Tempilstik" crayons may be used to measure the temperature. Only a small spot of pipe shall be touched with the Tempilstik. Optical pyrometers and infrared sensing devices may be used in addition to, or in lieu of Tempilstik.

7.6 The optical pyrometer calibration shall be checked at least twice daily. Infrared sensing devices shall be used to monitor the temperature of the applied coating.

7.7 Oxidation of the steel prior to the coating in the form of "Bluing" or other apparent oxide formation is not acceptable. If such oxidation occurs, the pipe shall be cooled to ambient temperature re-certified to the appropriate ASTM specification and re-cleaned at no additional cost to the Company.

7.8 The finish coat will have a minimum cutback (measured from bevel shoulder) of 2 inches with a maximum cutback of 2-1/2 inches.

7.9 Recycled coating powder shall be held to a minimum. At no time shall the ratio of recycled powder to virgin powder exceed 25%.

7.10 The recycled powder shall be screened through a filter of 70 mesh or finer.

7.11 Fluidized bed magnets shall be inspected and cleaned to least twice per shift.

7.12 All air used to fluidized, transport and apply powder shall be dry and free of oil. The system must be capable of delivering air at a minimum of 0° F (-8°C) dew point.

7.13 During the period of coating and curing, the pipe shall be properly handled as to avoid damage to the coating, and physical damage to the pipe surface or ends including bevel and land.

7.14 After the coating has cured, water or air may be used to cool the pipe to a temperature under 200° F (93°C) to facilitate inspection and repairs. The pipe shall be rolled on padded skids and protected from damage.

8. SURFACE PREPARATION & CLEANING FOR ABRASION RESISTANT OVERLAY

8.1 When the primary coating has been applied less than six (6) days prior, the surface shall be cleaned and free of all contaminants. If solvent is used, it shall be without residue and should not leave any traces. Following cleaning, the coating shall be examined for U. V.degradation ((fading, chalking, cracking or crazing)). If degradation is observed, see 9.2 for correction.

8.2 If the primary coating was applied six (6) or more days prior and the coated pipe was exposed to sunlight (or other U. V. source) the U. V. affected FBE surface shall be removed before Powercrete can be applied. The damaged surface shall be removed by lightly blasting (sweep blasting) with an air or rotary blaster using an appropriate angular blast media (not shot).

8.3 As an alternative to blasting, the coating shall be thoroughly abraded using an abrasive coated organic pad, equivalent to 3M scrubbing pad or medium grit emery cloth. Following blasting or abrading, the FBE coating shall be thoroughly cleaned using compressed air or water. If water is used on the coated pipe, the pipe shall be completely dry.

8.4 Following cleaning, no dust or any other particles shall be visible on the surface. A clear adhesive tape that shall be pressed on the surface of the FBE coating and removed for observation.

8.5 Immediately prior to the application of Powercrete the primary pipe coating shall be 100% inspected for holidays, pinholes, and other damage, subject to the same procedure for holiday inspection of the original coating. The repair procedure for discontinuous primary coating shall be identical to the repair during

9. COATING APPLICATION FOR ABRASION RESISTANT OVERLAY

9.1 The pipe shall be preheated to ensure that no surface moisture is present during the actual coating application. Under no conditions shall the coating be applied to a pipe surface temperature above 160°F (71°C).

9.2 The freshly coated areas shall be protected from being contaminated with dust or other foreign debris. Excessive particle contamination shall require stripping, reblasting, and recoating.

9.3 Pipe shall be coated immediately after heating using a spray gun or other acceptable methods.

9.4 The first layer shall be applied uniformly to a thickness that will not cause running/sagging of material. Applications shall be facilitated with a hand trowel or other tools if necessary.

9.5 Successive layers of 20-40 mils shall be applied allowing 10 minutes between applications until desired thickness is achieved.

9.6 Cured coating shall be of uniform color, gloss, and thickness and shall be free of blisters, pinholes, fish eyes, sags, pimples, craters, and other irregularities. It is understood that contact with moisture after application may cause discoloration with out affecting the quality of the coating.

9.7 The Powercrete coatings shall reach a minimum hardness of 65 (Type D Durometer—ASTM D2240) prior to handling.

9.8 The Powercrete coating shall reach a minimum hardness of 75 (Type D Durometer—ASTMD2240) prior to installation.

9.9 Any joint of pipe having less than the specified minimum hardness shall, at the Company's option be retested after 24 hours, or have the defective coating removed and reapplied as per this specification.

10. INSPECTION AND QUALITY CONTROL

10.1 It is the responsibility of the Applicator's Quality Control Inspector to advise the shift foreman so that immediate corrections can be made when conditions exist such as cleaning, application or material performance, which adversely affect the external coating operations.

10.2 At the completion of the coating operation (prior to storage) the coating shall be thoroughly inspected visually under adequate lighting.

10.3 The Applicator is responsible for meeting the following requirements for testing and acceptance of externally coated pipe.

10.3.1 The coating thickness checks shall be made at ambient temperature or at a temperature suitable for accurate measurement with properly calibrated gauges and have a minimum thickness as specified in section 1.3 of this specification.

10.3.2 The gauge shall be calibrated each day prior to inspection by using a National Bureau of Standards thickness standard (NBS) - SRM 1363, "Non-Magnetic Coating on Steel" that is within 20 microns of the specified coating thickness.

10.3.3 The thickness measurements shall be in accordance with SSPC-PA2, Section 2. The coating shall have a minimum thickness as specified on the purchase order. Pipe with less than the minimum thickness shall not be accepted.

10.4 Holiday detection (jeeping) shall be done with a steel spring or conductive rubber detector that fully encircles the circumference and comes in direct contact with the entire surface of the coating being inspected.

10.5 Alternatively, a straight edged rubber detector may be mounted parallel to the pipe, provided the length is sufficient enough to completely cover the entire surface area of the pipe, including weld toe area as the pipe rotates and advances.

10.6 The detector must detect and identify the location of a holiday both audibly and visually.

10.7 The holiday detector shall be compatible with FBE and designed for use on thin film coating.

10.8 The Company reserves the right to supply a non-pulsating holiday detector set at the appropriate voltage and re-check the coating prior to pipe storage and shipment. If any holidays are found, they shall be repaired by the Applicator.

10.9 The holiday detector shall not operate over 125 volts per mil of coating thickness. Higher voltage is likely to damage the coating and cause jeeps.

10.10 The accuracy of the holiday detector voltage shall be checked daily with the appropriate instrument and the necessary adjustments shall be made prior to use.

10.11 Any 40-foot joint of pipe containing more than the allowable number of holidays (prior to patching) as specified in the following table shall be rejected.

Pipe Size Outer Diameter (OD) (inches)	Number of Holidays Allowed Per40 Foot Joint prior to Patching
2	4
3	4
4	6
6	6
8	7
10	8
12	10
16	12
20	15
26	18
30	20
36	23

10.12 The use of the American Gas Association in-mill coating test devices is required of the Applicator. The tests shall be conducted at least three times per eight-hour shift.

10.13 The Company reserves the right to have all in-mill coating tests witnessed by a company Inspector or third party inspector if desired.

10.14 The Applicator shall have written documentation of all in-mill coating tests performed for the Company such as but not limited to:

10.14.1 Adhesive strength of cured coating test

10.14.2 Contamination detection test

10.14.3 Porosity, percentage of test

10.15 Cured coating shall be of uniform color, gloss, and thickness and shall be free of blisters, pinholes, craters, fish eyes, sags, and other irregularities.

10.16 The applicator shall send a copy of the results of all in-mill tests performed that is identified in Section 8.14 of the specification. The results shall be sent to:

Duke Energy
Attn: Mr. Samuel L. Vessel, Corrosion Engineer
5445 Audro Drive
Cincinnati, OH 45247

11. <u>STENCILLING, TRACKING, AND RECORDING</u>

The Applicator shall;

A. Maintaining all internal Manufacture's stencils, particularly manufacturer and heat identification.

B. Stencil or mark each stick of pipe PERMANENTLY with the information listed below. Use paint contrasting the color and compatible with the coating to the pipe being stenciled. This information can be printed in block form **<u>every 5'</u>** along the length of pipe or repeatedly printed in a straight or spiral wrap along the pipe length.

   i. Material specification or standard to which pipe was manufactured and Product Specification Level (PSL)
   ii. Manufacturing process / Seam Type (ERW, HFW, Seamless, DSAW, etc.)

iii. Nominal size or outside diameter (inches)
iv. Pipe Manufacturer's Full name (not abbreviated)
v. Heat Number (minimum every 5' along pipe length if not included in print line)
vi. Coating Applicator's name
vii. Date pipe coated in MM-DD-YY format
viii. Primary Coating Manufacturer & Type (e.g. 3M 6233)
ix. Primary coating average thickness in mils
x. Secondary Coating Manufacturer &Type (e.g. Powercrete DD, if applicable)
xi. Secondary coating average thickness in mils
xii. Weight (lbs. per foot)
xiii. Stick/Joint Length (feet)
xiv. Wall thickness in decimal format w/ leading zero (inches)
xv. Steel grade (psig)
xvi. Purchase order number (manufacturer or distributor number)

C. Individual stenciled properties shall be separated by a blank space or a slash (/) for ease of reading information.

D. The Applicator shall provide the Company with daily production tallies, which shall contain the following information:

i. Date and coating sequence number
ii. Manufacturer's joint/heat number (for X-grade 12-3/4" OD or larger)
iii. Average coating thickness
iv. Joint length
v. Jeep count
vi. Disposition (accepted, rejected for shipping and recoating or temporarily rejected (e.g., diverted for cut off, re-beveling, coating repairs that cannot be made at time of final inspection, etc.).

E. Pipe temporarily rejected shall be shown on a separate tally after repairs have been made.
F. Results of all production tests are to be documented and copies provided to the

Company's Purchasing Section with a cover letter referencing the purchase order number, pipe size and grade, coating type, and if requested, coating date/sequence number of test samples. A copy shall also be given to the company's on-site inspector when on site.

12. REPAIRS TO COATING

This section covers the repairs of coating rejects initially and specifically coated per Purchase Order with the intent of being sold exclusively to Duke Energy and Subsidiary Companies. Any coated joints found to be the rejects of any company other than the company identified in Section 1.2.6 of this specification shall not be used without written approval from the Company and written documentation from the Applicator identifying the reasons form rejection. Any non-compliance of this section is subject to total rejection and the shipment shall be returned at the Applicators expense.

12.1 Coating found to be damaged and coating that does not pass the electronic holiday inspection test shall be repaired or recoated at the expense of the Applicator, or documented arrangements shall be made to the satisfaction of the Company.

12.2 The maximum allowable total surface area of exposed steel that may be repaired by patching is 6 square inches (3,871 sq. mm.) of cumulative area per double random length of pipe.

12.3 Patching in excess of the limits indicated in 10.2 is permissible only with the specific approval of the Company's representative. Otherwise, the pipe must be stripped and recoated.

12.4 Scars, dents, damaged areas and holidays are to be cleaned by removing all rust, scale, loose coating, dirt and other foreign material by using hand or power driven wire brushes.

12.5 The area to be patched shall be roughened with 120 grit sand paper (or equivalent) wet or dry. Dust generated by the sanding process shall be removed with a clean dry cloth or brush prior to patching.

12.6 The coating Supplier's recommended patch material (liquid epoxy compound) shall be used for patching holidays and damaged coating to within 8 inches (203 mm) of each pipe ends.

12.7 The repaired pipe coating shall be protected from contacting surfaces that might smear or remove the material before it has cured.

12.8 The solid liquid epoxy compound shall not be applied if the pipe temperature is 55° F (13° C) or less except when manufacturer's recommended heat-curing procedures are followed.

12.9 Alternatively, the heat bondable Polymeric Hot Melt Patch (stick) compound that is compatible with the coating shall be applied in small areas to a minimum thickness of 15 mils (381 microns).

12.10 A non-contaminating heat source shall be used to heat the repair area to approx. 350° F (177° C).

12.11 As the cleaned and prepared area is heated, the patch compound shall be applied by rubbing the stick in a circular motion to achieve a smooth, neat, appearing patch. Patches shall overlap the surrounding undamaged coating by a minimum of 3/4inch (19 mm). The patch shall be allowed to cool before handling.

12.12 All repairs shall be re-jeeped; exceptions shall be made at the discretion of the Company.

13. REPAIRS TO PIPE

13.1 Damaged pipe is not salvageable if the total length remaining after cutoff is less than 15 linear feet (4.6 meters).

13.2 After the damaged and/or defective pipe ends are cutoff, the new pipe ends shall be beveled to a configuration similar to the original bevel.

13.3 Angular and dimensional tolerances shall comply with API 5L-PSL 2. Final bevel and land are to be machined or spider ground, unless otherwise permitted by the Company.

13.4 If the stencil end of the pipe is cut off, all Manufacturer's information in the original internal stencil, including joint/heat number shall be reapplied to the interior of the pipe per API specification 5L. Pipe less than 12.75 inches OD (324mm) may be stenciled on the exterior.

13.5 All stenciled pipe length shall be correct for any joint, which have been cut off or refaced.

14. PADDING, HANDLING, AND STORAGE OF COATED PIPE

The externally coated pipe shall be sufficiently cool to permit handling. The pipe shall be handled and stored in a manner to prevent damage to pipe walls, beveled ends and coating.

14.1 Pipe or coating damaged in handling or other operation shall be satisfactory repaired to the acceptance of the Company at no additional cost to the Company.

14.2 Before handling, protective separators are to be attached to each joint of coated pipe. Separators must be of the loop type or be attached to the pipe by metallic or nonmetallic strapping.

14.3 Nonmetallic strap that becomes brittle in cold temperatures should not be used.

14.4 Crimps used to bind strapping must be of such a material, or effectively positioned to avoid damage to coating on adjacent pipe when stored or loaded.

14.5 ACCEPTABLE SEPARATORS

The following types of separators are permitted. Separators are subject to the approval of the Company.

SEPARATOR TYPE	DESCRIPTION
A	Cardboard sleeves, single piece, waterproofed, 1/8-inch minimum thickness 2.0-inch minimum width
B	Dense rubber, 1/4-inch minimum thickness 3.0-inch minimum width
C	Dense rubber, 1/4-inch minimum thickness 1.5-inch minimum width
D	Dense rubber, 0.6-inch minimum thickness 3.0-inch minimum width
E	Rope, polypropylene, tight weave, 3/8-inch diameter
F	Rope, polypropylene, tight weave, 1/2-inch diameter
G	Rope, polypropylene, tight weave, 5/8-inch diameter
H	Rope, polypropylene, tight weave, 3/4-inch diameter
I	Rope, polypropylene, tight weave, 1.0-inch diameter

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14.6 NUMBER OF SEPARATORS

There shall be one separator for each increment of pipe length or a fraction thereof in the following separators tables. Under no circumstances shall any length of pipe have less than 3 separators.

PIPE OD	MAXIMUM NOMINAL WEIGHT / FOOT OF PIPE	SEPARATOR TYPE	MAXIMUM INCREMENTAL LENGTH PER SEPARATOR
Up to 4-5/8 in	All	A, B, C, E, F	15’
All	30 lb./ft.	B	05’
		C	14’
		E	13’
		F	15’
		G	15’
All	70 lb./ft.	B	12’
		C	06’
		F	08’
		G	15’
		H	15’

PIPE OD	MAXIMUM NOMINAL WEIGHT / FOOT OF PIPE	SEPARATOR TYPE	MAXIMUM INCREMENTAL LENGTH PER SEPARATOR
All	100 lb./ft.	B	08’
		C	04’
		D	15’
		F	05’
		G	10’
		H	15’
		J	15’
All	150 lb./ft.	B	05’
		D	15’
		G	07’
		H	15’
		J	15’

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All	200 lb./ft.	D	15’
		G	05’
		H	14’
		J	15’
All	250 lb./ft.	D	15’
		H	11’
		J	15’
All	300 lb./ft.	D	15’
		H	09’
		J	15’
All	400 lb./ft.	D	11’
		H	07’
		J	11’

14.7 EXAMPLE OF SEPERATORS TABLE USAGE:

a. Type F separators for 70-lb. / ft. pipes: incremental length is 8 feet. Thus A 40 foot length requires 5; 45 foot lengths require 6; 60 foot lengths require 8 separators.

b. Type D separators for 100-lb. / ft. pipes: incremental length is 15 feet. All pipe lengths up to 45 feet require 3: 60 foot lengths require 4 separators.

14.8 Separators should be evenly spaced along the pipe and must be applied to pipe before interim storage and load out. Outermost separators must be within 2 feet (0.6 m) of pipe ends.

14.9 Separator becomes the Company property.

14.10 Alternative types of separators must be approved by the Company.

14.11 Pipe will be handled, loaded and stacked in such a manner as to prevent damage to the walls, beveled ends and external coating.

14.12 Coated pipe may not be stored on windows. Solid wood racks or steel racks with good runners must be used. Rack must be free of any gravel, nails, grit, or other material that could damage the pipe or coating.

14.13 Coated pipe may be stacked if wood runners of 2 in. (51 mm.) minimum thickness separate each layer.

14.14 Coated pipe may be nested if handling is by overhead means, but all pipe hooks and cables must be properly padded.

14.15 PADDING AND HANDLING

Forks handling coated pipe must have dense rubber or polyurethane padding at least 3/16-inch (5 mm.) thickness. If any portion of the load is nested, the top and bottom (including tips) of the forks shall be padded.

14.15.1 Should any damage to pipe or coating occurs, the use of the forks shall be discontinued, and the balance of the order shall be loaded by crane.

14.15.2 The pipe hooks and cable of cranes are subject to the padding requirements of section 13.3.

14.16 Coated pipe, which is stored in the Applicator’s yard before load out, is subject to additional electronic inspection (Jeeping) by the Applicator if handling damage is judged to have occurred.

15. LOAD OUT REQUIREMENTS

15.1 Pipe may be loaded out only after passing all quality tests. Unless otherwise stipulated, it is the Applicator's responsibility to provide dunnage and to handle all loading requirements.

15.2 Pipe shall be loaded in accordance with API specification RP 5L1, 5L5, or 5L6 and the following supplemental restrictions.

15.2.1 Each pipe shall have the required number of separators in accordance with 12.7.

15.2.2 Dunnage shall be made from hard wood or dense fir, using spiral fluted nails. Nails in the pipe contact area are to countersink a minimum of 1/8 inch (3 mm).

15.2.3 Nails located well away from the pipe contact area (such as the back side of an end chock) are not required to be countersunk.

15.2.4 Dense rubber padding or carpet may be used as an alternate to countersinking nails, provided that covered nail heads are driven flush. However nails or staples attaching rubber or carpet should not contact pipe.

15.2.5 Dunnage should be placed behind loose separators to avoid loss of separators during transit. Alternatively, tapping may be used with the approval of the Company.

15.3 Forklift or crabs may be used for load out provided the following requirements are met:

15.3.1 The minimum thickness of the dunnage separating layers shall be at least 3/4 inch (19 mm) greater than the thickest portion on the fork.

15.3.2 The forks must be properly padded, per section 12.15. If any portion of the load is nested, the padding requirements in section 11.15 shall apply to both top and bottom (including tips) of the forks.

15.3.3 Should any fork damage occur to the pipe or coating, damaged pieces shall be unloaded and repaired. The remaining load shall be loaded by overhead means only. Otherwise, either forklifts with spreader bars or cranes are to be used for loading the coated pipe.

15.3.4 The outside of the pipe hooks and the first 4 ft. (12.2 m) of cable attached to the pipe hook must be padded with at least 1/8 inch (3mm) of rubber or urethane.

16. APPENDIX A: DOCUMENT REVISION HISTORY FOR RVTC RECORDS

Table A-1 below summarizes the historic plant applied coatings used by Duke Energy's legacy gas companies CG&E (DE Ohio) and ULH&P (DE Kentucky); and summarizes revisions to GD210. Specification GD210 evolved from specification 7.3.8. Fusion Bonded Epoxy (FBE) was the coating of choice for steel pipe 12" and smaller starting in 1970. FBE later became the mill applied coating of choice for all pipe sizes sometime after 1985.

Table A-1
History of Plant Applied Coatings at CG&E and ULH&P

Specification Number	Description	Year of Standard Origination per available records	Year Standard Officially Made Obsolete per available records	Standard Versions available in records	Revisions
7.3.1 (formerly G-52B, Spec G-1)	Mill Applied Pipe Coating (Coal Tar) for 8.625" and Larger Pipe and Summer (Mar through Nov) Installation	1952	1999	1952, 1957, 1960, 1968	No asbestos mentioned in any version of this standard. No size limit listed in 1952. Title changed to 3.5" & larger pipe in 1957. Title changed to 4.5" and larger in 1960. Title changed to 8.625" and larger in 1964.
7.3.2 (formerly G-52C, Spec G-2)	Mill Applied Pipe Coating (Coal Tar) for 8.625" and Larger Pipe and Winter Installation (Dec through Feb) and Stock Pipe	1952	1999	1952, 1957, 1960, 1968	1957 version first mentions asbestos. It specifies coal tar saturated asbestos felt (15lbs/square) as the shielding wrap and notes that it may be omitted if handling will be limited (e.g., shipped directly to jobsite). No size limit listed in 1952. Changed to 3.5" & larger pipe in 1957. Changed to 4.5" and larger in 1960. Changed to 8.625" and larger in 1964.

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7.3.4 (formerly Std G-52E, Spec G5)	Mill Applied Pipe Coating (Wax Only and Wax/Coal Tar Mix) for 6.625" and smaller pipe	1957	1970	1957, 1960, 1964	1964 revision changed the outer shielding wrap from Trenton Mummy Wrap 50-B (combination 5mil polyethylene film over Kraft Paper w/ overlapping plastic edge) to hot coal tar enamel (no asbestos) 1957 version did not specify a pipe size limit. Title changed to 6.625" & smaller in 1964. Made obsolete on 1/23/1970; switched coating to Std 7.3.8 for FBE
7.3.5 (formerly Std G-52F)	Mill Applied Pipe Coating (Rubber/Polyethylene) for 2" through 6" Pipe	1962	1999	1962, 1965, 1966	High Density Polyethylene applied by extrusion, 30mil - 40mil, similar to X-Tru-Coat used by Republic Steel Corp. Originally (1964) pipe range was 2" through 6". Title changed to 2" and smaller in 1965. Title changed to 3/4" through 6" in 1966. Made coating standard for 6" IPS steel pipe in Jan 1970
7.3.6	Mill Applied Pipe Coating (Polyester Resin) for 2"" and smaller	1965	1967	1965, 1966	Saturated linear polyester resin (similar to FlexClad manufactured by Goodyear Tire & Rubber Co.) bonded to pipe by fusion process, 10 mils.
7.3.7	Mill Applied Pipe Coating (PVC) for 2"" and smaller	1965	1968	1965, 1966	PVC (similar to Jal-Bond manufactured by Jones & Laughlin Steel Corp) bonded to pipe by fusion process
7.3.8	Mill Applied Pipe Coating (FBE) for 12.75" OD and Smaller	1967	1999	1967, 1978, 1981, 1985	Thermoset Epoxy Resin (similar to Scotchkote by 3M) Replaced by GD210 sometime after 1985
GD210	MATERIAL SPECIFICATION FOR PLANT APPLIED COATING MATERIAL	1985		2002 2016	2002 - 12 MIL min FBE 2016 – Expanded permanent marking / stenciling requirements on exterior of pipe; changed minimum thicknesses for corrosion resistant FBE layer and the abrasion resistant overlay layer; changed specified FBE from 3M 206N to 6233P; separated cleaning/surface preparation and coating application sections between corrosion resistant FBE layer and abrasion resistant overlay layer

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1. Purpose

To comply with PHMSA, State, Local, etc. regulations, the Duke Energy Natural Gas Business Unit has established this procedure to facilitate regulatory compliance and support safe, reliable operations.

2. Governing Code and References

- PHMSA reference: 49 CFR 192.XXX(x)(x)

3. State Specific Requirements

- Refer to Permit for specific requirements

4. Environmental Information

- Refer to the Environmental Handbook section 5, Contaminated Soil

5. Who

- This Procedure applies to anyone backfilling on behalf of Duke Energy

6. Backfill Requirements

1. Backfilling shall be done as soon as possible after the pipe has been placed in the trench **and in such a manner as not to damage the pipe, coating, or curb box**.

2. The preferred method of backfilling shall be by using compacted excavated material from the trench provided such material consists of finely divided top soil or sand. Backfill material must be free from organic matter, slag, cinders, frozen lumps, or debris; and is suitable for back filling.

3. The spoil removed from the excavation of a plastic main installation may be used as back fill material provided that it contains no stone greater than ½ inch in diameter. If it contains stone greater than one-half (½) inch but less than 6 inches in diameter, at least 6 inches of bank run or sand must be placed over the plastic pipe before backfilling with the spoil.

4. **Excavated rocks or stones with any dimension greater than 6 inches must not be returned to the trench.**

5. The backfill shall then be completed to grade, using the excavated material. Excavated material, which is not suitable for backfilling, shall be disposed of properly.

6. Padding shall be used at the discretion of the Inspector and/or Engineer. Padding is defined as bank run placed below and above the pipe and will be used in soils unsuitable for back fill. Bank run gravel shall be per ODOT 703.11 Ohio type 2 as listed in ODOT's "Construction Material Specification" or clean washed sand.

7. When rock, ledge, hardpan, or boulder is encountered, the trench bottom shall be undercut at least four (4) inches and the undercut refilled with a pad of clean spoil, good-bearing bank run (with some rounded stone), or sand. Refer to Gas Standard 2.18.1 *Typical Trench Details – Polyethylene Pipe*.

8. When ledge rock or hardpan is encountered during the construction of plastic main installation, at least twelve (12) inches of bank run or sand must be placed over the plastic pipe. The side fills must be compacted to prevent the plastic pipe from being in contact with the rocky trench walls.

9. Back filling shall be done in accordance with the rules of the governing agency responsible for the area where work is taking place, within the limits of all public or private roads and driveways.

10. CLSM must be used as required within the hard surface areas by the appropriate governmental agency or as directed by Duke Energy. CDF, CLSM or Flash Fill must meet the specifications of the appropriate governing agency (Hamilton Co. /Cincinnati, ODOT or KDOT specifications).

11. When backfilling in sod areas, the gas main, service tee, and stop cock shall be covered with sand before backfilling the remainder of the excavation with the removed spoil. The service pipe shall be installed with a smooth, gradual transition from the service tee to the required service installation depth. Sudden elevation changes in the service pipe overstress the service tee and can cause it to fracture over time.

12. When backfilling in roadways on:

    a. Two (2) inch – six (6) inch pipe, the gas main and service tee shall be covered with sand before backfilling the remainder of the excavation with the permit required backfill material. Sand shall be placed to a height of 6" above the pipe.

    b. Eight (8) inch and twelve (12) inch pipe, the excavation will be filled with permit required backfill material and not padded with sand to avoid settlement. If the required backfill is CLSM and the fill is over an extended length, placing sand over the main in a few locations may be required to prevent the main from "floating".

7. Backfill Compaction

1. Backfill Compaction" shall be defined as compaction by means of air tools, hand tools or machine tamping.

2. If the back fill is to be **hand tamped** it shall be compacted in horizontal layers not exceeding four inches in depth.

3. Back fill material shall be placed and compacted in uniform horizontal layers not exceeding twelve (12) inches in thickness, loose measurement. Each layer shall be compacted by means of approved tampers. Successive blows of the tamper shall overlap no less than one-fourth of the width of the tamper head. Each layer shall be dampened when necessary to ensure the maximum density obtainable, or as directed.

4. Extreme care will be taken to ensure that the back fill material is adequately compacted both underneath and around gas pipe and fittings to prevent excessive stress and shearing forces. Hand tamp around fittings where mechanical compaction cannot be used.

5. Where the pipeline passes under main line sewers or culverts, and the installation was done by tunneling, the backfill material shall be controlled density fill.

8. Operation

1. Backfilling shall follow the installation of the service pipe as closely as possible.

2. Backfilling shall be done by approved methods which provides desired compaction and in accordance with all requirements of local governmental authorities.

3. Foreign material that might damage the pipe, either physically or through corrosion, shall not be used in the backfill, i.e., cans, wood, glass, welding rods, etc.

4. All excavations in traffic areas of streets, alleys, roads, berms, etc. shall be compacted with pneumatic, hydraulic, or approved mechanical compactors.

5. Clean-up work shall closely follow backfilling and shall be finished as soon as possible.

6. Backfill shall be carefully shoveled around the pipe/curb box and thoroughly compacted.

7. The employee shall prevent pipe and curb box from moving either horizontally or vertically during placement and compaction. To prevent damage to the new piping, shovel pipe embedment material in place.

8. All backfill shall be brought up to equal height along each side of the pipe in such a manner as to avoid displacement

9. If shifting of the curb box occurs, the item is to be moved back to its correct position by hand or by the use of a steel bar with a blunt end. If unable to move the curb box without straining, the employee must remove backfill material with a shovel until realignment by hand may be achieved.

9. Preparation

- N/A

10. Safety Requirements

At Duke Energy, Health and Safety is a Core Company Value. Employees are responsible for maintaining the highest regard for safety while planning and conducting work. Employees are also responsible for ensuring a safe work environment exists for themselves, their coworkers and their surrounding community.

Icon Key:

NOTE: *This icon raises awareness to important non-safety related information.*

This icon references Duke Energy's "Keys to Life" safety information to note significant or life threatening hazards and related precautions to be taken. A link to the Keys to Life Gas Operations document is provided here. *Additional links may exist in the document.*

CAUTION: *This icon identifies possible safety hazards and/or serves as a reminder to take necessary precautions.*

11. Definitions/Acronyms

- CLSM – Controlled Low Strength Material
- CDF – Controlled Density Fill
- Flash Fill – Fly Ash Controlled Density Fill

12. Tools, Materials, and Equipment

- Steel Bars should only be used when attempting to straighten a curb or valve box

13. Procedures/Process

- N/A

14. Recordkeeping

- Complete Restoration Order for permanent restoration

15. Associated Operator Qualifications/Training

- OQ Task 410 Installing Service Piping and Backfilling

16. Contact

- N/A

17. Required Forms

- Restoration Order

18. Appendices

- N/A

19. Signature

Reviewed and approved by:

Chad Fritsch

Chad Fritsch (Feb 26, 2019)

20. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	2-20-19	• Initial Issue	Jerome Humphries Bruce Greer Greg Menetrey

Table of Contents*

**Please consult Table 2 in WEL-ST-1000 Duke Energy NGBU Welding Standard for details summarizing each welding procedure prior to locating the procedure in this document.*

Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

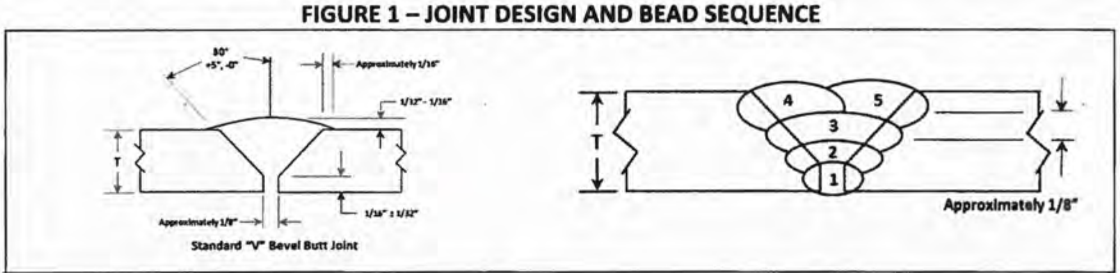
WPS Number: 10 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 1-1, 1-2, 1-3, 1-4

Welding Process: Manual Oxy-Acetylene Welding
Pipe or Fitting Material: API 5L X52 or less or equivalent material
Pipe or Fitting Diameter: 2.375 inch or less **Pipe or Fitting Wall Thickness:** 0.218 inch or less
Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness
Technique : Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Uphill or Horizontal
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection
Number 0 to Number 4 oxy-acetylene welding tips are permitted and should be based on wall thickness

WELDING PARAMETERS

Pass:	All		
AWS Classification:	RG60 or RG65		
Rod Diameter:	3/32"	1/8"	5/32"
Welding Gas:	Oxygen/Acetylene	Oxygen/Acetylene	Oxygen/Acetylene
Acetylene Flow Rate, CFH:	2 – 25	2 – 25	2 – 25
Gas Pressure, psi:	3 – 10 / 3 – 7	3 – 10 / 3 – 7	3 – 10 / 3 – 7
Flame Type:	Neutral	Neutral	Neutral
Travel Speed Range, ipm:	0.5 – 2.0	0.5 – 2.0	0.5 – 2.0

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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Approved (Dir. of Eng.): **Date:**

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 20 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 2-1, 2-2, 2-3, 2-4

Welding Process: Manual Oxy-Acetylene Welding

Pipe or Fitting Material: API 5L X52 or less or equivalent material

Pipe or Fitting Diameter: 2.375 inch or less

Pipe or Fitting Wall Thickness: 0.218 inch or less for run pipe with slightly larger diameter permitted for the expanded pipe end

Joint Design: Socket welds, Figure 1

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the shall be cleaned between passes with power or hand tools

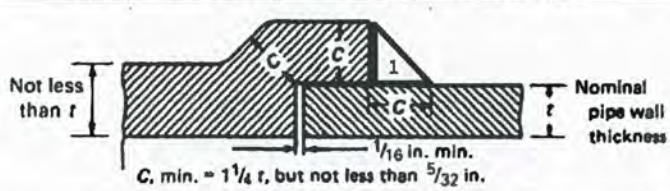
Comments: The weld should be allowed to air cool prior to inspection

Number 0 to Number 4 oxy-acetylene welding tips are permitted and tip selection should be based on wall thickness

WELDING PARAMETERS

Pass:	All		
AWS Classification:	RG60 or RG65		
Rod Diameter:	3/32"	1/8"	5/32"
Welding Gas:	Oxygen/Acetylene	Oxygen/Acetylene	Oxygen/Acetylene
Acetylene Flow Rate, CFH:	2 – 25	2 – 25	2 – 25
Gas Pressure, psi:	3 – 10 / 3 – 7	3 – 10 / 3 – 7	3 – 10 / 3 – 7
Flame Type:	Neutral	Neutral	Neutral
Travel Speed Range, ipm:	0.5 – 2.0	0.5 – 2.0	0.5 – 2.0

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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Approved (Dir. of Eng.): ______ **Date:** ______

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 30 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 3-1, 3-2, 3-3, 1-X42-179, 2-X42-154, 12-X42-219, 20-GRB-250

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** All

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 250°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

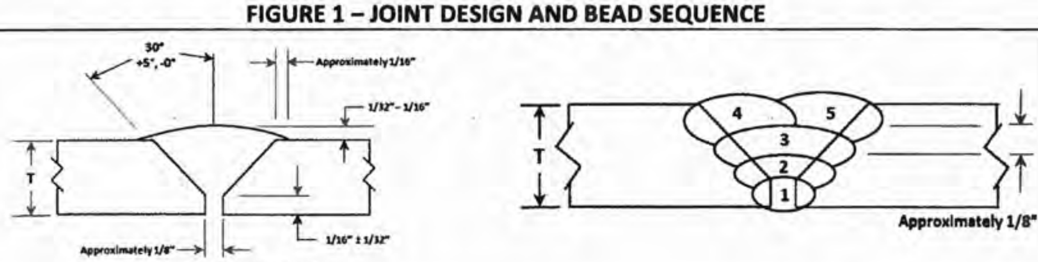
Comments: The weld should be allowed to air cool prior to inspection
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	All (including backwelding*)			All (including backwelding*)		
AWS Classification:	E6010			E7010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	19 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

Approved (SME): ____________________ **Date:** __________

Approved (Dir. of Eng.): ____________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 40 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 4-1, 4-2, 4-3, 4-4, 12-X60-375, 12-X52-375, 16-X60-312

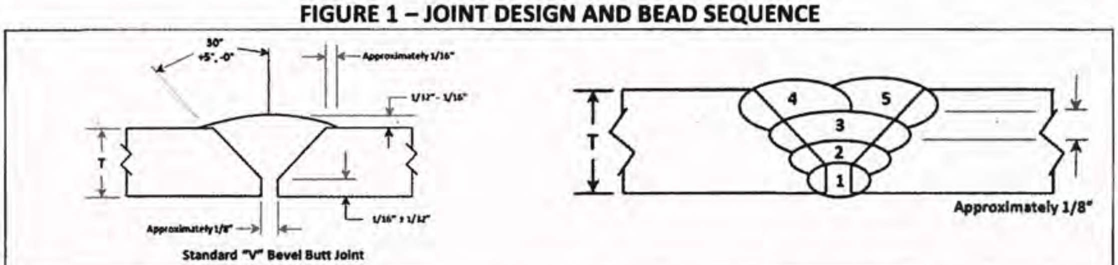
Welding Process: Manual SMAW
Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material
Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater
Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited
Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Downhill or Horizontal
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 250°F by any suitable means
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	Root or All			Remainder (including backwelding*)		
AWS Classification:	E6010			E7010 or E8010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 140	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	18 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 50 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 5-1, 16-X65-375

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

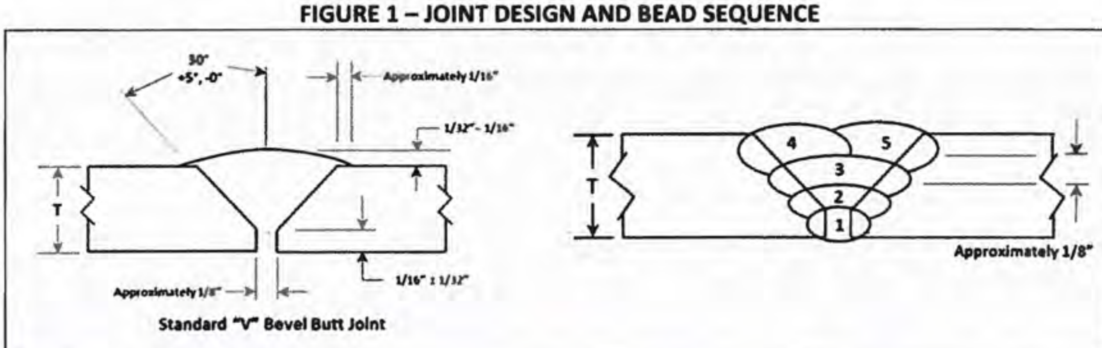
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder (including backwelding*)		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): **Date:**

Approved (Dir. of Eng.): **Date:**

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 60 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 6-1

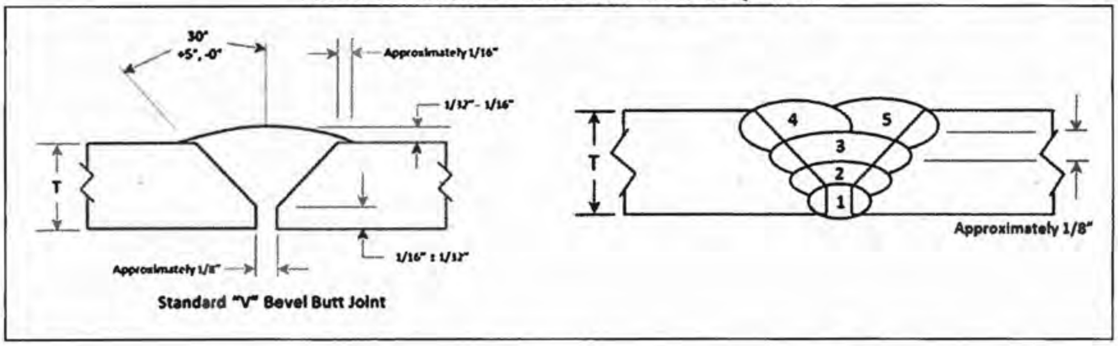
Welding Process: Manual SMAW
Pipe or Fitting Material: API 5L X70 or equivalent material
Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch
Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited
Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Downhill or Horizontal
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: Minimum temperature of 250°F should be used
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder (including backwelding*)		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 125	100 – 165	65 – 120	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ______ **Date:** ______
Approved (Dir. of Eng.): ______ **Date:** ______

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 70 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 7-1, 7-2

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 200°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

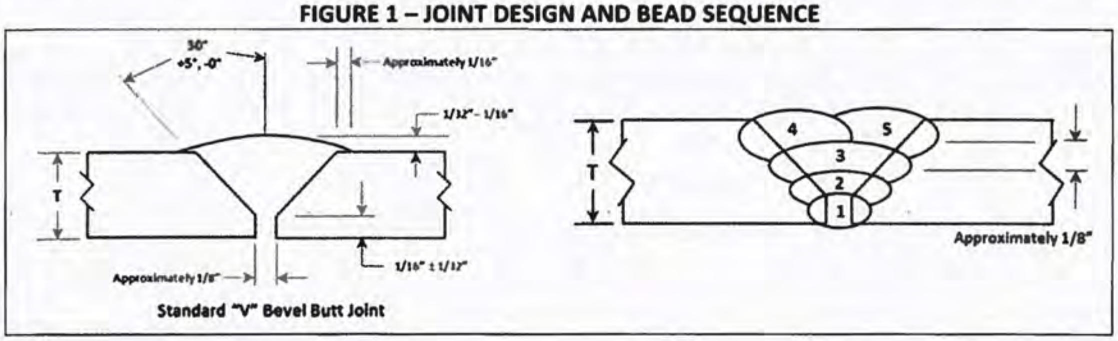
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional) (including backwelding*)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ______________________ **Date:** ____________

Approved (Dir. of Eng.): ______________________ **Date:** ____________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 80 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 8-1, 8-2

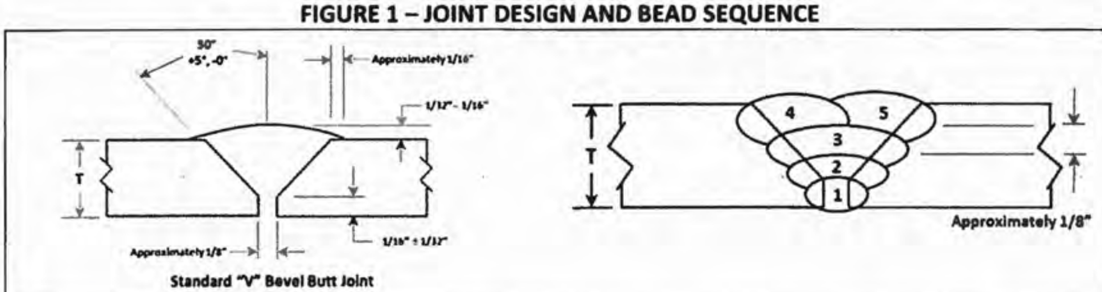
Welding Process: Manual SMAW
Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material
Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater
Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited
Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Uphill or Horizontal
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 200°F by any suitable means
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional) (including backwelding*)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ______ **Date:** ______
Approved (Dir. of Eng.): ______ **Date:** ______

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 90 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 9-1, 9-2, F12-X42-219

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.75 inch or less

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means.

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

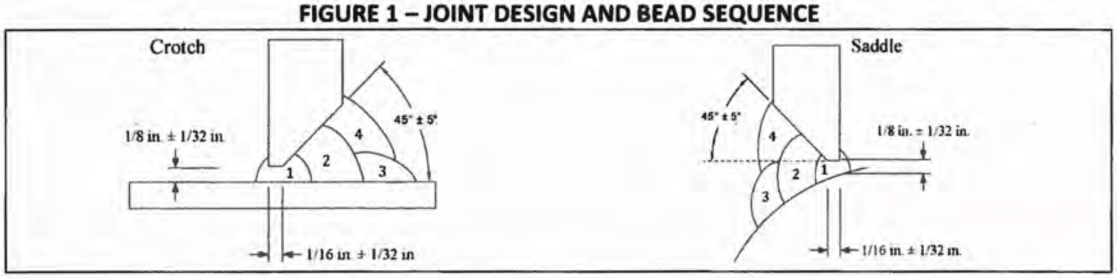
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	All			All		
AWS Classification:	E6010			E7010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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Approved (Dir. of Eng.): ______ **Date:** ______

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 100 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 10-1, 10-3, F6-X60-280

Welding Process: Manual SMAW

Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

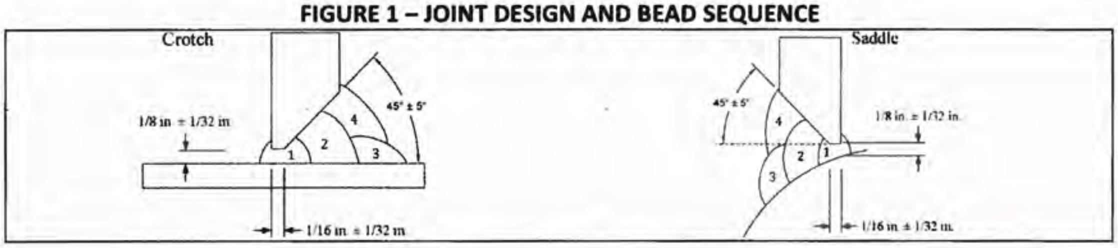
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection.
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E7010 or E8010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 140	90 – 165	130 – 210
Voltage Range:	20 – 32	19 – 33	20 – 32	18 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ________ **Date:** ________

Approved (Dir. of Eng.): ________ **Date:** ________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 110 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 11-1, F8-X65-322

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

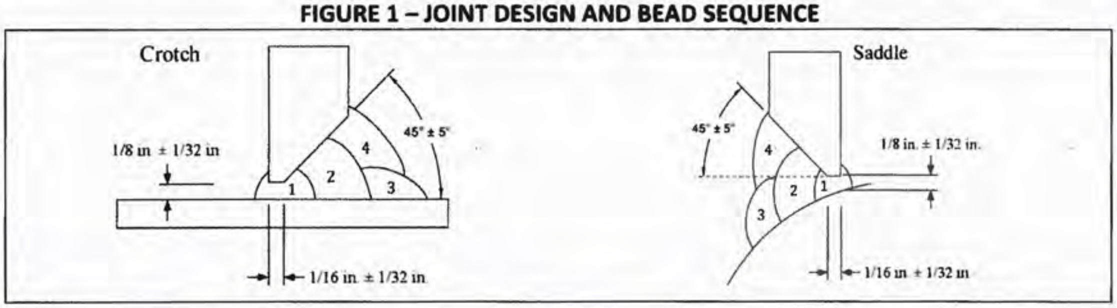
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 135	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 33	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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Approved (Dir. of Eng.): ______ **Date:** ______

DUKE ENERGY.

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 120 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 12-1

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X70 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

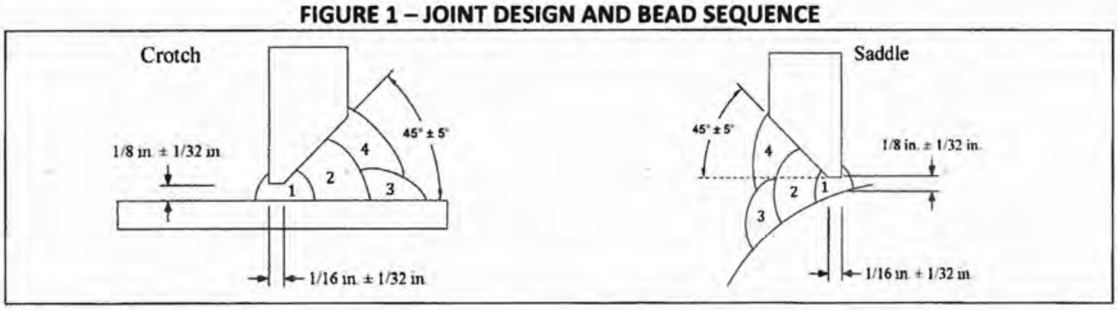
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 125	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 33	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ____________ **Date:** ________

Approved (Dir. of Eng.): ____________ **Date:** ________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 130 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 13-1

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

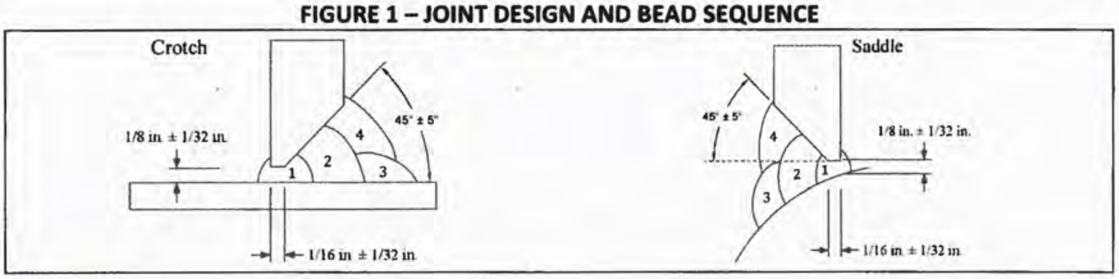
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): ____ **Date:** ____

Approved (Dir. of Eng.): ____ **Date:** ____

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 140 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: N16-02081

Welding Process: SMAW
Pipe or Fitting Material: <API 5L (X42) thru **API 5L (X65)**
Pipe or Fitting Diameter: ≤2.375"
Pipe or Fitting Wall Thickness: **≤0.188"**
Joint Design and Bead Sequence: Single "V" Butt Weld / See Figure 1

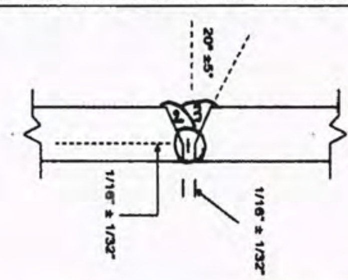
Position: Horizontal (Fixed) **Welding Direction:** Horizontal
Filler Metal: Group 1
Time Between Passes: **12 Minutes**
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Post-weld Heat Treatment: N/A **Interpass Temperature:** 80°F
Line-up Clamps: External
Cleaning: Grinding / Power Wire Brush

Comments:

WELDING PARAMETERS

Pass:	1	2	3			
AWS Classification:	A5.1	A5.1	A5.1			
Electrode Diameter:	1/8"	3/32"	3/32"			
Current/Polarity:	DCRP	DCRP	DCRP			
Current Range:	72 - 75	75 - 80	80 - 84			
Voltage Range:	20 - 22	22 - 24	24 -26			
Travel Speed Range, ipm:	6 - 12 IPM	4 - 8 IPM	4 - 8 IPM			

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved By: **Date:**

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 150 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: N16-02081

Welding Process: SMAW
Pipe or Fitting Material: <API 5L (X42) thru API 5L (X65)
Pipe or Fitting Diameter: ≤2.375"
Pipe or Fitting Wall Thickness: ≤0.188"
Joint Design and Bead Sequence: Fillet Weld / See Figure 1

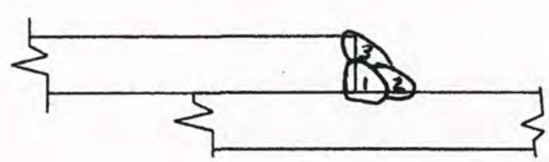
Position: Horizontal (Fixed) **Welding Direction:** Downhill
Filler Metal: Group 1
Time Between Passes: 12 Minutes
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Post-weld Heat Treatment: N/A **Interpass Temperature:** 80°F
Line-up Clamps: External
Cleaning: Grinding / Power Wire Brush

Comments:

WELDING PARAMETERS

Pass:	1	2	3			
AWS Classification:	A5.1	A5.1	A5.1			
Electrode Diameter:	1/8"	3/32"	3/32"			
Current/Polarity:	DCRP	DCRP	DCRP			
Current Range:	72 - 75	75 - 80	80 - 84			
Voltage Range:	20 - 22	22 - 24	24 -26			
Travel Speed Range, ipm:	6 - 12 IPM	4 - 8 IPM	4 - 8 IPM			

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved By: **Date:**

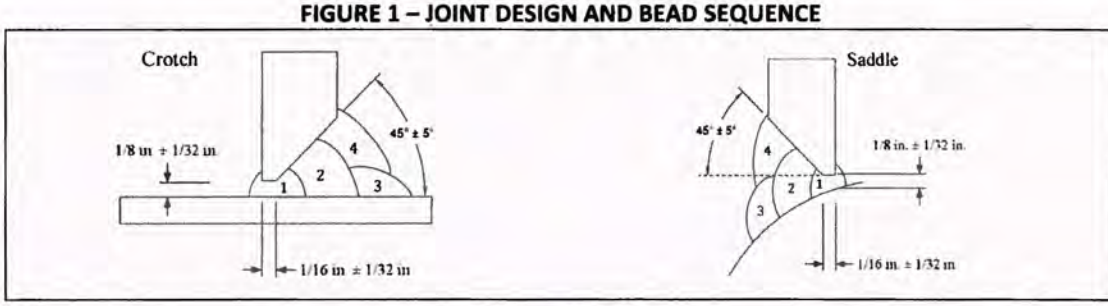
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 160 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 25CLH-B-1 and supporting verification welds 35LH, 35LH-BW, 48LH and 42LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness (2): 0.188 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 160 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Branch
Category I	CE (IIW) ≤ 0.35	CE (IIW) ≤ 0.48
Category II	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.48

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

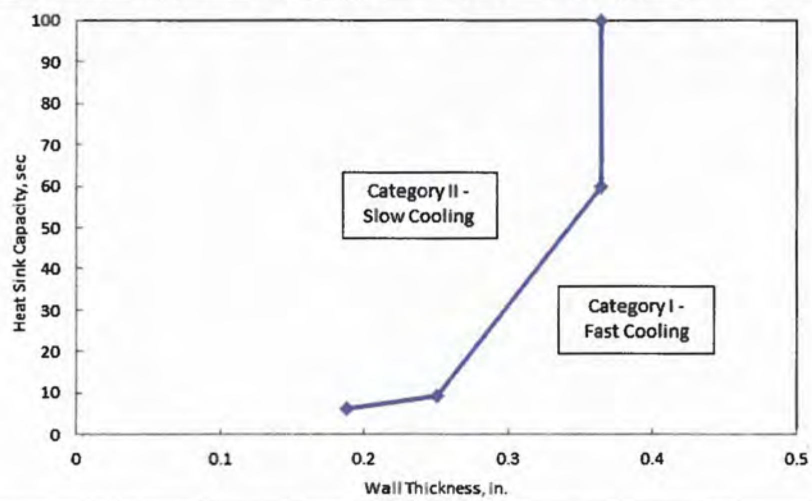
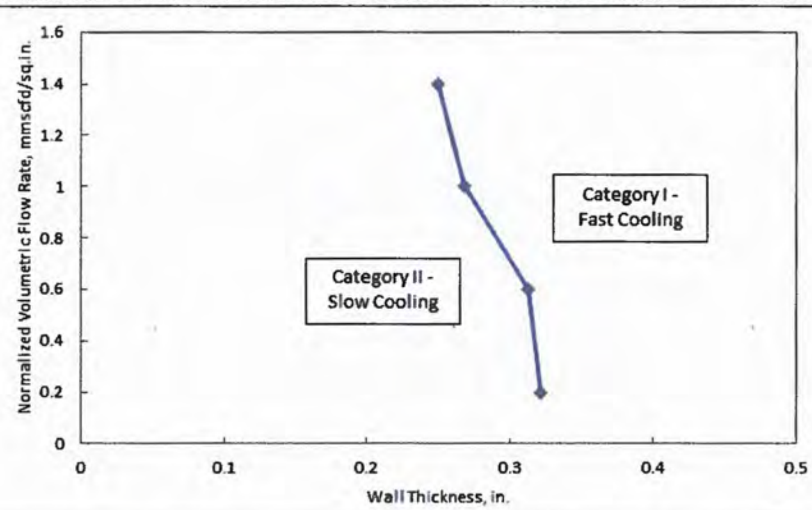


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW RATE



WPS Number: 160 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Root			
AWS Classification:	E7018 H4R		or E7016 H4	
Electrode Diameter (in.) (3):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 7	2 – 11
Heat Input Min. (kJ/in.) (5):	25	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.37	0.61

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ____________ **Date:** ________

Approved By: ____________ **Date:** ________

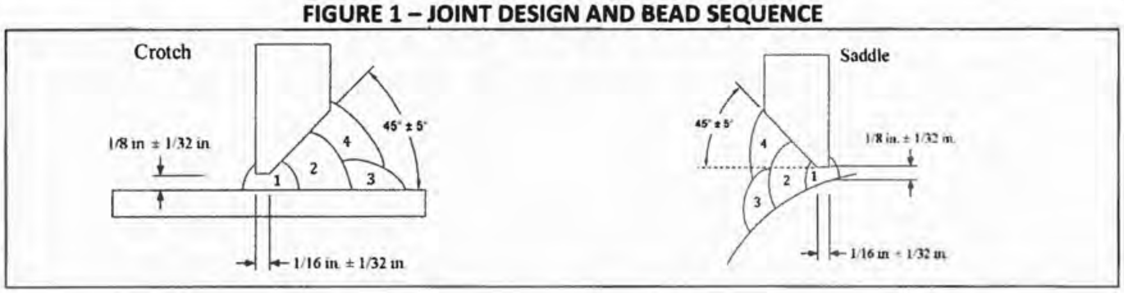
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 170 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 40LH-B-1 and supporting verification welds 42LH, 42LH-BW and 50LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness: 0.250– 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188– 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 170 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Branch
Category I	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.42
Category II	CE (IIW) ≤ 0.50	CE (IIW) ≤ 0.50

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

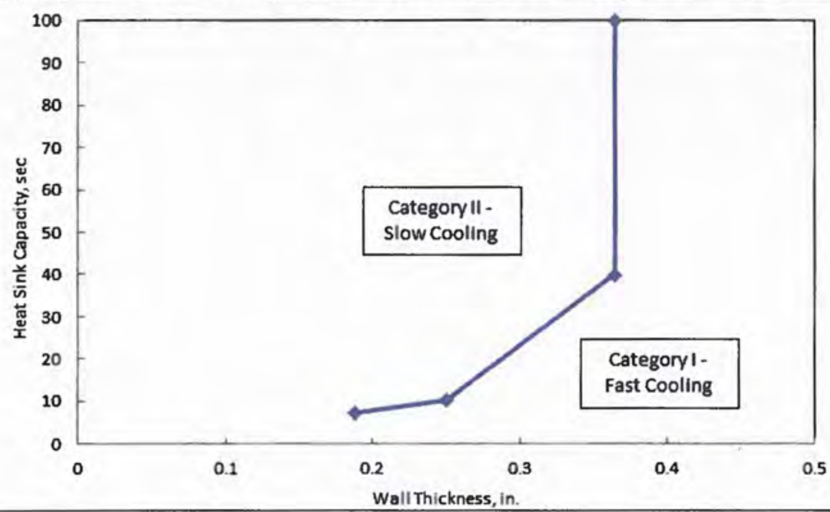
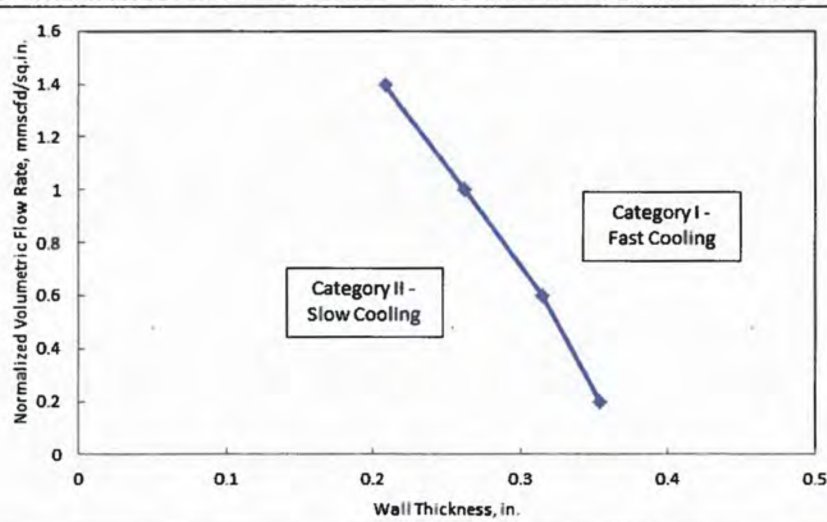


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW



WPS Number: 170 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Root			
AWS Classification:	E7018 H4R	or	E7016 H4	
Electrode Diameter (in.):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 4	2 – 7
Heat Input Min. (kJ/in.) (3):	40	40	40	40
Run-Out Ratio Max. (4):	0.23	0.38	0.23	0.38

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 13
Heat Input Min. (kJ/in.) (3):	40	40	40
Run-Out Ratio Max. (4):	0.23	0.38	0.59

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The welding parameter ranges in the parentheses are recommended
(3) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(4) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

DUKE ENERGY

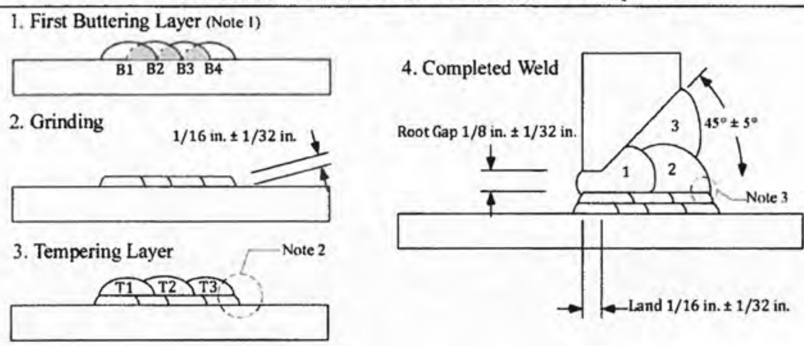
IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 4**

WPS Number: 180 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: TBLH-B-1 and supporting verification welds 50LH-2 and 50LH-BW
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent, Table 1
Pipe and Branch Material CE (1): Less than or equal to 0.50 CE (IIW)
Pipe Wall Thickness (2): 0.157 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.157 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1 or Figure 2, the figures are not intended to show all possible bead sequences, only the buttering layers shall contact the run pipe and minimum of three passes is required after the buttering layer. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe OD. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Any flow conditions

WPS Number: 180 **Rev.:** 1 **Page:** 2 of 4

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



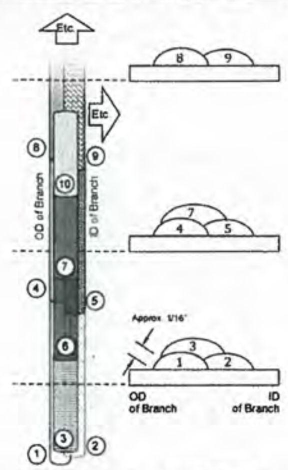
Note 1: 50% linear overlap of buttering beads for proper tempering.

Note 2: Toe of second buttering layer just consumes corner produced by grinding step. No new heat-affected zone in base material permitted.

Note 3: Grinding may be performed on the temper layer to create a uniform surface for fit-up.

Comment: The buttering layer beads are deposited directly on the run pipe at a heat input of approximately 15 kJ/in. The temper layer beads shall be deposited on the buttering layer at a heat input level of approximately 25 kJ/in. The number of buttering layer beads is determined by the required fillet weld leg length.

FIGURE 2 – ALTERNATIVE TEMPER BEAD DEPOSITION SEQUENCE



Comment: When high thermal severity is expected a block deposition sequence should be considered. Block deposition sequence requires tempering the buttering layer as soon as possible.

WPS Number: 180 **Rev.:** 1 **Page:** 3 of 4

WELDING PARAMETERS

Pass:	Buttering Layer		Temper Layer	
AWS Classification:	E7018 H4R		E7018 H4R	
Electrode Diameter (in.) (3):	5/64	3/32	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (4):	40 – 96 (50 – 80)	48 – 132 (60 – 110)	48 – 132 (60 – 110)	68 – 192 (85 – 160)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 13	2 – 17	2 – 10	2 – 15
Heat Input Range (kJ/in.) (5):	11 – 19	11 – 19	21 – 29	21 – 29
Nominal Run-Out Ratio (6):	0.51	0.62	0.37	0.61

Pass:	Root			
AWS Classification:	E7018 H4R	or	E7016 H4	
Electrode Diameter (in.):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 7	2 – 11
Heat Input Min. (kJ/in.) (5):	25	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.37	0.61

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

WPS Number: 180 **Rev.:** 1 **Page:** 4 of 4

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The risk of burn-through should be evaluated when run pipe is less than 0.25 in.
(3) Only 5/64 and 3/32 in. electrodes permitted when the run pipe is less than 0.25 in.
(4) The welding parameter ranges in the parentheses are recommended
(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______ **Date:** ______

Approved By: ______ **Date:** ______

DUKE ENERGY

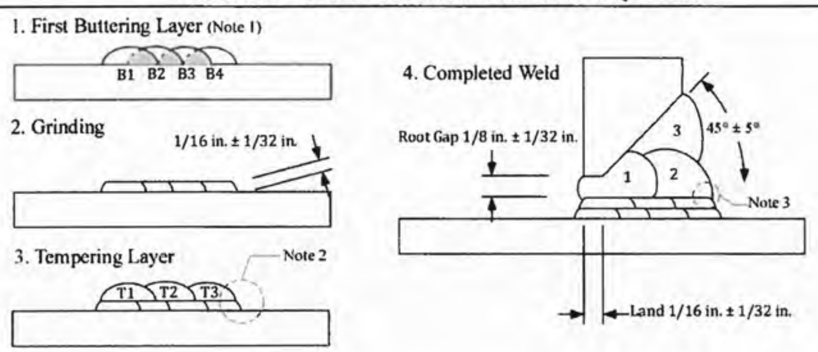
IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page:** 1 of 4

WPS Number: 190 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: TBLH-B-1 and supporting verification welds 50LH-TW-2 and 50LH-TW-3
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Less than or equal to 0.50 CE (IIW)
Pipe Wall Thickness (2): 0.125 – 0.156 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.125 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1 or Figure 2, the figures are not intended to show all possible bead sequences, only the buttering layers shall contact the run pipe and minimum of three passes is required after the buttering layer. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe OD. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Any flow conditions

WPS Number: 190 **Rev.:** 1 **Page:** 2 of 4

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



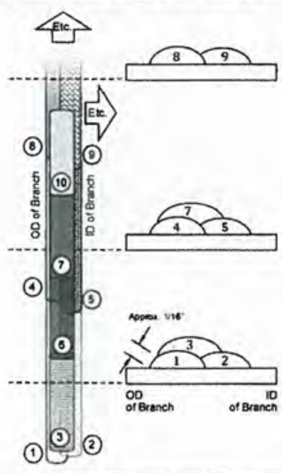
Note 1: 50% linear overlap of buttering beads for proper tempering.

Note 2: Toe of second buttering layer just consumes corner produced by grinding step. No new heat-affected zone in base material permitted.

Note 3: Grinding may be performed on the temper layer to create a uniform surface for fit-up.

Comment: The buttering layer beads are deposited directly on the run pipe at a heat input of approximately 10 kJ/in. The temper layer beads shall be deposited on the buttering layer at a heat input level of approximately 16 kJ/in. The number of buttering layer beads is determined by the required fillet weld leg length.

FIGURE 2 – ALTERNATIVE TEMPER BEAD DEPOSITION SEQUENCE



Comment: When high thermal severity is expected a block deposition sequence should be considered. Block deposition sequence requires tempering the buttering layer as soon as possible.

WPS Number: 190 **Rev.:** 1 **Page:** 3 of 4

WELDING PARAMETERS

Pass:	Butter Layer		Temper Layer
AWS Classification:	E7018 H4R		E7018 H4R
Electrode Diameter (in.):	5/64	3/32	3/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (3):	40 – 96 (50 – 80)	48 – 132 (60 – 110)	48 – 132 (60 – 110)
Voltage Range (volts) (3):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	4 – 19	4 – 26	3 – 16
Heat Input Range (kJ/in.) (4):	6 – 14	6 – 14	12 – 20
Nominal Run-Out Ratio (5):	0.76	0.94	0.58

Pass:	Root			
AWS Classification:	E7018 H4R		or E7016 H4	
Electrode Diameter (in.):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (3):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (3):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 7	2 – 11
Heat Input Min. (kJ/in.) (4):	25	25	25	25
Run-Out Ratio Max. (5):	0.37	0.61	0.37	0.61

Pass:	Remainder	
AWS Classification:	E7018 H4R	
Electrode Diameter (in.):	3/32	1/8
Current/Polarity:	DCEP	DCEP
Current Range (amps) (3):	48 – 132 (60 – 110)	68 – 192 (85 – 160)
Voltage Range (volts) (3):	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15
Heat Input Min. (kJ/in.) (4):	25	25
Run-Out Ratio Max. (5):	0.37	0.61

WPS Number: 190 **Rev.:** 1 **Page:** 4 of 4

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The risk of burn-through should be evaluated prior to welding.
(3) The welding parameter ranges in the parentheses are recommended
(4) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(5) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ____________________ **Date:** __________

Approved By: ____________________ **Date:** __________

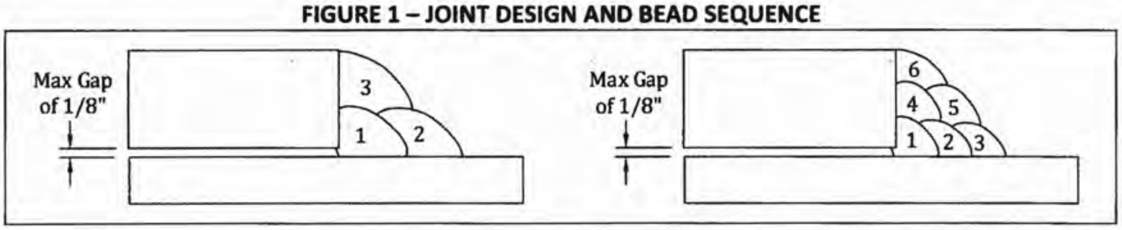
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 200 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 25LH-S-1 and supporting verification welds 35LH, 48LH and 42LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Sleeve Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Sleeve Material CE (1): Table 1
Pipe Wall Thickness (2): 0.188 – 0.75 in. **Pipe Diameter:** All diameters
Sleeve Wall Thickness: 0.188 – 1.25 in.
Joint Design: Figure 1, fillet welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required.
Weld Size and Shape: Fillet welds shall have leg lengths at least equal to the lengths required by the code of construction and shall not be excessively concave or convex.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 200 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Sleeve
Category I	CE (IIW) ≤ 0.35	CE (IIW) ≤ 0.48
Category II	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.48

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

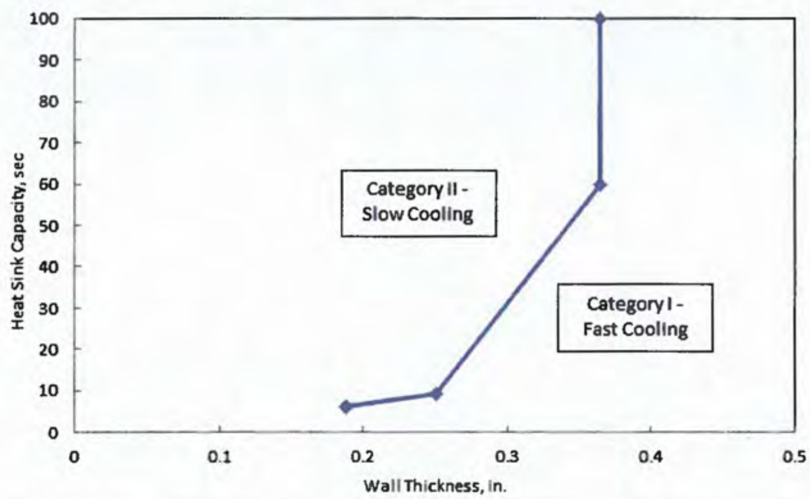
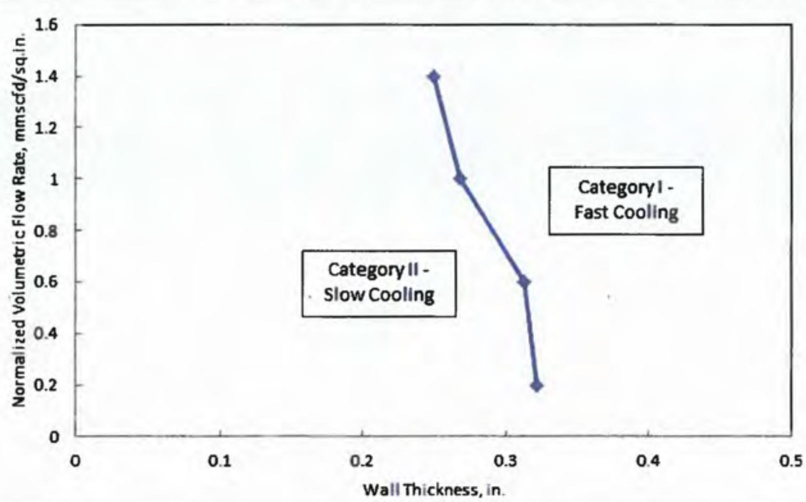


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW RATE



WPS Number: 200 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

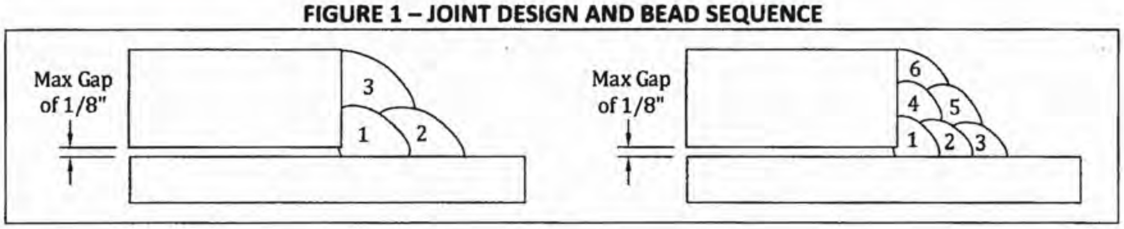
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page:** 1 of 3

WPS Number: 210 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 40LH-S-1 and supporting verification welds 42LH and 50LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Sleeve Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Sleeve Material CE (1): Table 1
Pipe Wall Thickness: 0.250 – 0.75 in. **Pipe Diameter:** All diameters
Sleeve Wall Thickness: 0.188 – 1.25 in.
Joint Design: Figure 1, fillet welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required.
Weld Size and Shape: Fillet welds shall have leg lengths at least equal to the lengths required by the code of construction and shall not be excessively concave or convex.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 210 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Sleeve
Category I	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.42
Category II	CE (IIW) ≤ 0.50	CE (IIW) ≤ 0.50

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

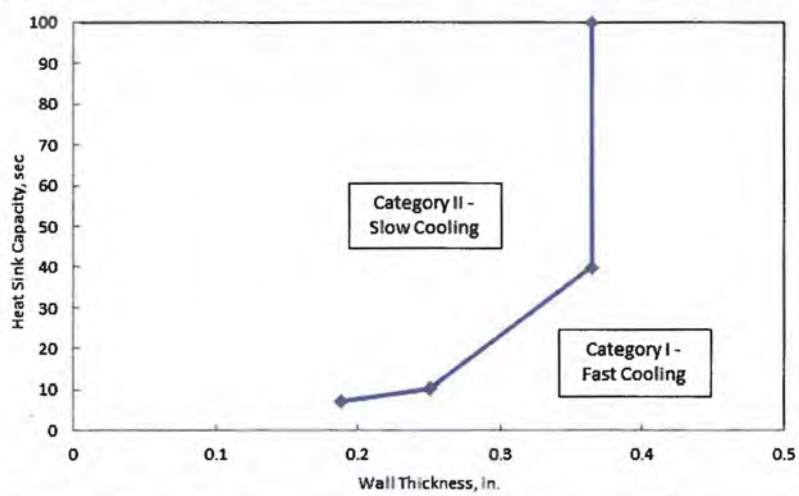
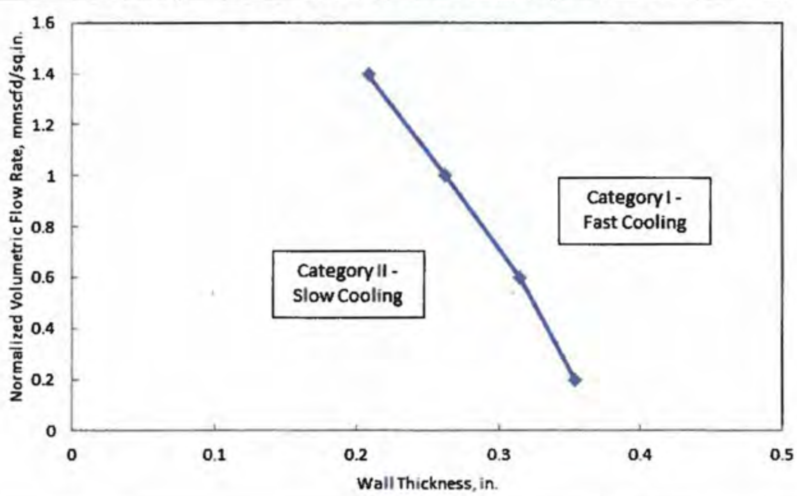


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW



WPS Number: 210 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps)(2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 13
Heat Input Min. (kJ/in.) (2):	40	40	40
Run-Out Ratio Max. (3):	0.23	0.38	0.59

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The welding parameter ranges in the parentheses are recommended
(3) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(4) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

DUKE ENERGY.

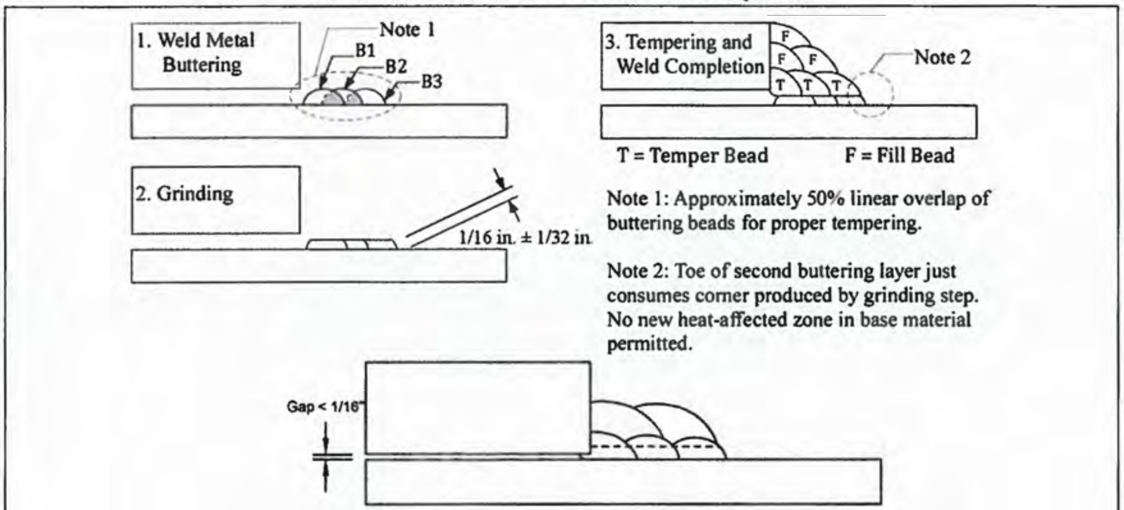
IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 220 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: TBLH-S-1 and supporting verification weld 50LH-2
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Sleeve Material SMYS: Less than or equal to API 5L X70 or equivalent, Table 1
Pipe and Sleeve Material CE (1): Less than or equal to 0.50 CE (IIW)
Pipe Wall Thickness (2): 0.157 – 0.75 in. **Pipe Diameter:** All diameters
Sleeve Wall Thickness: 0.157 – 1.25 in.
Joint Design: Figure 1, fillet welds
Bead Sequence: Figure 1 or Figure 2, the figures are not intended to show all possible bead sequences, only the buttering layers shall contact the run pipe and minimum of three passes is required after the buttering layer.
Weld Size and Shape: Fillet welds shall have leg lengths at least equal to the lengths required by the code of construction and shall not be excessively concave or convex.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Any flow conditions

WPS Number: 220 **Rev.:** 1 **Page:** 2 of 3

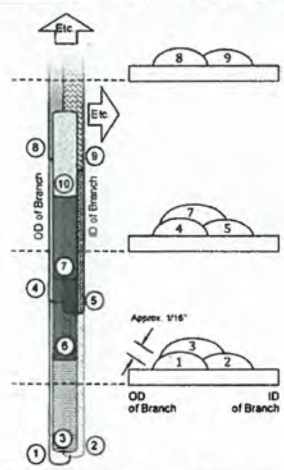
FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



This option for bead sequencing is acceptable for tight fitting sleeves.

Comment: The buttering layer beads are deposited directly on the run pipe at a heat input of approximately 15 kJ/in. The temper layer beads shall be deposited on the buttering layer at a heat input level of approximately 25 kJ/in. The number of buttering layer beads is determined by the required fillet weld leg length.

FIGURE 2 – ALTERNATIVE TEMPER BEAD DEPOSITION SEQUENCE



Comment: When high thermal severity is expected a block deposition sequence should be considered. Block deposition sequence requires tempering the buttering layer as soon as possible.

WPS Number: 220   **Rev.:** 1   **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Buttering Layer		Temper Layer	
AWS Classification:	E7018 H4R		E7018 H4R	
Electrode Diameter (in.) (3):	5/64	3/32	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (4):	40 – 96 (50 – 80)	48 – 132 (60 – 110)	48 – 132 (60 – 110)	68 – 192 (85 – 160)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 13	2 – 17	2 – 10	2 – 13
Heat Input Range (kJ/in.) (5):	11 – 19	11 – 19	21 – 29	21 – 29
Nominal Run-Out Ratio (6):	0.51	0.62	0.37	0.61

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ____________________ **Date:** __________

Approved By: ____________________ **Date:** __________

DUKE ENERGY

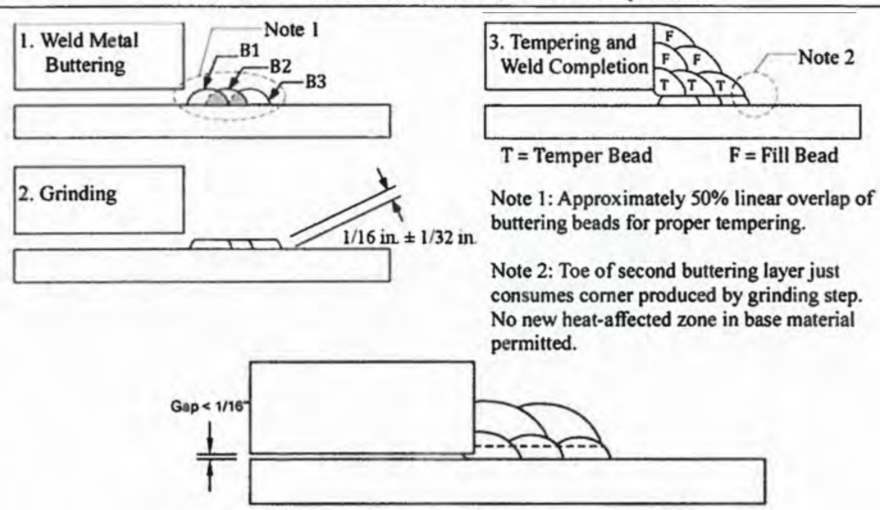
IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page:** 1 of 3

WPS Number: 230 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: TBLH-S-1 and supporting verification welds 50LH-TW-2 and 50LH-TW-3
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Sleeve Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Sleeve Material CE (1): Less than or equal to 0.50 CE (IIW)
Pipe Wall Thickness (2): 0.125 – 0.156 in. **Pipe Diameter:** All diameters
Sleeve Wall Thickness: 0.188 – 0.75 in.
Joint Design: Figure 1, fillet welds
Bead Sequence: Figure 1 or Figure 2, the figures are not intended to show all possible bead sequences, only the buttering layers shall contact the run pipe and minimum of three passes is required after the buttering layer.
Weld Size and Shape: Fillet welds shall have leg lengths at least equal to the lengths required by the code of construction and shall not be excessively concave or convex.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Any flow conditions

WPS Number: 230 **Rev.:** 1 **Page:** 2 of 3

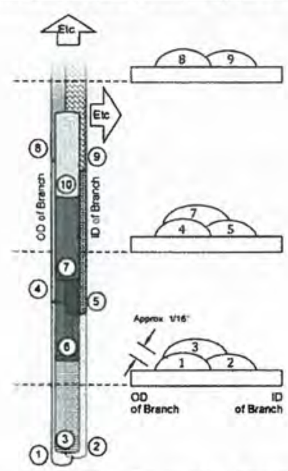
FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



This option for bead sequencing is acceptable for tight fitting sleeves.

Comment: The buttering layer beads are deposited directly on the run pipe at a heat input of approximately 10 kJ/in. The temper layer beads shall be deposited on the buttering layer at a heat input level of approximately 16 kJ/in. The number of buttering layer beads is determined by the required fillet weld leg length.

FIGURE 2 – ALTERNATIVE TEMPER BEAD DEPOSITION SEQUENCE



Comment: When high thermal severity is expected a block deposition sequence should be considered. Block deposition sequence requires tempering the buttering layer as soon as possible.

WPS Number: 230 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Butter Layer		Temper Layer
AWS Classification:	E7018 H4R		E7018 H4R
Electrode Diameter (in.):	5/64	3/32	3/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (3):	40 – 96 (50 – 80)	48 – 132 (60 – 110)	48 – 132 (60 – 110)
Voltage Range (volts) (3):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	4 – 19	4 – 26	3 – 16
Heat Input Range (kJ/in.) (4):	6 – 14	6 – 14	12 – 20
Nominal Run-Out Ratio (5):	0.76	0.94	0.58

Pass:	Remainder	
AWS Classification:	E7018 H4R	
Electrode Diameter (in.):	3/32	1/8
Current/Polarity:	DCEP	DCEP
Current Range (amps) (3):	48 – 132 (60 – 110)	68 – 192 (85 – 160)
Voltage Range (volts) (3):	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15
Heat Input Min. (kJ/in.) (4):	25	25
Run-Out Ratio Max. (5):	0.37	0.61

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The risk of burn-through should be evaluated prior to welding.
(3) The welding parameter ranges in the parentheses are recommended
(4) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(5) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

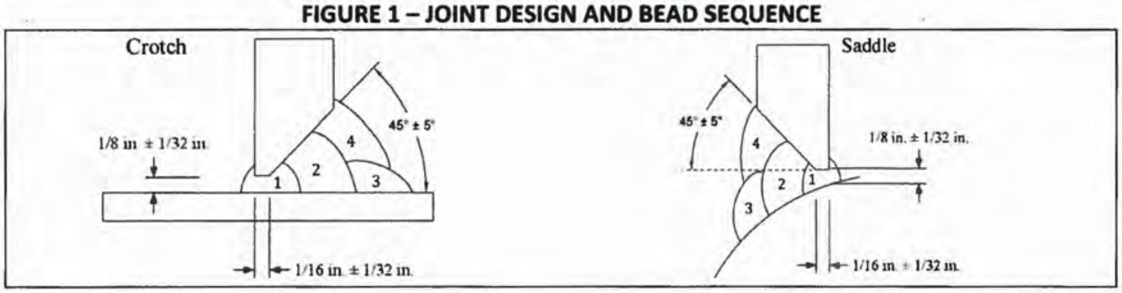
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page:** 1 of 3

WPS Number: 240 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 25CLH-B-1 and supporting verification weld 35CLH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness (2): 0.188 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Root – Downhill or horizontal; Rem. – Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 240 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (IIW) (1)	
	Pipe	Branch
Category I	N/A	N/A
Category II	CE (IIW) ≤ 0.35	CE (IIW) ≤ 0.35

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

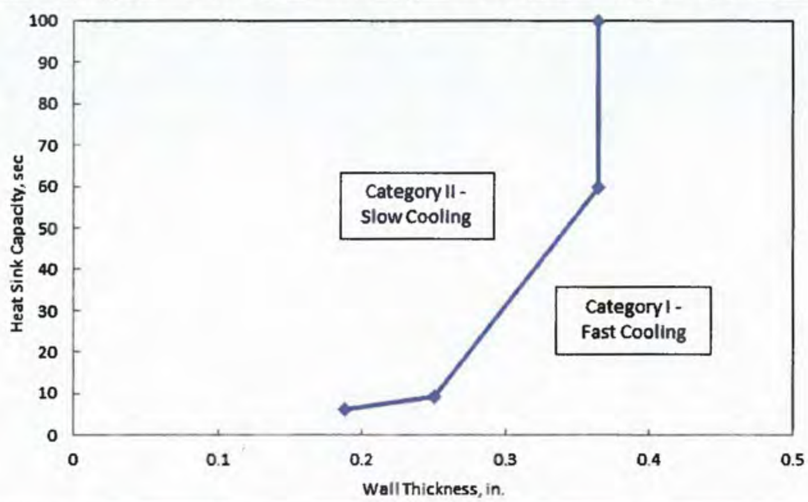
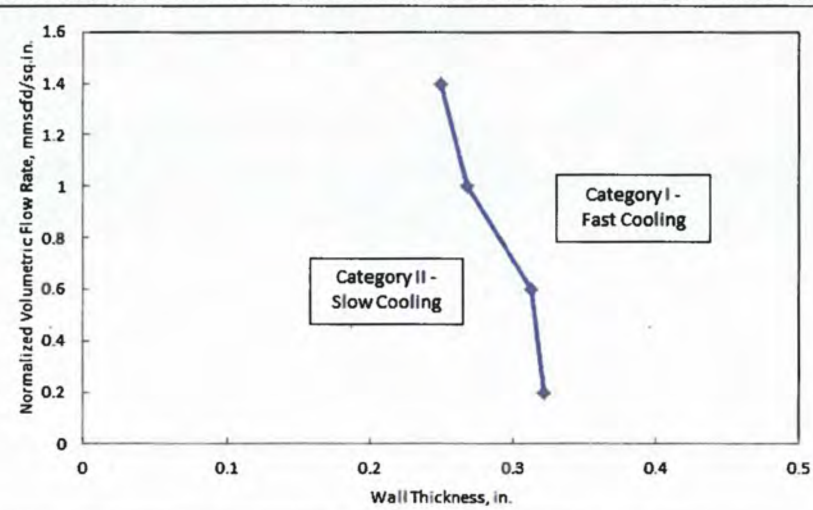


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW RATE



WPS Number: 240 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Root		
AWS Classification:	E6010		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	32 – 102 (40 – 85)	56 – 162 (70 – 135)	72 – 210 (90 – 175)
Voltage Range (volts) (4):	18 – 40 (22 – 34)	18 – 40 (22 – 34)	18 – 40 (22 – 34)
Travel Speed Range (ipm):	2 – 9	2 – 15	3 – 20
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.32	0.52	0.81

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** ______________

Approved By: ______________________ **Date:** ______________

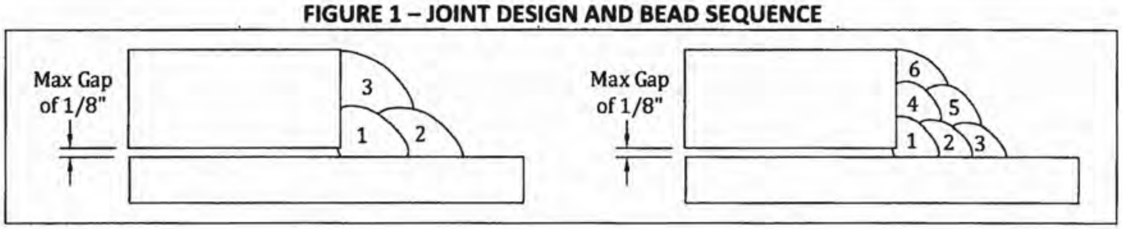
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page:** 1 of 3

WPS Number: 250 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 25CLH-S-1 and supporting verification weld 35CLH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Sleeve Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Sleeve Material CE (1): Table 1
Pipe Wall Thickness (2): 0.188 – 0.75 in. **Pipe Diameter:** All diameters
Sleeve Wall Thickness: 0.188 – 1.25 in.
Joint Design: Figure 1, fillet welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required.
Weld Size and Shape: Fillet welds shall have leg lengths at least equal to the lengths required by the code of construction and shall not be excessively concave or convex.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Root – Downhill or horizontal
Rem. – Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 250 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Sleeve
Category I	N/A	N/A
Category II	CE (IIW) ≤ 0.35	CE (IIW) ≤ 0.35

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

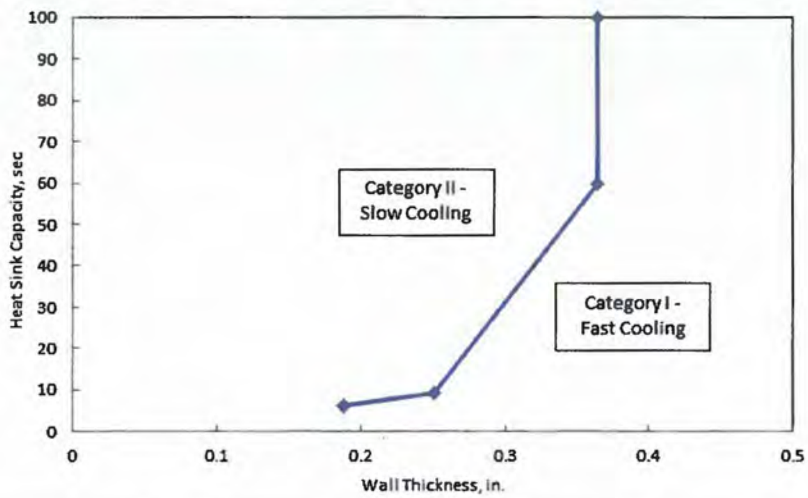
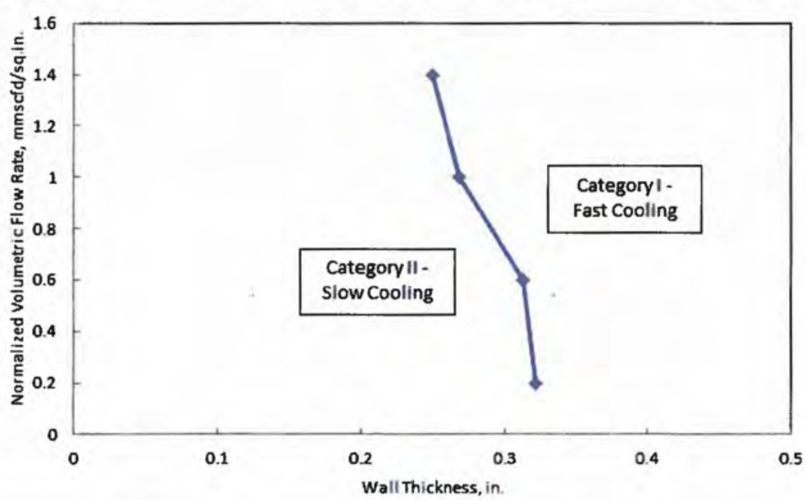


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW RATE



WPS Number: 250 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Root		
AWS Classification:	E6010		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	32 – 102 (40 – 85)	56 – 162 (70 – 135)	72 – 210 (90 – 175)
Voltage Range (volts) (4):	18 – 40 (22 – 34)	18 – 40 (22 – 34)	18 – 40 (22 – 34)
Travel Speed Range (ipm):	2 – 9	2 – 15	3 – 20
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.32	0.52	0.81

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

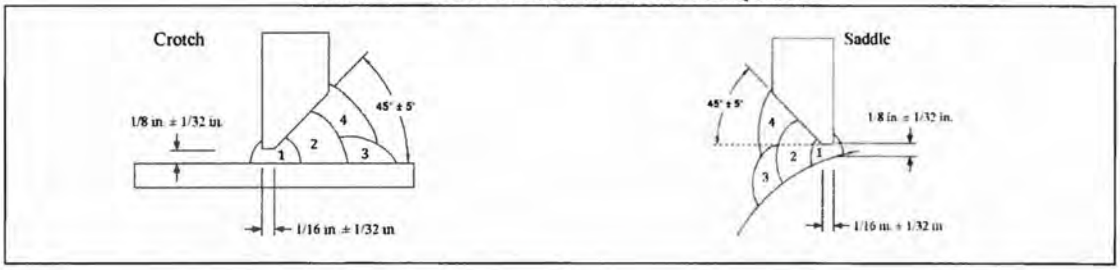
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 260 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 40CLH-B-2 and supporting verification weld 42CLH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent, Table 1
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness: 0.25 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required.
Weld Size and Shape Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Root – Downhill or horizontal
Rem. – Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 260 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Branch
Category I	N/A	N/A
Category II	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.42

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

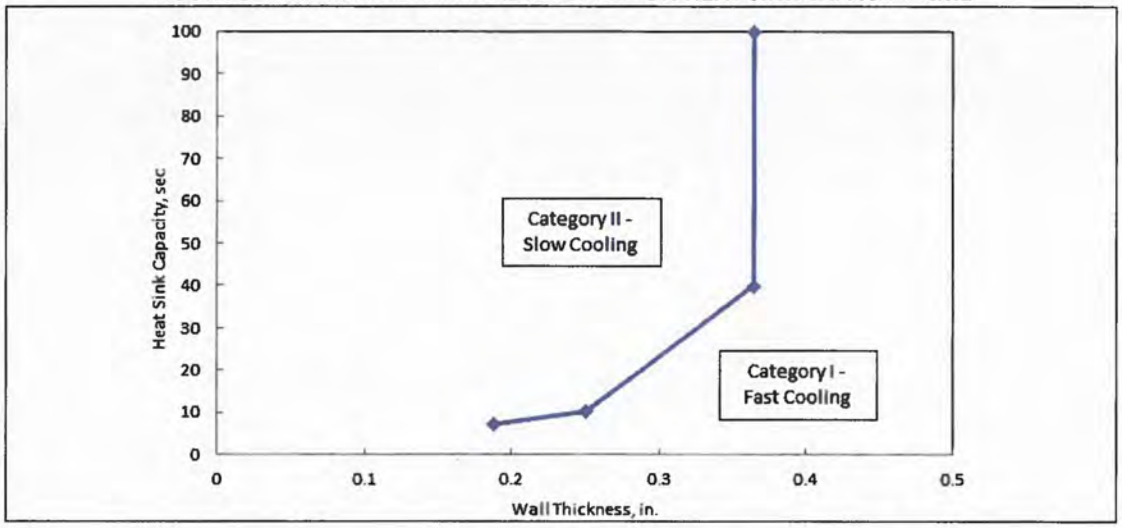
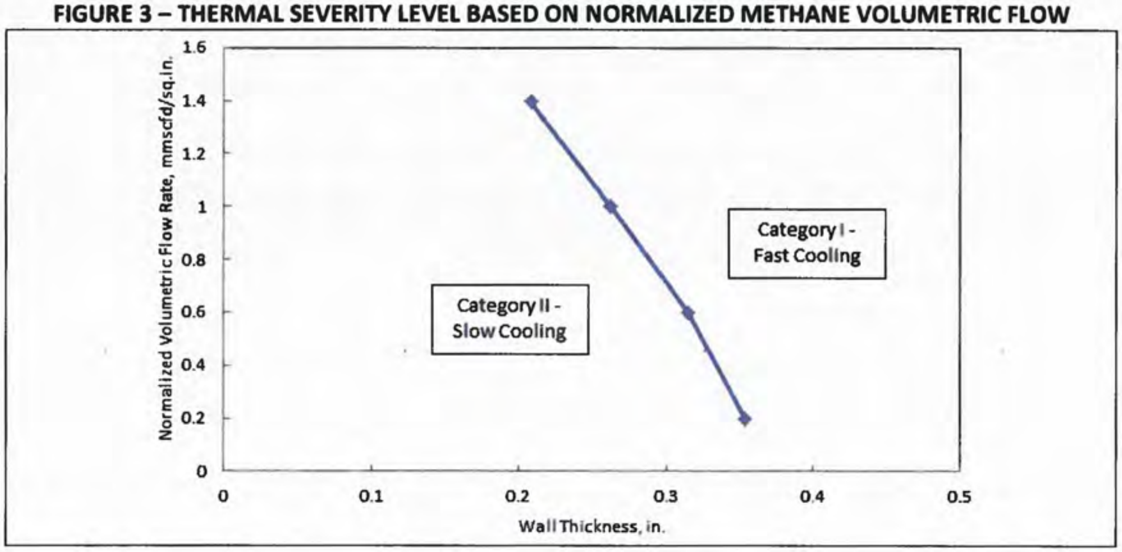


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW



WPS Number: 260 **Rev.:** 1 **Page:** 3 of 3

WELDING PARAMETERS

Pass:	Root		
AWS Classification:	E6010		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (2):	32 – 102 (40 – 85)	56 – 162 (70 – 135)	72 – 210 (90 – 175)
Voltage Range (volts) (2):	18 – 40 (22 – 34)	18 – 40 (22 – 34)	18 – 40 (22 – 34)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 12
Heat Input Min. (kJ/in.) (3):	40	40	40
Run-Out Ratio Max. (4):	0.20	0.33	0.50

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 13
Heat Input Min. (kJ/in.) (3):	40	40	40
Run-Out Ratio Max. (4):	0.23	0.38	0.59

Comment:
(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5
(2) The welding parameter ranges in the parentheses are recommended
(3) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)
(4) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

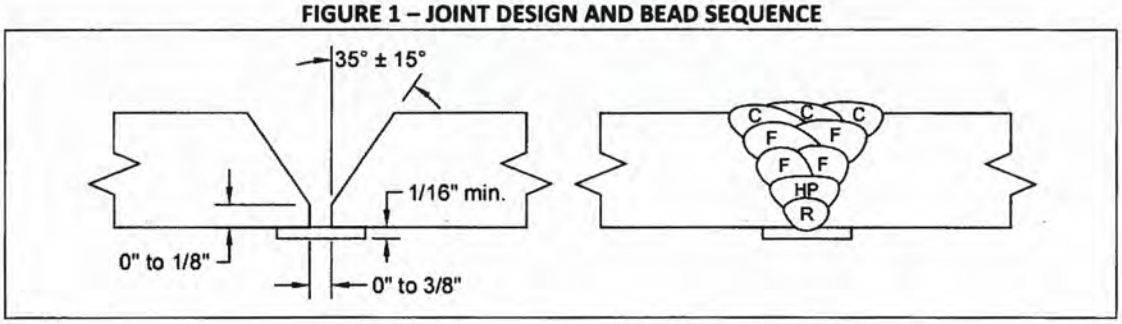
DUKE ENERGY

WELDING PROCEDURE SPECIFICATION **Page:** 1 of 2

WPS Number: 270 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X42LH-LS-1
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: Less than or equal to API 5L X42 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 270 Rev.: 1 Page: 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps):	60 – 110	85 – 160	110 – 220
Voltage Range (volts):	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

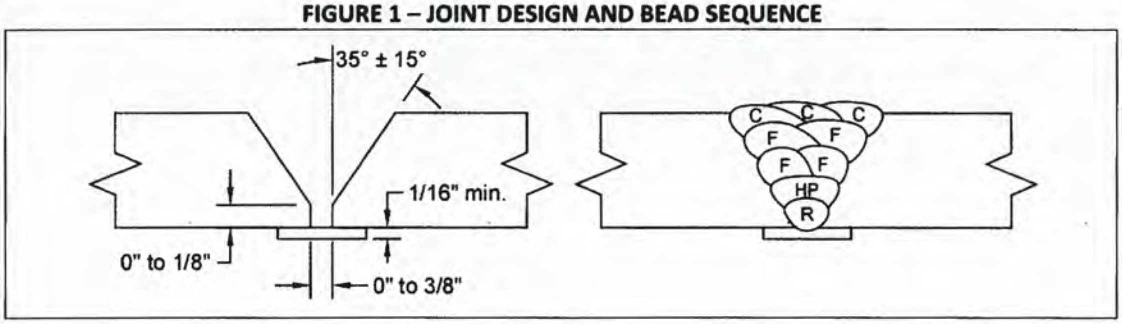
DUKE ENERGY

WELDING PROCEDURE SPECIFICATION **Page:** 1 of 2

WPS Number: 280 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X60LH-LS-1
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: Greater than API 5L X42 and less than or equal to API 5L X60 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 280 **Rev.:** 1 **Page:** 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps):	60 – 110	85 – 160	110 – 220
Voltage Range (volts):	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

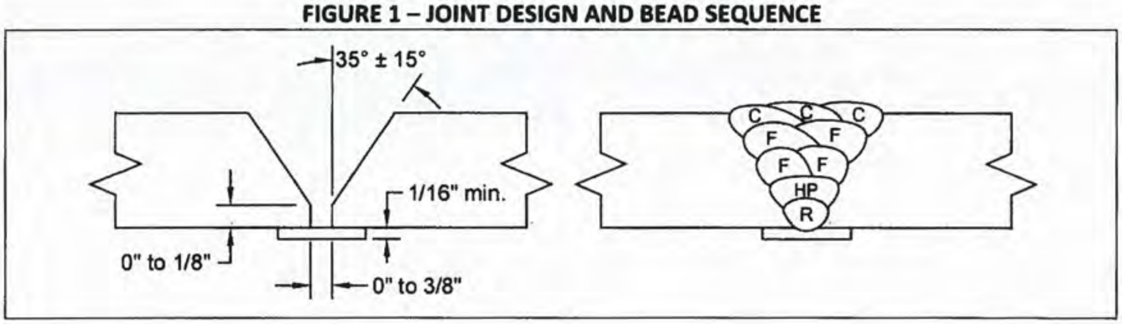
DUKE ENERGY

WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 290 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X65LH-LS-7018-1
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: API 5L X65 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline contents.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 290 **Rev.:** 1 **Page:** 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range:	60 – 110	85 – 160	110 – 220
Voltage Range:	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

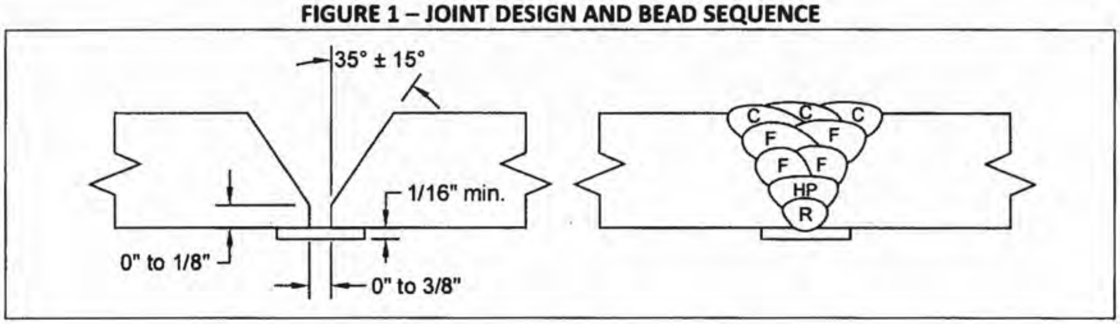
DUKE ENERGY

WELDING PROCEDURE SPECIFICATION **Page:** 1 of 2

WPS Number: 300 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X65LH-LS-8018-1
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: API 5L X65 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline contents.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 300 **Rev.:** 1 **Page:** 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E8018-C3 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range:	70 – 120	80 – 160	120 – 220
Voltage Range:	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ______________________ **Date:** __________

Approved By: ______________________ **Date:** __________

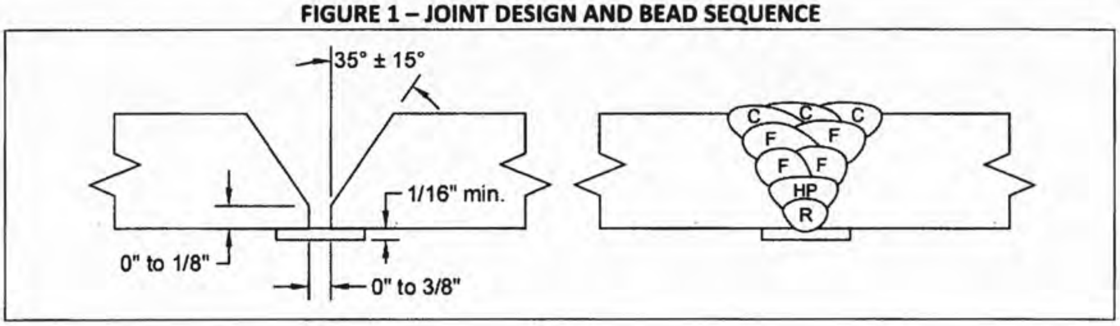
DUKE ENERGY.

WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 310 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X70LH-LS-7018-1 and supporting verification welds 7018LS-1 and 7018LS-2
Standard: API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: API 5L X70 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline contents.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 310 **Rev.:** 1 **Page:** 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range:	60 – 110	85 – 160	110 – 220
Voltage Range:	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ____________________ **Date:** __________

Approved By: ____________________ **Date:** __________

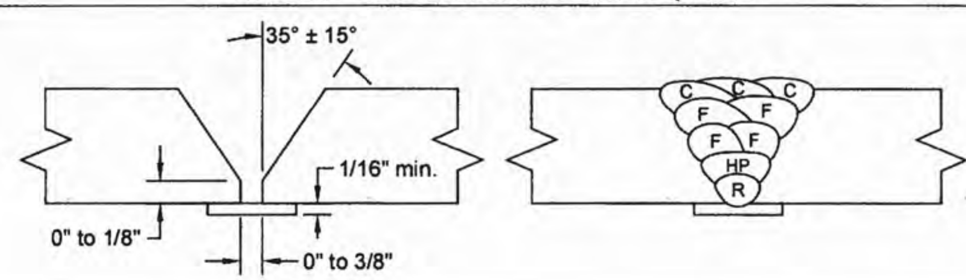
DUKE ENERGY

WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 320 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: X70LH-LS-8018-1 and supporting verification welds 8018LS-1 and 8018LS-2
Standard: API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Sleeve Material: API 5L X70 or equivalent
Sleeve Wall Thickness: 0.188 – 1.25 in. **Sleeve Diameter:** All diameters
Joint Design: Figure 1, groove butt weld with backing strip
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequence and minimum of three passes is required.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline contents.
Pipeline Operating Conditions: All flow rates and pressures

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 320 **Rev.:** 1 **Page:** 2 of 2

WELDING PARAMETERS

Pass:	All		
AWS Classification:	E8018-C3 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range:	60 – 110	85 – 160	110 – 220
Voltage Range:	18 – 28	18 – 28	18 – 28
Travel Speed Range (ipm):	2 – 10	2 – 12	2 – 14

Prepared By: ____________________ **Date:** __________

Approved By: ____________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 330 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-1-GRB-179

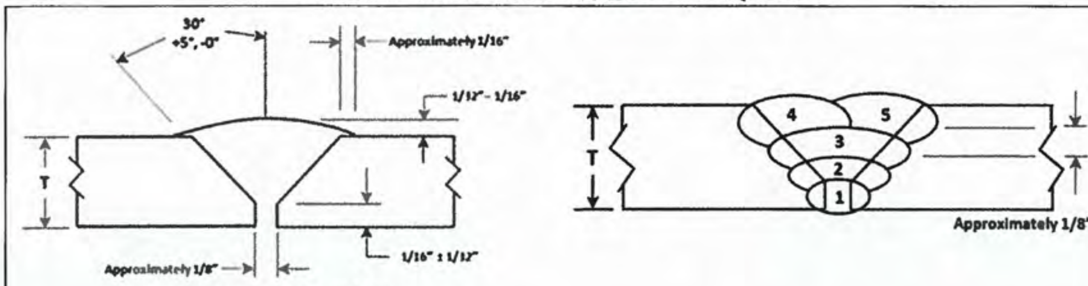
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Less than or equal to API 5L Grade B or equivalent material
Pipe or Fitting Diameter: Less than 2.375 inch
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 170 – 200 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________ **Date:** ____________

Approved (Dir. of Eng.): ______________________ **Date:** ____________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 2

WPS Number: 340 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-2-X42-154

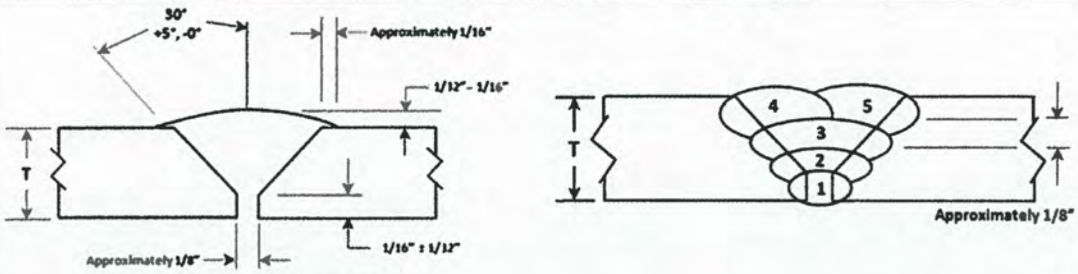
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Less than or equal to API 5L X42 or equivalent material
Pipe or Fitting Diameter: 2.375 inch through 12.75 inch
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION   **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ____________________   **Date:** __________
Approved (Dir. of Eng.): ____________________   **Date:** __________

DUKE ENERGY.

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 2

WPS Number: 350 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-1-X52-179

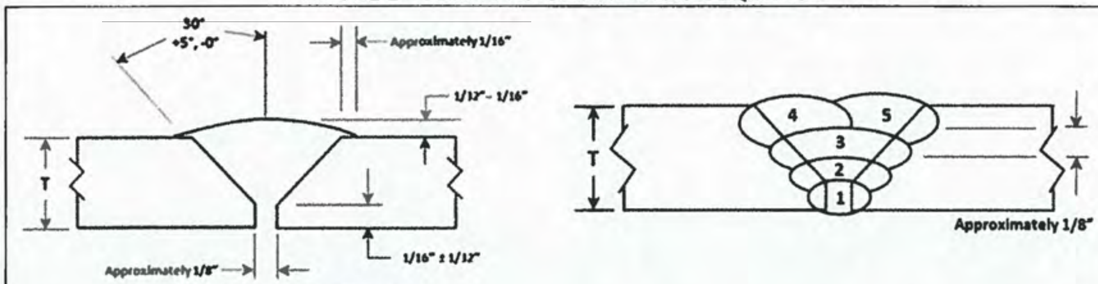
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Greater than API 5L X42 to less than or equal to API 5L X52 or equivalent material
Pipe or Fitting Diameter: Less than 2.375 inch
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 170 – 200 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools.
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________________ **Date:** ______________
Approved (Dir. of Eng.): ______________________________ **Date:** ______________

DUKE ENERGY.

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 360 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-2-X52-154

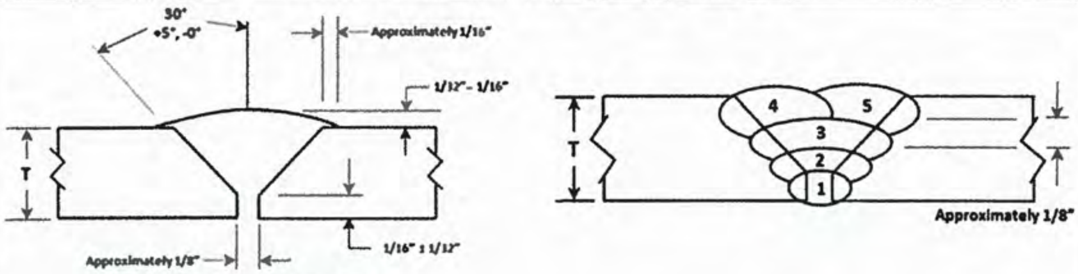
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Greater than API 5L X42 to less than or equal to API 5L X52 or equivalent material
Pipe or Fitting Diameter: 2.375 inch thru 12.75 inch
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools.
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________ **Date:** __________
Approved (Dir. of Eng.): ______________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 2

WPS Number: 370 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-4-X52-188

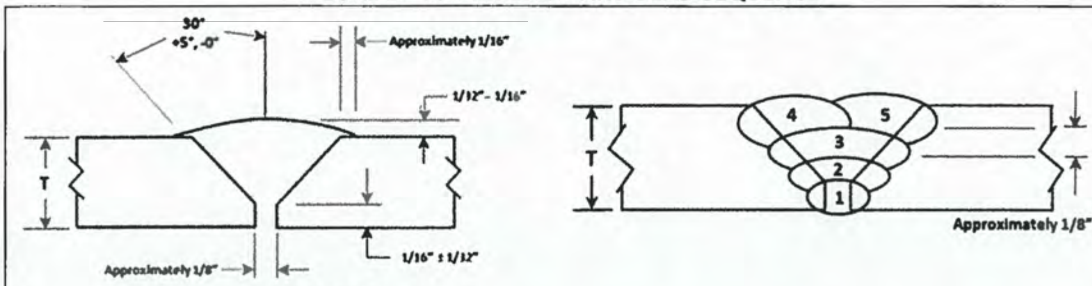
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Greater than API 5L X42 to less than or equal to API 5L X52 or equivalent material
Pipe or Fitting Diameter: 2.375 inch thru 12.75 inch
Pipe or Fitting Wall Thickness: 0.188 inch thru 0.750 inch
Joint Design and Bead Sequence: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools.
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint

*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________ **Date:** __________
Approved (Dir. of Eng.): ______________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 380 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-F-2-X42-154

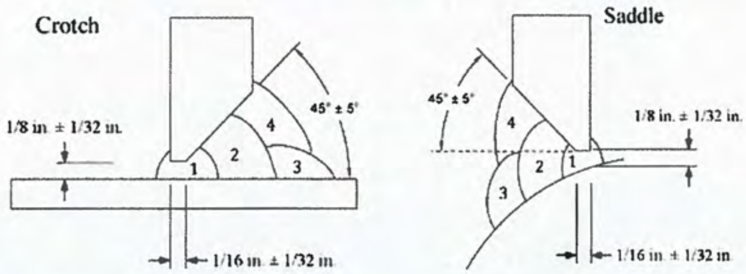
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Less than or equal to API 5L X42 or equivalent material
Pipe or Fitting Diameter: All
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools.
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME):____________________ **Date:** __________
Approved (Dir. of Eng.):____________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 2

WPS Number: 390 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-F-2-X52-154

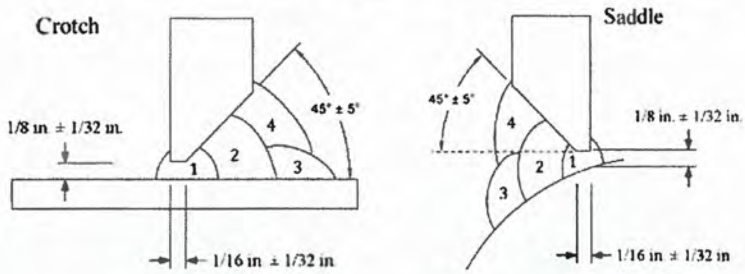
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Greater than API 5L X42 to less than or equal to API 5L X52 or equivalent material
Pipe or Fitting Diameter: All
Pipe or Fitting Wall Thickness: Less than 0.188 inch
Joint Design and Bead Sequence: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools.
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________ **Date:** __________
Approved (Dir. of Eng.): ______________________ **Date:** __________

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 1 of 2**

WPS Number: 400 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: M-F-4-X52-188

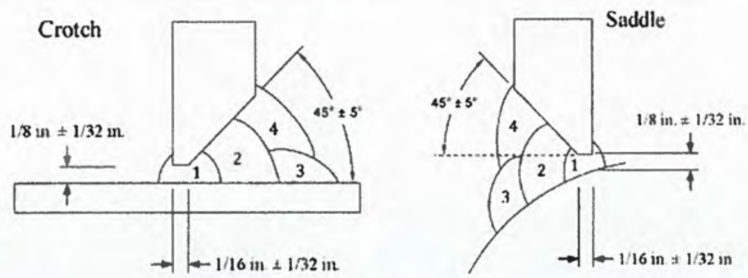
Welding Process: GMAW (MIG)
Pipe or Fitting Material: Greater than API 5L X42 to less than or equal to API 5L X52 or equivalent material
Pipe or Fitting Diameter: All
Pipe or Fitting Wall Thickness: 0.188 inch thru 0.750 inch
Joint Design and Bead Sequence: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.
Position: Rolled **Welding Direction:** Backhand or Vertical Down
Filler Metal: ER70S-3
Wire Feed Rate: 200 – 280 IPM
Shielding Gas: 75/25 Argon/CO2
Flow Rate: 40 cfm
Time Between Passes: 5 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means. Preheat to 250°F if the time lapse is greater than 5 minutes between any passes at any time following the second pass.
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: Temperature to be determined by pyrometer or temp stick.
The weld should be allowed to air cool prior to inspection.

WELDING PARAMETERS

Pass:	All
AWS Classification:	A5.18
Wire Size:	0.035
Current/Polarity:	DCEP
Current Range:	N/A
Voltage Range:	15 – 19
Travel Speed Range, ipm:	12

API 1104 WELDING PROCEDURE SPECIFICATION **Page: 2 of 2**

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



*Note that Figure 1 is not intended to show all bead sequences. The number of beads will vary with wall thickness. A minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Approved (SME): ______________________ **Date:** ____________

Approved (Dir. of Eng.): ______________________ **Date:** ____________

Signature

Reviewed and approved by:

Randy L Bost

Randy L Bost (Apr 30, 2019)

Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this procedure: • CM-PL-4000 *PNG Welding Manual Attachment 1 Piedmont Natural Gas Welding Procedures (OAW and SMAW)* • WPS (SMAW and GMAW) *Welding Procedure Specifications* • WPS 14 – 27 *Welding Procedure Specifications*	Members of Work Process Integration Team
1	05/01/2019	• Revised the "WHO" section, added Engineering, Gas Field Operations, and Technical Field Operations • Legacy Documents incorporated into this procedure: BW-1-A-I, BW-2-A-I, BW-2-A-II, BW-2-B-II, BW-2-B-II R, BW-3-A-II, BW-3-B-II, BW-3-C-II, FW-A-II, FW-B-II, FW-C-II, M-BW-1-A-I , M-BW-1-B-I, M-BW-2-A-I, M-BW-2-B-I, M-BW-2-B-II, M-FW-A-I, M-FW-B-I, M-FW-B-II, WPS 14, WPS 15, WPS 16A, WPS 16B, WPS 17A, WPS 17B, WPS 18, WPS 19A, WPS 19B, WPS 20A, WPS 20B, WPS 21, WPS 22, WPS 23A, WPS 23B, WPS 24, WPS 25, WPS 26, WPS 27, and WPS' 1-13 (Attachment 1 of CM-PL-4000)	Work Process Integration Team

DUKE ENERGY.	Duke Energy NGBU Welding Standard	WEL-ST-1000
		Revision Number: 2
	Welding	Effective Date: 05/01/2019
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Table of Contents

1. Purpose

To comply with Federal (PHMSA) and State regulations, as well as industry guidance, the Duke Energy Natural Gas Business Unit (NGBU) has established this Welding Standard to provide guidelines and responsibilities for the welding of steel pipelines covered by 49 CFR 192 and API 1104 in order to produce sound welds and support safe, reliable operations. This includes the qualification of welding procedures and welders across construction, repair, and in-service applications. Following these requirements is imperative in the prevention of failed welds during the course of operations. The requirements set forth in the Welding Standard shall not be applied to existing facilities retroactively.

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2. Governing Code and References

Title 49, Code of Federal Regulations, Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards*

American Petroleum Institute, API Standard 1104, *Welding of Pipelines and Related Facilities*

American Society of Mechanical Engineers, ASME B31.8 – *Gas Transmission and Distribution Piping Systems*

American Society for Testing and Materials, ASTM E23 – *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

American Society for Testing and Materials, ASTM E165 – *Standard Test Method for Liquid Penetrant Examination*

American Society for Testing and Materials, ASTM E384 – *Standard Test Method for Knoop and Vickers Hardness of Materials*

American Society for Testing and Materials, ASTM E709 – *Standard Guide for Magnetic Particle Testing*

National Association of Corrosion Engineers, ANSI/NACE MR0175/ISO 15156 – *Petroleum and Natural Gas Industry – Materials for use in H2S-containing Environments in Oil and Gas Production*

American Society for Nondestructive Testing, ASNT Recommended Practice SNT-TC-1A – *Personnel Qualification and Certification in Nondestructive Testing.*

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3. State Specific Requirements

N/A

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4. Environmental Information

Refer to the Environmental Health and Safety Handbook or contact Duke Environmental Support at 1-800-527-3853.

5. Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

6. Standard Summary

The Welding Standard provides guidelines for welding steel pipelines covered by 49 CFR 192 and API 1104 and associated welding responsibilities, including the qualification of welding procedures and welders across construction, repair, and in-service applications. The requirements set forth in the Welding Standard shall not be applied to existing facilities retroactively.

7. Safety Requirements

At Duke Energy, Health and Safety is a Core Company Value. Employees and contingent workers are responsible for maintaining the highest regard for safety while planning and conducting work. Employees and contingent workers are also responsible for ensuring a safe work environment exists for themselves, their coworkers, and their surrounding community.

Icon Key:

NOTE: *This icon raises awareness to important non-safety related information.*

Keys to Life: *This icon references Duke Energy's "Keys to Life" safety information to note significant or life threatening hazards and related precautions to be taken. A link to the Keys to Life Gas Operations document is provided* here. *Additional links may exist in the document.*

CAUTION: *This icon identifies possible safety hazards and/or serves as a reminder to take necessary precautions.*

8. Definitions/Acronyms

Welding Procedure Qualifier – A designated NGBU Employee or third party representative authorized to qualify welding procedures for use on NGBU system. This individual must possess at a minimum a Certified Welding Inspector (CWI) certification.

Welding Procedure Approver – A designated NGBU Employee that is responsible for approving the welding procedures and answering any welding procedure related questions. This individual must have the following credentials:

- Minimum 5 years of pipeline construction welding knowledge
- Certified Pipeline Welding Inspector, degreed Metallurgist, or Welding Engineer

Welder Qualifier – A designated NGBU Employee or third party representative that is responsible for qualifying all employee and contract welders. This individual must have the following credentials:

- Minimum 5 years of pipeline construction welding knowledge or Level II NDT Technician
- Certified Pipeline Welding Inspector or Certified Welding Inspector

Welding Inspector – An individual responsible for overseeing all the on-site welding tasks and ensuring that procedures are being properly followed. Major projects Welding Inspectors must meet one of the following criteria: possess a CWI, hold a CPWI and have 5 years pipeline welding/inspection experience, or have 15 years pipeline welding experience.

Third Party Fabrication Contractor – Any fabrication shop contractor hired to build skid mounted piping systems.

Construction Weld – A weld in a pipeline system that has not been commissioned

In-Service Weld – A weld that fuses directly to the wall of an in-service (contains product that may be pressurized and/or flowing) pipeline or piping system that has previously been commissioned. In-service welding is performed in accordance with API 1104 Appendix B.

Repair Weld – A construction or in-service weld requiring additional work due to defects outside the standards identified in this document. Such additional work amounts to a repair weld only if the defect is identified by non-destructive testing after the original weld was completed.

9. Qualifications/Certifications

Operator Qualifications:

- TWELD001 – Welding (on Physically Connected Pipe)
- TWELD002 – Non-Destructive Testing of Welds
- TWELD003 – Visual Examination of Welds

10. Welding Procedure Qualifications

10.1. General

10.1.1. Prior to welding, all welding procedures shall be qualified in accordance with API 1104 and the following applicable sections to ensure the welding procedure produces welds with suitable mechanical properties. The applicable sections may exceed, but in no instance shall reduce, the requirements specified in API 1104. Wherever there is a contradiction the requirements the more stringent requirement shall govern. Unless otherwise indicated, welding procedures are made to the 20th edition of API 1104, which is the current edition incorporated by reference into 49 CFR 192/195. Procedures qualified under a previous version of API 1104 do not need to be requalified. When a new welding procedure is required, a Welding Procedure Qualifier shall develop and qualify it in accordance with this standard.

10.1.2. All welding procedures shall be supported by destructively testing a qualification weld. A welding procedure qualification record (PQR), also known as a coupon test report, shall record the actual welding procedure variables used to deposit the qualification weld and the results of destructive tests. Procedure qualification welds and all required tests to confirm the acceptability of the resulting welds shall be performed in the presence of a Welding Procedure Qualifier. The required form for a PQR is referenced in Section 10.9. Any deviation from the welding procedure involving essential variables is strictly prohibited.

10.1.3. The material to be used for qualifying welding procedures shall be representative of the material that is to be welded in the field. If the total length of a single qualification weld is insufficient to remove all the required destructive test samples than an additional qualification weld shall be made.

10.2. Welding Procedure Variables

10.2.1. Each welding procedure shall provide sufficient detail to the welder on the form referenced in Section 10.9 manual SMAW (stick), OAW (oxyacetylene), or GMAW (MIG) procedures shall address all the applicable welding procedure variables listed in

10.2.2.

10.2.3. **Table 1** that are shaded based on the welding application. Variables that are marked with an "X" are variables that if changed shall require the qualification of a new welding procedure. Qualification of other manual welding processes, semi-automatic welding, mechanized welding or automatic welding procedures shall be approved by welding SME's within NGBU.

10.2.4. The current, voltage and travel speed recorded on the procedure qualification record are the basis for the permitted range of welding procedure variables so a wide range of current, voltage and travel speed shall be used during the procedure qualification weld. A Welding Procedure Qualifier shall provide guidance on how other welding procedure variables shall be addressed.

Table 1. Welding Procedure Variables

Variable Description	Construction Welding Procedure	Repair Welding Procedure	In-Service Welding Procedure
Welding Process (SMAW, OAW, or GMAW)/Method of Application (Manual, Semi-Auto, Mechanized, Auto)	X	X	X
Base Material Strength Grouping	X	X	
Material Diameters			
Material Thicknesses	X	X	
Joint Design Information	X	X	X
Fillet Weld Size and Classification Number			
Filler Metal Group	X	X	X
Filler Metal Diameter			
Minimum Number of Beads			
Sequence of Beads			
Current Type (AC or DC)	X	X	X
Current Polarity (Electrode + or -)	X	X	X
Voltage (per filler metal rod and diameter)			
Amperage (per filler metal rod and diameter)			
Flame Characteristics (OAW only) (Neutral, Carburizing or Oxidizing)			
Torch Tip Orifice (OAW only)			
Position (Roll or Fixed)	X	X	X
Welding Direction (Uphill, Downhill)	X	X	X
Time between Root Bead and 2nd Bead	X	X	X
Time between 2nd Bead and Start of Rem. Beads			
Lineup Clamp Type (Internal, External or None)			
% of Completed Root Bead when Lineup Clamp is Used			
Cleaning (Hand or Power Tools)			
Preheat Temperature	X	X	X
Preheat Method and Temperature Control Method			
Minimum Ambient Temperature Preheat should Apply			
Stress Relief	X	X	X
Stress Relief Method			

Variable Description	Construction Welding Procedure	Repair Welding Procedure	In-Service Welding Procedure
Stress Relief Time and Temperature	X	X	X
Stress Relief Temperature Control Method			
Welding Speed	X	X	X
Method of Cooling after Welding (Air or Forced Cooling)*			
Temperature at which Forced Cooling is Applied*			
Repair Location (Weld centerline or Fusion line) and Method for Exploration of Defect		X	
Defect Removal Method			
Inspection Method			
Interpass Temperature (min/max), Location, and Extent		X	
Interpass Temperature Application Method			
Interpass Inspection			
Filler Metal Storage, Handling, & Usage			
Repair Type		X	
Repair Procedure Limitations			
Time Delay Prior to Inspection			
Material Carbon Equivalent			X**
Pipeline Operating Conditions			X
Heat Input Ranges			
Bead Spacing Tolerances			X**

*Only required in API 1104 21st Edition
**Only essential variables in API 1104 21st Edition.

10.3. Welding Procedure Selection

10.3.1. A summary of approved NGBU welding procedures is provided in **Table 2**. The welding procedures are provided in WEL-PR-1010. The supporting procedure qualification records are provided in WEL-PR-1020. Selection of the appropriate construction welding procedure(s) shall be made by the welder(s) performing the welds and based on the following criteria:

- Welding Process
- Welding Application
    - Construction welding, repair of construction welds or in-service welding
- Material

- SMYS for construction and repair of construction welds
- Carbon equivalent (CE) for in-service welds
- If materials of different SMYS or CE are to be welded then the welding procedure qualified for the higher SMYS or CE shall be used
- In the event that CE or SMYS of existing facilities are not known, NGBU construction staff shall make every effort to determine these properties as part of the construction planning process. This includes, but is not limited to looking at records and the stencil on the pipe. If this information cannot be found, material Grade A and a CE of 0.50 will be assumed.

- Pipeline Outside Diameter
- Pipe Wall Thickness
  - Joint Type

CAUTION: _When welding on a pipeline with an MAOP greater than 125 psig an in-service welding permit shall be approved by Gas Engineering (See OM-PL-1230 and OM-PR-1230). When welding on an in-service pipeline with a MAOP 125 psig or lower, the welder(s) is(are) responsible for selecting their own procedure._

Table 2. Approved NGBU Welding Procedures

New WPS Number	Old WPS Number	SMYS Range, ksi	Outside Diameter Range	Nominal Wall Thickness Range	Rod Material	Joint Type
OAW (Oxy-Acetylene) Construction Butt Welding Procedures						
WPS 10	WPS 1	API 5L X52 or less	2.375 inch or less	0.218 inch or less	RG60 or RG65	Butt
OAW (Oxy-Acetylene) Construction Fillet Welding Procedures						
WPS 20	WPS 2	API 5L X52 or less	2.375 inch or less	0.218 inch or less	RG60 or RG65	Fillet
SMAW (Stick) Construction Cellulosic Butt Welding Procedures						
WPS 30	WPS 3	API 5L X42 or less	All	All	E6010, E7010	Butt
WPS 40	WPS 4	> API 5L X42 and < API 5L X65	All	0.188 inch or greater	E6010, E7010, E8010	Butt
WPS 50	WPS 5	API 5L X65	All	0.188 inch to 0.750 inch	E6010, E8010-P1	Butt
WPS 60	WPS 6	API 5L X70	All	0.188 inch to 0.750 inch	E6010, E8010-P1	Butt

New WPS Number	Old WPS Number	SMYS Range, ksi	Outside Diameter Range	Nominal Wall Thickness Range	Rod Material	Joint Type
SMAW (Stick) Construction Low Hydrogen Butt Welding Procedures						
WPS 70	WPS 7	API 5L X42 or less	All	0.188 inch or greater	E7016, E7018	Butt
WPS 80	WPS 8	> API 5L X42 and < API 5L X65	All	0.188 inch or greater	E7016, E7018	Butt
SMAW (Stick) Construction Cellulosic Fillet Welding Procedures						
WPS 90	WPS 9	API 5L X42 or less	All	0.750 inch or less	E6010, E7010	Branch Groove or Fillet
WPS 100	WPS 10	> API 5L X42 and < API 5L X65	All	0.188 inch to 0.750 inch	E6010, E7010, E8010	Branch Groove or Fillet
WPS 110	WPS 11	API 5L X65	All	0.188 inch to 0.750 inch	E6010, E8010-P1	Branch Groove or Fillet
WPS 120	WPS 12	API 5L X70	All	0.188 inch to 0.750 inch	E6010, E8010-P1	Branch Groove or Fillet
SMAW (Stick) Construction Low Hydrogen Fillet Welding Procedures						
WPS 130	WPS 13	API 5L X42 or less	All	0.188 inch to 0.750 inch	E7016, E7018	Fillet
SMAW (Stick) In-Service Cellulosic Butt Welding Procedures						
WPS 140	WPS 23A	> API 5L X42 and < API 5L X65	2.375 inch or greater	≤ 0.188 inches	A5.1	Long Seam
SMAW (Stick) In-Service Cellulosic Fillet Welding Procedures						
WPS 150	WPS 17A	> API 5L X42 and < API 5L X65	2.375 inch or greater	≤ 0.188 inches	A5.1	Fillet
SMAW (Stick) In-Service Low Hydrogen Fillet Welding Procedures						
WPS 160	WPS 14	Less than or equal to API 5L X70	All	0.188 inch to 0.750 inch	E7018 H4R, E7016 H4	Branch Groove

New WPS Number	Old WPS Number	SMYS Range, ksi	Outside Diameter Range	Nominal Wall Thickness Range	Rod Material	Joint Type
WPS 170	WPS 15	Less than or equal to API 5L X70	All	0.250 inch to 0.750 inch	E7018 H4R, E7016 H4	Branch Groove
WPS 180	WPS 16A	Less than or equal to API 5L X70	All	0.157 inch to 0.750 inch	E7018 H4R, E7016 H4	Branch Groove
WPS 190	WPS 16B	Less than or equal to API 5L X70	All	0.125 inch to 0.156 inch or 0.125 inch to 0.750 inch	E7018 H4R, E7016 H4	Branch Groove
WPS 200	WPS 17B	Less than or equal to API 5L X70	All	0.188 inch to 0.750 inch or 0.188 inch to 1.25 inch	E7018 H4R	Fillet
WPS 210	WPS 18	Less than or equal to API 5L X70	All	0.250 inch to 0.750 inch or 0.188 inch to 1.25 inch	E7018 H4R	Fillet
WPS 220	WPS 19A	Less than or equal to API 5L X70	All	0.157 inch to 0.750 inch or 0.157 inch to 1.25 inch	E7018 H4R	Fillet
WPS 230	WPS 19B	Less than or equal to API 5L X70	All	0.125 inch to 0.156 inch or 0.188 inch to 0.750 inch	E7018 H4R	Fillet
WPS 240	WPS 20A	Less than or equal to API 5L X70	All	0.188 inch to 0.750 inch	E6010, E7018 H4R	Branch Groove
WPS 250	WPS 20B	Less than or equal to API 5L X70	All	0.188 inch to 0.750 inch or 0.188 inch to 1.25 inch	E6010, E7018 H4R	Fillet
WPS 260	WPS 21	Less than or equal to API 5L X70	All	0.250 inch to 0.750 inch or 0.188 inch to 0.750 inch	E6010, E7018 H4R	Branch Groove or Fillet

New WPS Number	Old WPS Number	SMYS Range, ksi	Outside Diameter Range	Nominal Wall Thickness Range	Rod Material	Joint Type
SMAW In-Service Low Hydrogen Butt Welding Procedures						
WPS 270	WPS 22	API 5L X42 or less	All	0.188 inch to 1.25 inch	E7018 H4R	Long Seam
WPS 280	WPS 23B	> API 5L X42 and ≤ API 5L X60	All	0.188 inch to 1.25 inch	E7018 H4R	Long Seam
WPS 290	WPS 24	API 5L X65	All	0.188 inch to 1.25 inch	E7018 H4R	Long Seam
WPS 300	WPS 25	API 5L X65	All	0.188 inch to 1.25 inch	E8018-C3 H4R	Long Seam
WPS 310	WPS 26	API 5L X70	All	0.188 inch to 1.25 inch	E7018 H4R	Long Seam
WPS 320	WPS 27	API 5L X70	All	0.188 inch to 1.25 inch	E8018-C3 H4R	Long Seam
GMAW (MIG) Construction Butt Welding Procedures						
WPS 330	M-BW-1-A-I	API 5L X42 or less	Less than 2.375 inch	Less than 0.188 inch	ER70S-3	Butt
WPS 340	M-BW-2-A-I	API 5L X42 or less	2.375 inch to 12.750 inch	Less than 0.188 inch	ER70S-3	Butt
WPS 350	M-BW-1-B-I	> API 5L X42 and ≤ API 5L X52	Less than 2.375 inch	Less than 0.188 inch	ER70S-3	Butt
WPS 360	M-BW-2-B-I	> API 5L X42 and ≤ API 5L X52	2.375 inch to 12.750 inch	Less than 0.188 inch	ER70S-3	Butt
WPS 370	M-BW-2-B-II	> API 5L X42 and ≤ API 5L X52	2.375 inch to 12.750 inch	0.188 inch to 0.750 inch	ER70S-3	Butt
GMAW (MIG) Construction Fillet Welding Procedures						
WPS 380	M-FW-A-I	API 5L X42 or less	All	Less than 0.188 inch	ER70S-3	Fillet
WPS 390	M-FW-B-I	> API 5L X42 and ≤ API 5L X52	All	Less than 0.188 inch	ER70S-3	Fillet

New WPS Number	Old WPS Number	SMYS Range, ksi	Outside Diameter Range	Nominal Wall Thickness Range	Rod Material	Joint Type
WPS 400	M-FW-B-II	> API 5L X42 and ≤ API 5L X52	All	0.188 inch to 0.750 inch	ER70S-3	Fillet

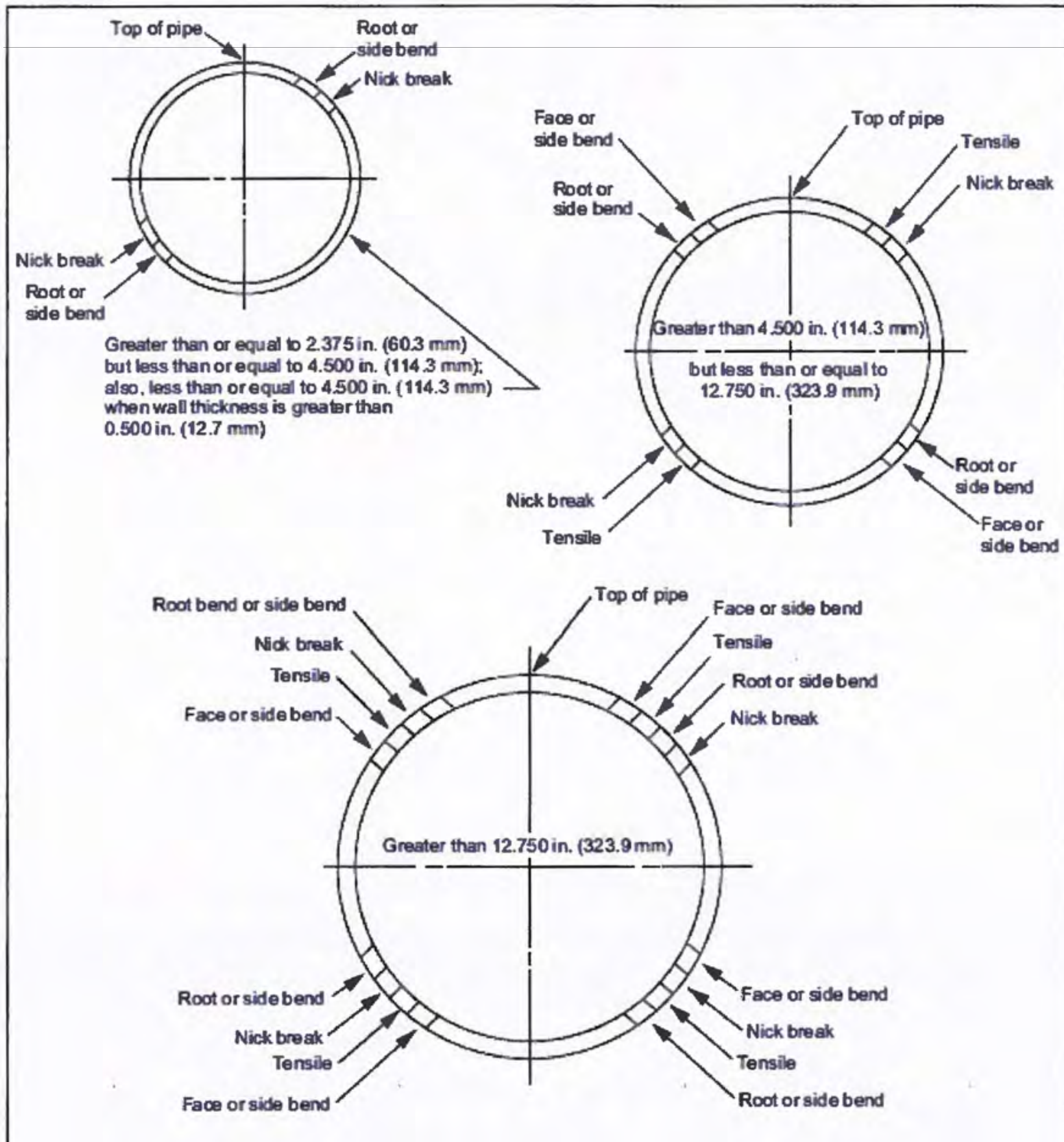
10.4. Qualification and Testing of Construction Butt Welding Procedures

The completed qualification weld shall be allowed to air cool to ambient temperature prior to destructive testing. The destructive test specimens shall be removed from the weld in accordance with **Table 3** and **Figure 1**. None of the destructive test specimens shall include a portion of the pipe seam weld. The destructive test specimens shall be tested in accordance with Section 10.4.1 through Section 10.4.4, as applicable.

Table 3. Type and Number of Construction Butt Welding Procedure Qualification Test Specimens

Outside Diameter of Pipe		Number of Specimens					
in.	mm	Tensile Strength	Nick Break	Root Bend	Face Bend	Side Bend	Total
Wall Thickness ≤ 0.500 in. (12.7 mm)							
2.375 to 4.500	60.3 to 114.3	0 [b]	2	2	0	0	4
>4.500 to 12.750	>114.3 to 323.9	2	2	2	2	0	8
>12.750	>323.9	4	4	4	4	0	16
Wall Thickness > 0.500 in. (12.7 mm)							
≤4.500	≤114.3	0 [b]	2	0	0	2	4
>4.500 to 12.750	>114.3 to 323.9	2	2	0	0	4	8
>12.750	>323.9	4	4	0	0	8	16

[b] For materials with SMYS's greater than the material specified as API 5L Grade X42, a minimum of one tensile test is required.



NOTE 1 At the company's option, the locations may be rotated, provided they are equally spaced around the pipe; however, specimens do not include the longitudinal weld.

Figure 1. Location of Butt Welding Procedure Qualification Test Specimens

10.4.1. Tensile-Strength Test

The tensile-strength test specimens shall be prepared in accordance with **Figure 2**. They may be machine cut or oxygen cut, and no other preparation is needed unless the sides are notched or are not parallel. If necessary, the specimens shall be machined so that the sides are smooth and parallel.

Prior to testing the smallest cross-sectional area of the specimen shall be determined. The tensile-strength specimen shall then be loaded until failure, using equipment capable of measuring the load at which failure occurs. The tensile strength shall be computed by dividing the maximum load by the measured cross-sectional area of the specimen.

The tensile-strength specimen shall be considered acceptable if one of the following requirements is met.

- The specimen breaks in the parent pipe material and meets the specified minimum tensile strength of the pipe material. It does not need to be greater than or equal to the actual tensile strength of the material
- The specimen breaks in the weld or fusion zone and meets the specified minimum tensile strength of the pipe, the exposed surfaces of each nick-break specimen shall show complete penetration and fusion, and the fracture surface is acceptable in accordance with Form O of WEL-PR-1000. It does not need to be greater than or equal to the actual tensile strength of the material.

A new qualification weld shall be deposited if the specimen does not meet the requirements specified above.

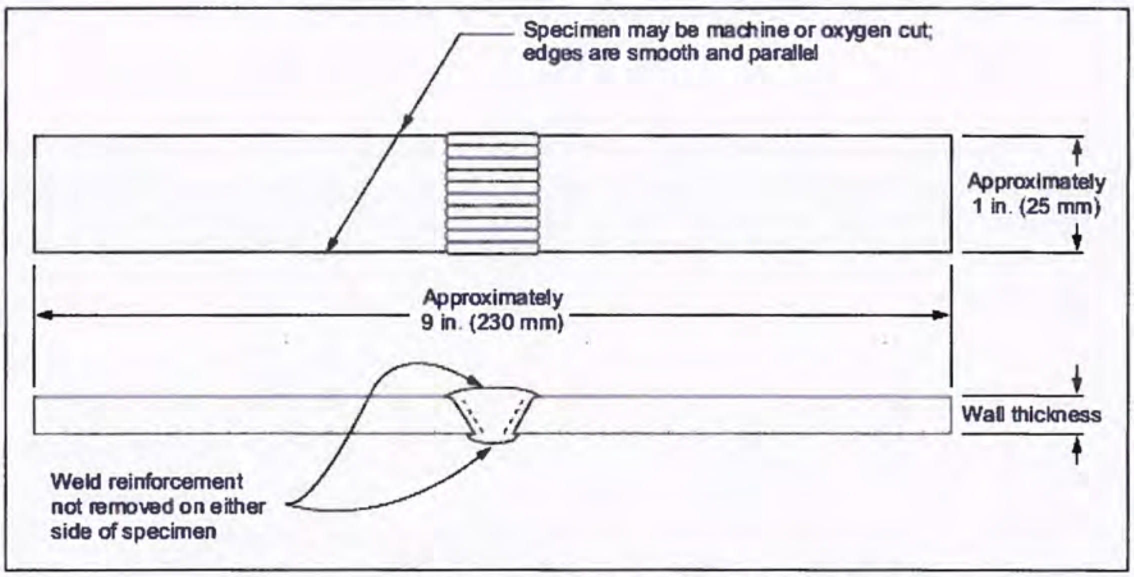


Figure 2. Tensile-Strength Test Specimen Preparation

10.4.2. Nick Break Test

The nick-break test specimens shall be prepared in accordance with **Figure 3**. They shall be machine cut or oxygen cut, they shall be notched with a hacksaw on each side at the center of the weld, and each notch shall be approximately 1/8" deep. Notching the face of the nick-break test specimen is permitted when failure in the pipe is expected. After notching, the specimen shall be loaded until failure. The exposed fracture surface shall be at least 3/4 inch wide.

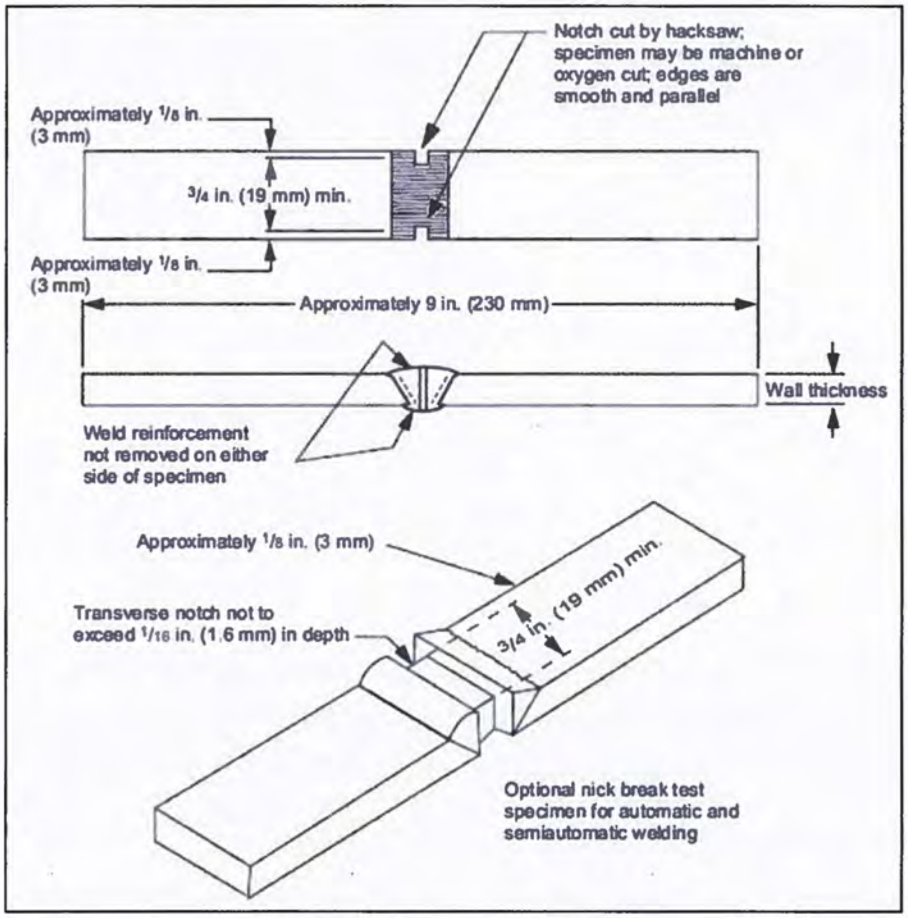


Figure 3. Nick-Break Test Specimen Preparation

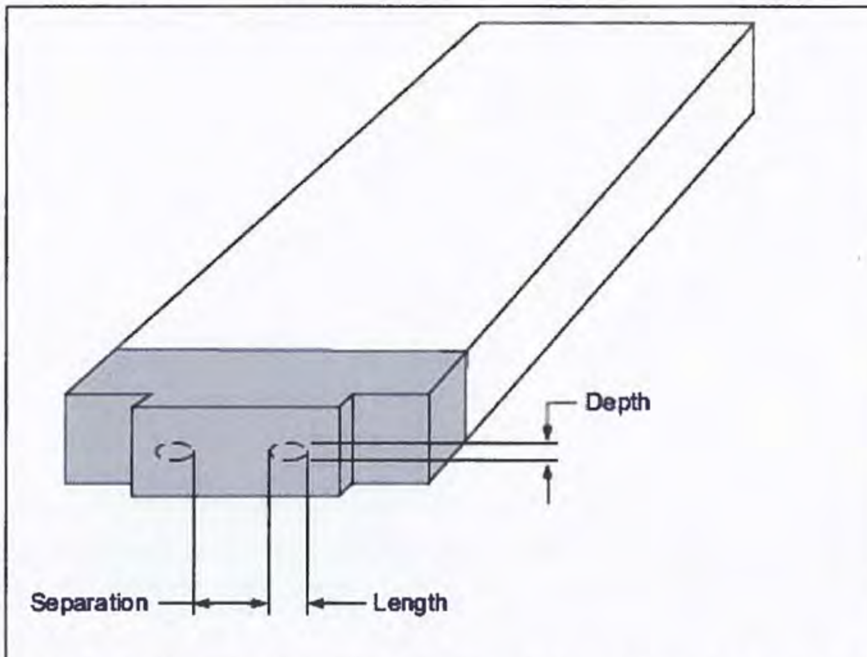
The nick-break specimen shall be considered acceptable if all of the following requirements are met.

- The fracture surface shows complete penetration and fusion.
- The greatest dimension of any gas pocket does not exceed 1/16 inch and the combined areas of all gas pockets shall not exceed 2% of the fracture surface area.

- Any slag inclusions shall not exceed 1/32 inch in depth, shall not exceed 1/8 inch or one-half the nominal wall thickness in length, whichever is smaller and there is at least 1/2 inch separation between adjacent slag inclusions as defined in **Figure 4**.
- Fisheyes, as defined in AWS A3.0, are not cause for rejection.

With approval by the Welding Procedure Qualifier, if one nick-break test specimen fails during the testing of a qualification weld that is deposited in a 12.75 inch or greater outside diameter pipe then two additional nick-break specimens could be taken from the same approximate location and tested. If both of the additional nick-break specimens pass then the weld could be considered acceptable.

A new qualification weld shall be deposited if the specimen does not meet the requirements specified above.



NOTE A broken nick break test specimen is shown; however, this method of dimensioning applies also to broken tensile and fillet weld test specimens.

Figure 4. Dimensions of Indications in Nick-Break and Tensile Test Specimens

10.4.3. Bend Test

There are three types of bend tests, which are defined by the portion of the weld that is put in tension. Root bends place the root portion of the weld in tension. Face bends place the face portion of the weld in tension. Side bends place the through thickness portion of the weld in tension.

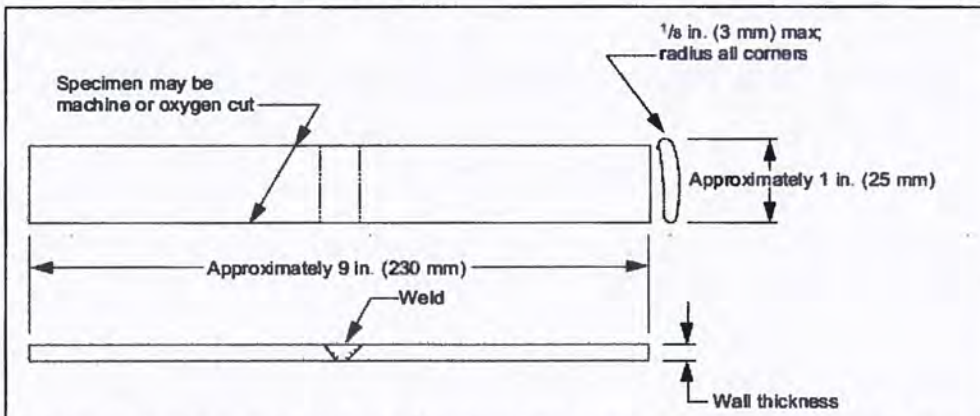
The bend test specimen shall be prepared in accordance with **Figure 5** or **Figure 6** depending on the wall thickness of the qualification weld and the long edges shall be rounded. All surfaces shall be smooth with any scratches being light and transverse to the weld. Any undercut that is present shall not be removed. The bend test specimen shall be bent in a bend test fixture similar to what is shown in **Figure 7**. The weld shall be located in the middle of the span with the surface of interest opposite the plunger. Face-bend specimens shall be placed with the face of the weld toward the gap, and root-bend specimens shall be placed with the root of the weld toward the gap. The specimen shall be bent until the curvature of the specimen is approximately U-shaped.

The bend specimen shall be considered acceptable if all of the following requirements are met.

- No weld induced crack or other imperfection exceeding 1/8 inch or one-half the nominal wall thickness, whichever is smaller, in any direction, is present in the weld of between the weld and the fusion zone after bending.
- Weld induced cracks that originate on the edge of the specimen that are less than 1/4 inch, measured in any direction shall not be considered unless obvious imperfections are observed.

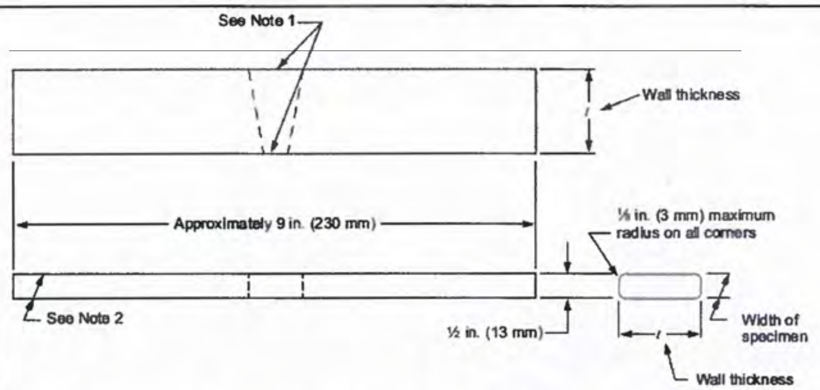
With approval by the Welding Procedure Qualifier, if one bend specimen fails during the testing of a qualification weld deposited that is deposited in 12.75 inch or greater outside diameter pipe then two additional bend specimens of the same orientation could be taken from the same approximate location and tested. If both of the additional bend specimens pass then the weld could be considered acceptable.

A new qualification weld shall be deposited if the specimen does not meet the requirements specified above.



NOTE The weld reinforcement is removed from both faces and made flush with the surface of the specimen. The specimen is not flattened prior to testing.

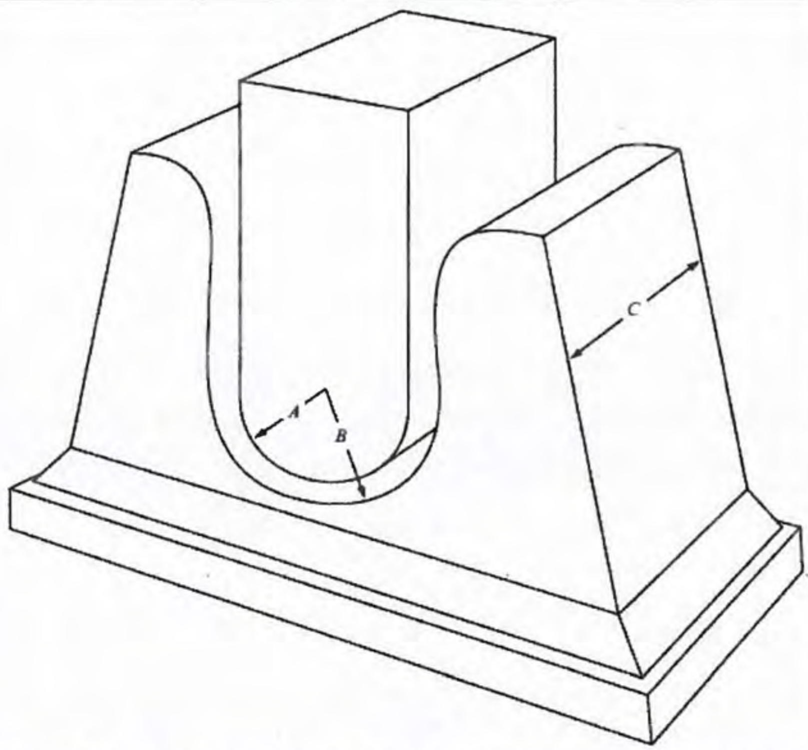
Figure 5. Root and Face Bend Test Specimen Preparation



NOTE 1 The weld reinforcement is removed from both faces flush with the surface of the specimen.

NOTE 2 Specimens may be machine cut to a width of ½ in. (13 mm), or they may be oxygen cut to a width of approximately ¾ in. (19 mm) and then machined or ground smooth to a width of ½ in. (13 mm). Cut surfaces are smooth and parallel.

Figure 6. Side Bend Test Specimen Preparation



NOTE This figure is not drawn to scale. Radius of plunger, A = 1 ¾ in. (45 mm); radius of die, B = 2 ⅜ in. (60 mm); width of die, C = 2 in. (50 mm).

Figure 7. Example Bend Test Jig

10.4.4. Additional Construction Butt Welding Procedure Qualification Tests

Additional destructive tests may be required based on the operating conditions of the pipeline when requested by Gas Engineering. These tests may include but are not limited to Macro-section Tests in accordance with Section 10.4.4.1, Hardness Tests in accordance with Section 10.4.4.2, and Charpy V-Notch Impact Energy Tests in accordance with Section 10.4.4.3. Contact Gas Engineering for approval and to ensure that the proper tests are performed during qualification.

10.4.4.1. Macro-Section Tests

One weld macro-section shall be removed from the 3 o'clock or 9 o'clock positions of the qualification weld and prepared using standard metallographic techniques and shall be polished to at least a 600-grit finish and etched with a suitable etchant to give a clear definition of the weld. The macro-section shall allow for visual examination of the weld cross-section including the weld metal and adjacent base material.

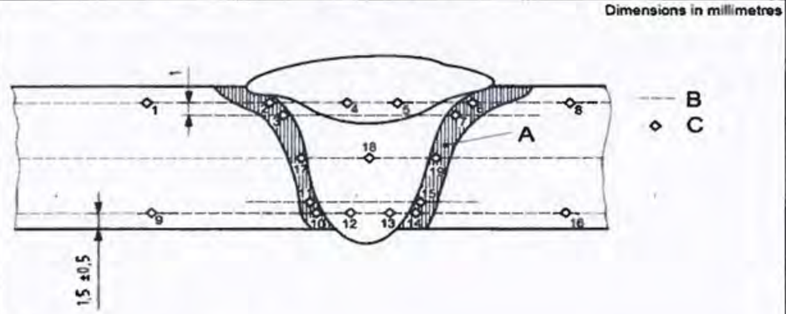
The macro-section specimen shall be considered acceptable if:

- The weld is free of weld induced cracks
- The weld is completely fused to the adjacent base material and/or weld metal at the root and between weld passes.
- There are no other obvious defects that would cause a weld to be considered unacceptable by other inspections

10.4.4.2. Hardness Test

The macro-section test specimen shall be used for hardness test in accordance with ASTM 384. The hardness test shall be performed using a Vickers hardness indenter with a 10 kg load. The location of the hardness indents are shown in **Figure 8**. The test results shall be approved by Gas Engineering.

Dimensions in millimetres



Key

A weld heat-affected zone (visible after etching)

B lines of survey

C hardness impressions: impressions 2, 3, 6, 7, 10, 11, 14, 15, 17 and 19 should be entirely within the heat-affected zone and located as close as possible to the fusion boundary between the weld metal and the heat-affected zone

The top line of survey should be positioned so that impressions 2 and 6 coincide with the heat-affected zone of the final run or change of profile of the fusion line associated with the final run.

Figure 8. Hardness Indent Locations for a Butt Welding Procedure Qualification

10.4.4.3. Charpy V-Notch Impact Energy Test

A minimum of six Charpy V-notch impact test specimens shall be removed from the 3 o'clock or 9 o'clock positions of the qualification weld, prepared and tested in accordance with ASTM A370 and ASTM E23. The specimen length shall be parallel to the pipe axis with the notch orientated in the through thickness direction of the sample. Three samples shall be notched in the weld centerline and three samples shall be notched in heat-affected zone of the weld in accordance with **Figure 9**. The test temperature for the Charpy V-notch impact test shall be a maximum of 0°C or as approved by Gas Engineering. The test results shall be approved by Gas Engineering.

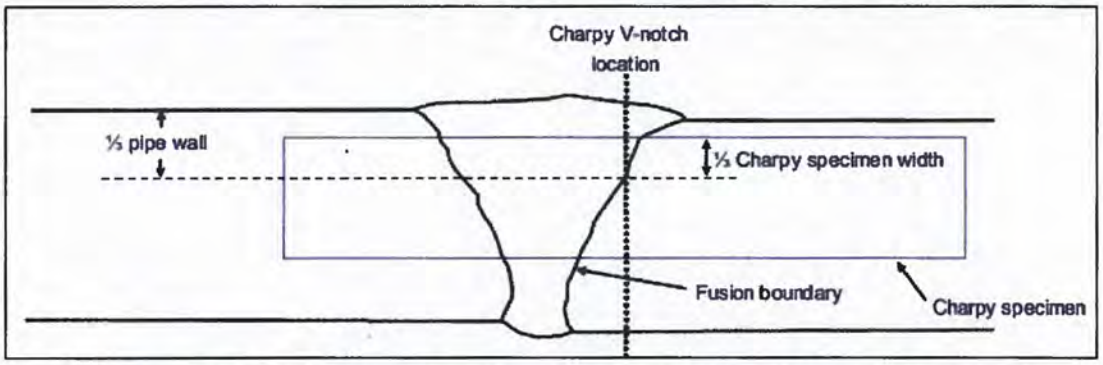


Figure 9. Charpy V-Notch Impact Specimen Location for Heat-Affected Zone Toughness Test for a Butt Welding Procedure Qualification

10.5. Qualification and Testing of Construction Branch Groove of Fillet Welding Procedures

After the inspection is completed, four nick-break test specimens shall be removed from the weld in accordance with **Figure 10**. After sectioning, the destructive test specimens shall be allowed to air cool to ambient temperature prior to testing. None of the test specimens shall include a portion of the pipe seam weld. The destructive test specimens shall be tested in accordance with Section 10.5.1. and Section 10.5.2, as applicable.

10.5.1. Nick Break Test

The nick-break test specimen shall be prepared in accordance with **Figure 10**. Notching the face of the nick-break test specimen is permitted when failure in the pipe is expected. After the specimen has been notched, the specimen shall be loaded until failure. The exposed fracture surface shall be at least 3/4 inch wide. The specimen shall be considered acceptable if they meet the requirements of Section 10.4.2.

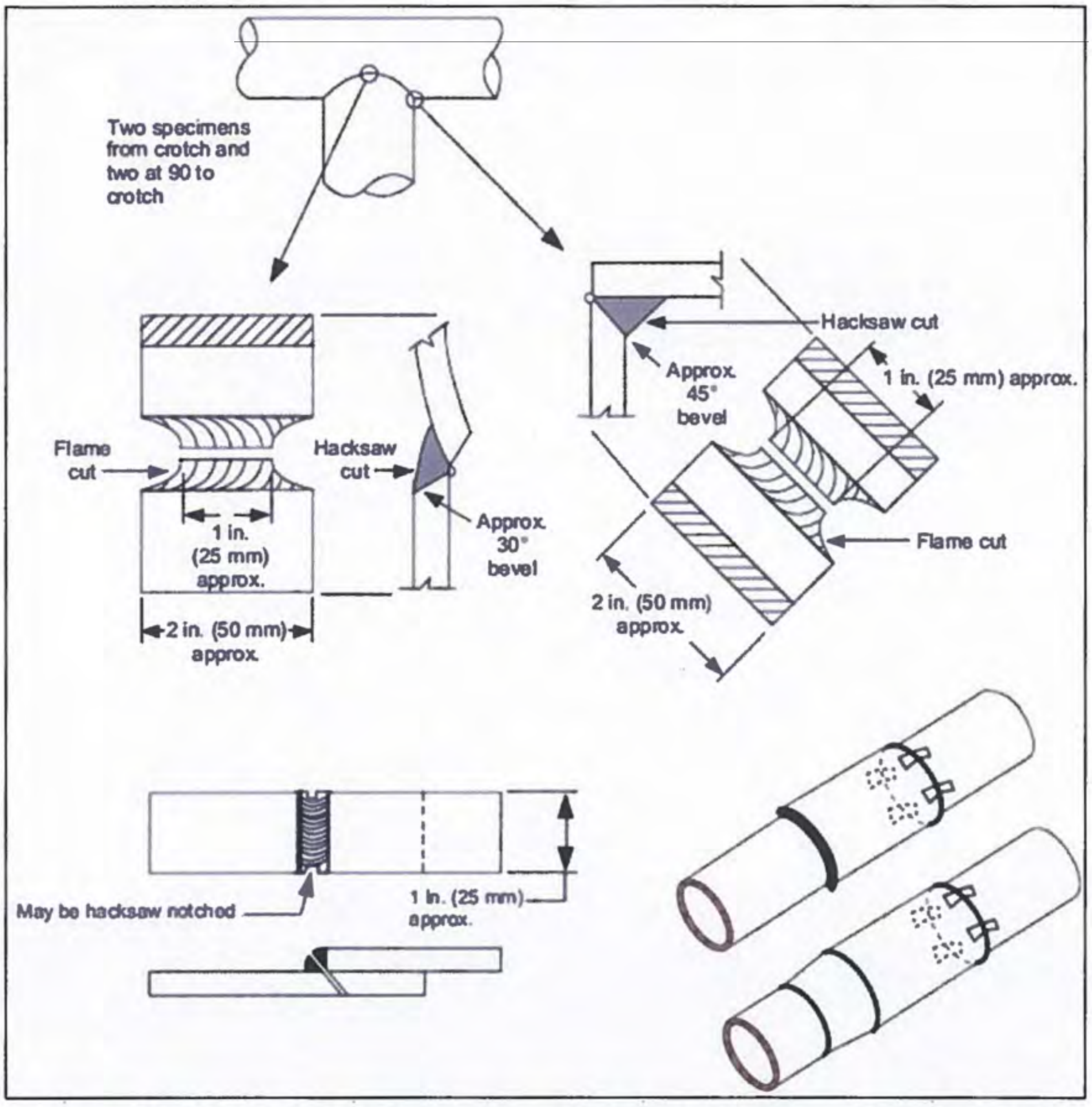


Figure 10. Location and Preparation of Nick-Break Branch Groove and Fillet Welding Procedure Qualification Test Specimens

10.5.2. Additional Branch Groove or Fillet Welding Procedure Qualification Test

Additional destructive tests may be required based on the operating conditions of the pipeline when requested by Gas Engineering. Additional tests may include but are not limited to Macro-section Tests in accordance with Section 10.5.2.1 and Hardness Test in accordance with Section 10.5.2.2.

Contact Gas Engineering for approval and to ensure that the proper tests are performed during qualification.

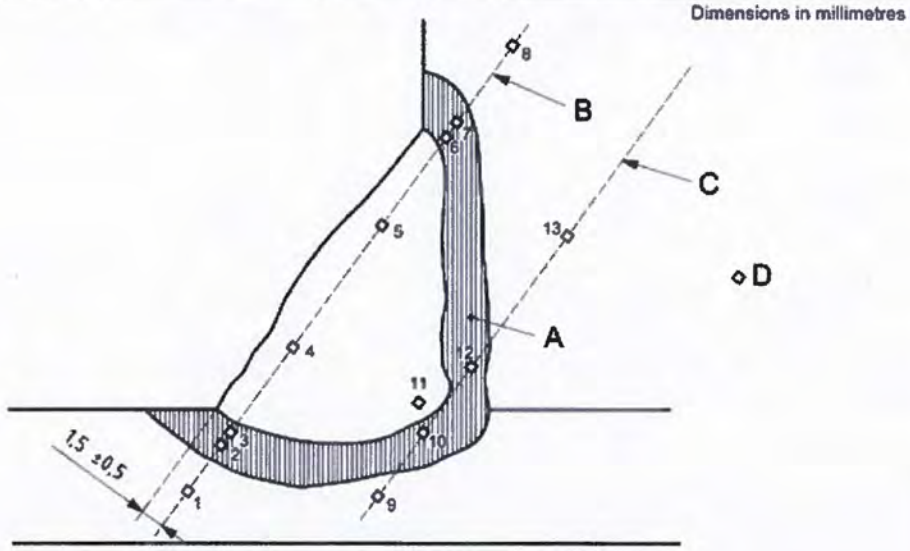
10.5.2.1. Macro-Section Test

One weld macro-section shall be removed from near the crotch location of the qualification weld, prepared, and evaluated in accordance with Section 10.4.4.1.

10.5.2.2. Hardness Test

The macro-section test specimen shall be used for the hardness test in accordance with Section 10.4.4.2 with the following exception.

- The location of the hardness indents for a branch groove weld or fillet weld shall be in accordance with **Figure 11**.



Key

A weld heat-affected zone (visible after etching)

B line of survey

C line of survey, parallel to line B and passing through the fusion boundary between the weld metal and the heat-affected zone at the throat

D hardness impressions: Impressions 3, 6, 10 and 12 should be entirely within the heat-affected zone and located as close as possible to the fusion boundary between the weld metal and the heat-affected zone.

Figure 11. Hardness Indent Locations for a Branch Groove or Fillet Welding Procedure Qualification

10.6. Qualification and Testing of Repair Welding Procedures (API 1104 21st Ed. Only)

Qualification of repair welding procedures requires testing repair welds deposited in previously deposited construction welds, for which the repair welding procedure is be used. This section was written to conform to Section 10 of the 21st edition of API 1104, though currently neither Section 10 of any edition or the 21st Edition of API 1104 are incorporated by reference into CFR 192/195. NGBU currently does not qualify separate repair procedures, but has written this section for future use should Section 10 of the 21st Edition of API 1104 become incorporated by reference.

The construction welds shall be deposited in a 12.75 inch or greater outside diameter, minimum 0.375 inch thick pipe oriented in the horizontal position. Two sections of the construction weld shall be ground out resulting in two repair grooves that shall be used to qualify a full-thickness, weld-centerline repair and a fusion-line, cover-pass repair.

The full-thickness, weld-centerline repair groove shall include the removal of the entire construction weld including the root pass. The repair groove shall have a minimum length of 8 inches of removed root pass. The total repair groove length shall be longer than 8 inches to allow a gradual transition from the outside diameter to the bottom of the repair groove to allow the welder access to the bottom of repair groove.

The fusion-line, cover-pass repair groove shall be on the opposite half of the pipe diameter from the full-thickness, weld-centerline repair groove. The repair groove shall be located at the weld toe of the cap pass. The depth of the groove shall be approximately 0.100 inch deep to allow the groove to be filled with a single layer. The minimum length of the full-thickness, weld-centerline repair groove shall be 8 inches.

10.6.1. Qualification of Repair Butt Welding Procedures

The completed qualification welds shall be inspected in accordance with:

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding
- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines
- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation

not less than 24 hours after welding has been completed. After the inspection is completed, the destructive test specimens shall be removed from the weld and tested in accordance with Section 10.4 with the following exceptions.

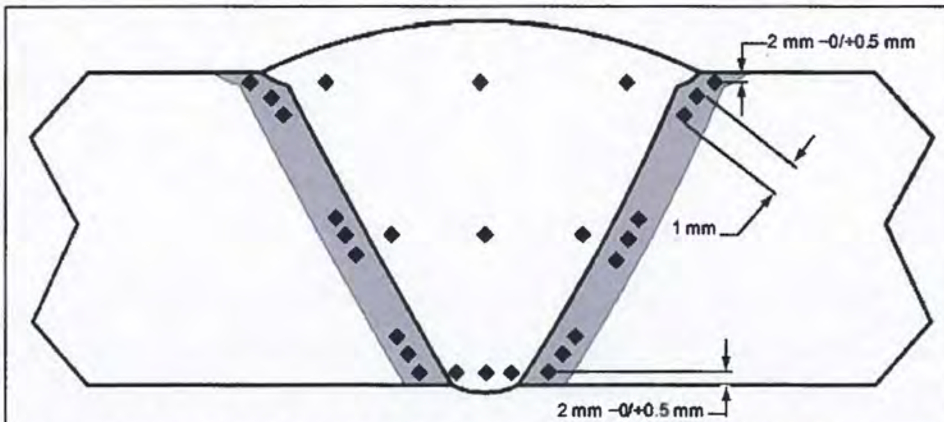
- The destructive test specimens required for qualifying full thickness weld centerline and fusion-line, cover-pass repair of butt welding procedures are provided in **Table 4**.

- The destructive test specimens shall be removed from the each repair weld in sequence starting in the center of the repair welds and tested in accordance with Section 10.4
- If the macro-section test shows a defect not associated with the repair weld, an additional macro-section test can be performed. If the second macro-section test contains other defects then the repair qualification weld is rejected.
- The hardness indent locations shall be in accordance with **Figure 12** or **Figure 13** as applicable.

Table 4. Type and Number of Test Specimens for Repair Butt Welding Procedure Qualifications

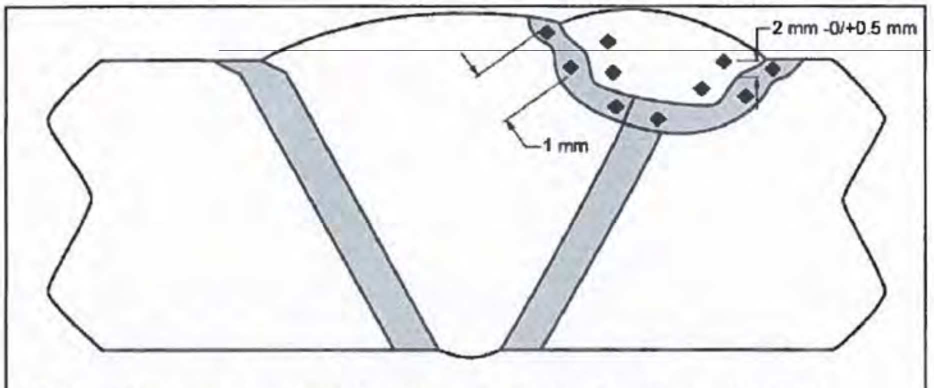
Repair Type	Tensile Strength	Nick Break	Root Bend	Face Bend	Side Bend	Macro/ Hardness [b]	Total (Minimum)	Charpy Impact
Full thickness	1	1	1 [a]	1 [a]	0	1	5	Note c
Cover pass	0	0	0	1	0	1	2	0

[a] Side bend tests are substituted for face bend or root bend tests when wall thickness is over 0.500 in. (12.7 mm).
[b] The hardness survey is made on the macrosection test specimen.
[c] When required by the company.



NOTE Heat-affected zone (HAZ) hardness impressions must be entirely within the HAZ and located as close as possible to the fusion boundary (between the weld metal and HAZ).

Figure 12. Hardness Indent Locations for a Full Thickness Centerline Repair Welding Procedure Qualification for Butt Weld Repairs



NOTE HAZ hardness impressions shall be entirely within the heat-affected zone and located as close as possible to the fusion boundary (between the weld metal and heat-affected zone).

Figure 13. Hardness Indent Locations for a Cover Pass Fusion Line Repair Welding Procedure Qualification for Butt Weld Repairs

10.6.2. Qualification of Repair Branch Groove or Fillet Welding Procedures

The completed qualification welds shall be inspected in accordance with

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding
- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines
- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation

not less than 24 hours after welding has been completed. After the inspection is completed, the destructive test specimens shall be removed from the weld and tested in accordance Section 10.5 with the following exceptions.

- The destructive test specimens required for qualifying a full thickness weld centerline repair of a branch groove weld or fillet welding procedure is two nick-break specimen, one macro-section specimen and one hardness test specimen
- The destructive test specimens required for qualifying a fusion line cover pass repair of a branch groove weld or fillet welding procedures include one macro-section specimen and one hardness test specimen
- The destructive test specimens shall be removed from the each repair weld in sequence starting in the center of the repair welds
- If the macro-section test shows a defect not associated with the repair weld, an additional macro-section test can be performed. If the

second macro-section test contains other defects then the repair qualification weld is rejected.

- The hardness indent for the fusion line cover pass repair shall be located in the following locations:
  - Three indents in the heat-affected zone of the fusion line cover pass repair located in the construction weld
  - Three indents in the heat-affected zone of the fusion line cover pass repair in the pipe or attachment material
  - Two indents in the intersection of the heat-affected zones of the fusion line cover pass repair and construction weld
  - Four indents in the fusion line cover pass repair weld metal

10.7. Qualification and Testing of In-Service Welding Procedures

CAUTION: *In-service welding procedures are required separately from standard welding procedures because of the inherent safety issues and special circumstances required to weld on pressurized pipelines. The goal of in-service welding procedures are to avoid burn-through of the pipe wall and hydrogen cracking of the weld.*

10.7.1. In-service welding procedures shall be performed in accordance with API 1104 Appendix B and considered either a heat input control in-service welding procedure or a temper bead welding procedure. Heat input control in-service welding procedures rely on the heat from the welding process to counteract the cooling aspects of the operating pipeline. Temper bead in-service welding procedures rely on the welding heat from subsequent weld pass to temper the previously deposited weld pass.

10.7.2. All in-service welding procedures shall be qualified as an in-service branch groove weld or an in-service sleeve fillet welding procedure. Qualification of in-service weld metal deposition welding procedures shall be approved by Gas Engineering.

10.7.3. All in-service welding procedures shall be qualified with water or flowing motor oil to simulate the cooling conditions of a natural gas operating pipeline. The heat sink capacity shall be measured for all qualification welds in accordance with WEL-PR-1040 "Heat Sink Capacity Measurement."

10.7.4. The material used during qualification shall have a representative CE of the material that is to be welded in the field. The welding heat input shall be calculated using hand held meters, a stopwatch, and tape measure in accordance with Section 11.2.2 of WEL-ST-1010. The average heat input per weld pass used to deposit the in-service qualification weld shall be considered the minimum allowable welding heat input for the in-service welding procedure.

The completed qualification welds shall be inspected in accordance with:

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding
- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines

- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation

not less than 24 hours after welding has been completed. After the inspection is completed, the destructive test specimens shall be removed from the weld and tested in accordance with Section 10.5 with the following exceptions:

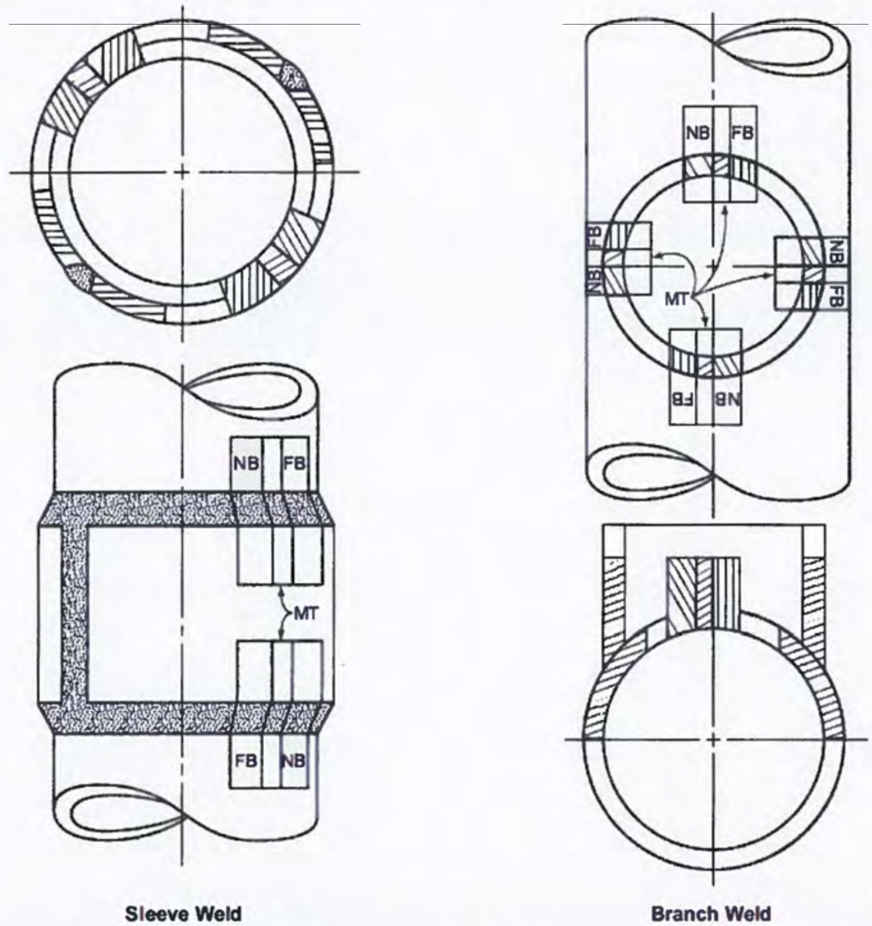
- The destructive test specimens required for qualifying an in-service branch groove or sleeve fillet welding procedure are provided in **Table 5**.
- The test specimens shall be removed from the weld in accordance with **Figure 14**, as applicable.
- Two of the macro-section tests shall be used for hardness testing.
- The face bend specimen shall be prepared in accordance with **Figure 15** and tested in accordance with Section 10.4.3 with the weld toe area being placed opposite the plunger
- The remaining portion of the nick-break specimen could be used for the face bend specimen with approval by the Welding Procedure Qualifier.
- For temper bead welding procedures, the distance from the weld toe on the first layer to the weld toe on the subsequent pass shall be measured and recorded on the in-service welding procedure as the maximum weld bead spacing permitted.
- The hardness indent locations shall be in accordance with **Figure 16** and there should be a minimum of five indents in the area, which is expected to have the highest expected hardness.

Table 5. Type and Number of Test Specimens for In-Service Welding Procedure Qualifications

Wall Thickness	Weld Type	Number of Specimens [a]						
		Tensile	Nick Break	Root Bend	Face Bend	Side Bend	Macro Test	Total
All	Sleeve		4 [b]		4		4	12
	Branch		4 [b]		4		4	12

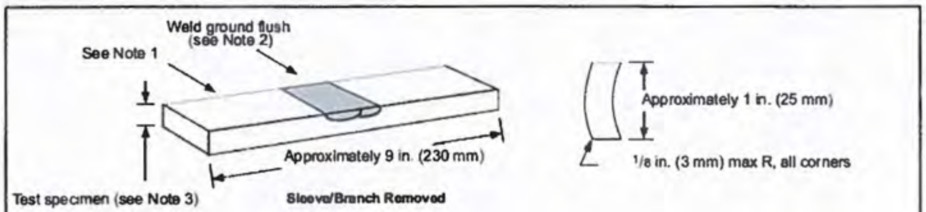
[a] For pipe or branch OD less than or equal to 4.500 in. (114.3 mm), two welds may be required.

[b] At the owner's option, the remaining portion of these specimens may be prepared for and submitted to the face bend test after they are submitted to the nick break test.



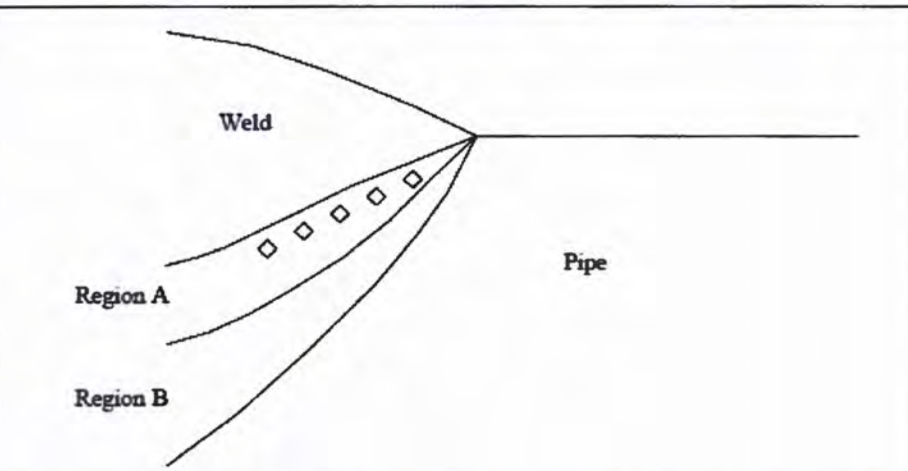
NOTE FB = face bend; NB = nick break; MT = macro test.

Figure 14. Location of Test Specimens for In-Service Welding Procedure Qualification



NOTES:
1. Test specimens may be machine cut or oxygen cut oversized and machined (see B.2.4.5.1).
2. The sleeve or branch weld reinforcement is removed flush with the surface of the test specimen. The branch weld test specimen is shown in the axial direction; specimens in the other direction are curved. Test specimens are not flattened prior to testing.
3. Where wall thickness is greater than 0.500 in. (12.7 mm), it may be reduced to 0.500 in. (12.7 mm) by machining the inside surface.

Figure 15. Face Bend Test Specimen Preparation for In-Service Welding Procedure Qualification



* Indents are spaced 0.2 mm from fusion line and 0.6 mm apart. Initial indent is located 0.6 mm from weld toe. Region A is coarse-grain HAZ and Regions A and B are visible HAZ. Figure is not to scale.

Figure 16. Hardness Indent Locations for In-Service Welding Procedure Qualification

10.8. Approval of Third Party Fabrication Contactor Welding Procedures

Contractor welding procedures can be used when welding on NGBU facilities upon review and approval by a Welding Procedure Approver. Contractor procedures shall be qualified to either API 1104 or ASME Section IX. The Contractor Qualification Approval Form provided in Appendix C shall be signed and dated by a Welding Procedure Evaluator accepting responsibility of the contractor's welding procedure. Appendix C and the contractor's welding procedures shall be filed in the job book.

10.9. Documentation and Recordkeeping Requirements for Welding Procedure Qualifications

Once all documentation is complete showing the weld procedure to comply with this standard, the new procedure will be signed off and accepted by the Welding

Procedure Approver and the standard will be updated by Asset Safety Management. The PQR shall be signed by the Welding Procedure Qualifier and the Welding Procedure Approver. The procedure qualification record shall be maintained by Asset Safety Management.

Form A (for welding procedures) and Form B (for PQRs) in WEL-PR-1000 provide the required forms for appropriate documentation. Other forms will be considered acceptable upon approval by the Welding Procedure Approver.

The welding procedure shall be retained for the lifetime of the pipeline it was used on and followed whenever the procedure is used. The PQR shall be maintained as long as the welding procedure is in use.

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11. Welder Qualifications

11.1. General

11.1.1. This section covers the operator qualification of welders (both NGBU and Contract welders). New welders shall be qualified to the edition of API 1104 that is referenced in 49 CFR 192 at the time of qualification and the following applicable sections. The applicable sections may exceed, but shall in no instance reduce, the requirements specified in API 1104. Wherever there is a contradiction, the more stringent requirement shall govern.

11.1.2. Welders qualified under a previous version of API 1104 may continue welding, however their welder qualification maintenance shall be in compliance with the edition of API 1104 which is referenced in the most recent version of 49 CFR 192. The welders shall be qualified using the qualified welding procedures included in the Welding Standard that have been qualified to produce sound ductile welds. Before starting the qualification test, the welder shall be given a reasonable time to adjust the welding equipment to be used. The welder shall use the same welding technique and proceed with the same speed used during field welding.

11.1.3. Qualified welders shall be given a Welders Certificate that will specify the welder endorsement in accordance with Section 11.2 and the test date. The required format for a Welders Certificate is provided in Form M of WEL-PR-1000. Welders shall keep the Welding Certificate with them when welding for NGBU as proof of their qualification. The Welders Certificate shall be completed, signed, and issued by the welding supervisor or designate. All NGBU employees holding a Welding Certificate shall be within the reporting structure of the Fabrication Resources Group. Any deviation from the range of conditions for which the welder is qualified is strictly prohibited.

11.2. NGBU Welder Endorsements

NOTE: *Welder endorsements (formerly designations) are based on experience and associated work restriction as defined in Table 6.*

11.2.1. The highest welder endorsement (A Welder) is a welder who is considered to have achieved the greatest technical skill based on documented experience and testing. The lowest welder endorsement (C Welder) is a welder who is considered to require significant skill development based on experience and testing. Welder endorsements apply to SMAW construction welders using cellulosic electrodes. In addition to the welder endorsements defined in **Table 6**, a welder can designated as a oxy-acetylene construction welder in accordance with Sections 11.3.4, a gas metal arc weld (GMAW/MIG) construction welder in accordance with 11.3.5, a repair welder (R Welder) in accordance with Section 11.4, a low-hydrogen in-service welder (IN-A Welder) in accordance with Section 11.5.1, or a cellulosic in-service welder (IN-B Welder) in accordance with Section 11.5.2.

11.2.2. All contract welders shall meet the qualification requirements of an "A" Welder in accordance with this section. Any contract welder can be disqualified in accordance with Section 11.8.

Table 6. NGBU Specific Welder Endorsements

Welder Endorsements	Work Restrictions		
	Welding Process	Pipe Outside Diameter	Pipe Pressure
A	Cellulosic SMAW	All	All
AO	Oxy-acetylene	≤ 2.375"	All
AM	GMAW (MIG)	≤ 6.625"	All
B	Cellulosic SMAW	≤ 8.625"	400 psig
BO	Oxy-acetylene	≤ 2.375"	400 psig
BM	GMAW (MIG)	≤ 6.625"	All
C	Cellulosic SMAW	≤ 6.625"	125 psig
CO	Oxy-acetylene	≤ 2.375"	125 psig
CM	GMAW (MIG)	≤ 6.625"	All

11.3. Construction Welder Qualification Requirements (A, B, C Welders)

11.3.1. SMAW A Welder Qualification Requirements

The welder shall complete a butt weld following WPS 40 and a branch groove qualification weld following WPS 100 using 12.75 inch outside diameter, greater than or equal to 0.250 inch to 0.500-inch thick pipe. The SMAW butt weld shall be deposited in the 5G position. For the branch groove weld the welder shall lay out, cut, and fit the branch pipe to the second pipe. The branch pipe shall be vertical located underneath the second pipe, which shall be positioned horizontally. Prior to welding the branch groove weld a hole shall be cut into the second pipe equivalently equal to the inside diameter of the branch pipe.

At a minimum the joint configuration, including the joint bevel and root opening, travel speed, and corresponding welding parameters shall be monitored to ensure compliance with the corresponding welding procedure.

11.3.1.1. Inspection and Testing of All SMAW Welder Qualification Welds

The completed qualification weld shall be allowed to air cool to ambient temperature prior to inspection. The weld shall be visually inspected by personnel qualified in accordance with Section 12 and to the acceptance criteria in accordance with Section 12.

After the visual inspection is completed, the qualification weld shall be destructively tested if it is for a compressor station welder or an entry-level welder (initial qualification). Qualification extensions may be tested by radiographic testing (RT). The completed qualification butt weld shall be tested in accordance with Section 10.4 with the following exceptions.

- The type and number of destructive test specimens are provided in **Table 7**.
- The destructive test specimens shall be removed from the weld in accordance with **Figure 17**.

Table 7. Type and Number of SMAW Welder Qualification Butt Weld Test Specimens

Outside Diameter of Pipe		Number of Specimens					
in.	mm	Tensile Strength	Nick Break	Root Bend	Face Bend	Side Bend	Total
>4.500 to 12.750	>114.3 to 323.9	2	2	2	0	0	6

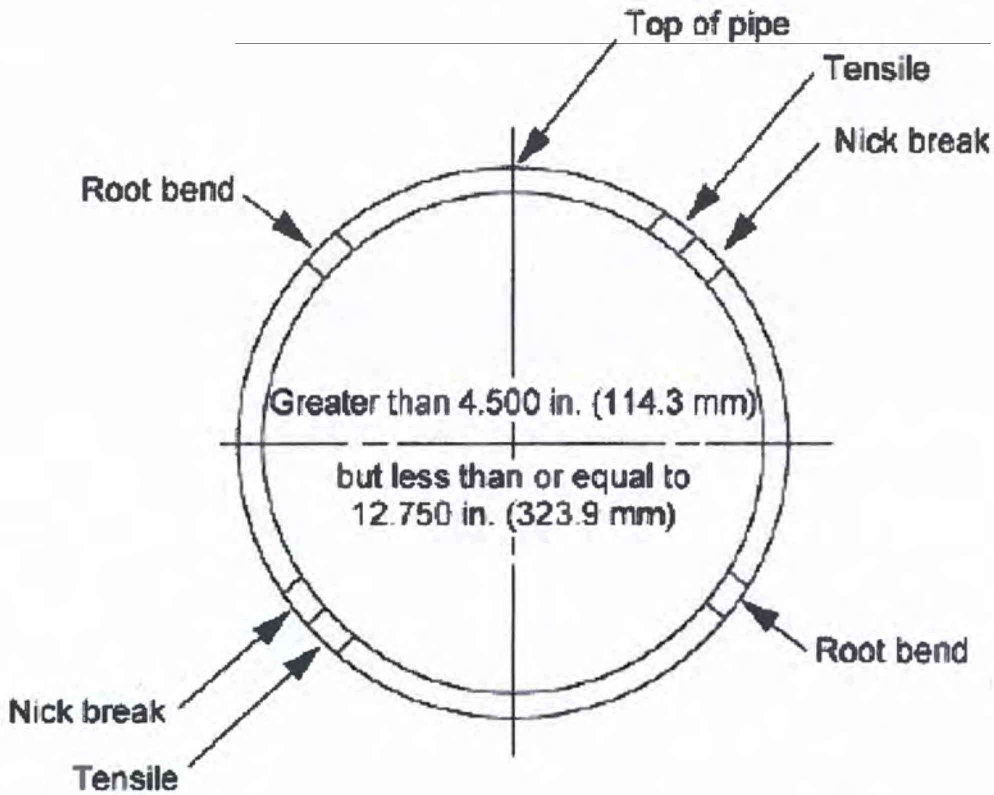

Figure 17. Location of SMAW Welder Qualification Butt Weld Test Specimens

Radiographic inspection shall performed by qualified personnel in accordance with API 1104. Radiographic inspection shall not be used to inspect butt welds to locate sound areas for destructive testing.

The branch groove weld test specimens include four nick-break test specimens and shall be removed from the weld and tested in accordance with Section 10.5.

Finally, there will also be a written exam given which tests basic welding knowledge.

After successful completion of the A welder qualification tests, the welder will be qualified to deposit construction welds following any SMAW welding procedure in accordance with **Table 8** and Section 11.2.

Table 8. A Welder Qualification Ranges for Construction Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Max. MAOP
Downhill	Group 1 or 2	All	All	All	All	None

11.3.2. SMAW B Welder Qualification Requirements

The welder shall complete the qualification welds in accordance with Section 11.3.1 with the exception that the pipe outside diameter shall be 8.625 inch. After successful completion of the B welder qualification tests, the welder will be qualified to deposit construction welds in accordance with any SMAW welding procedure in accordance with **Table 9** and Section 11.2.

Table 9. B Welder Qualification Ranges for Construction Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Max. MAOP
Downhill	Group 1 or 2	≤ 8.625 inch	All	All	All	400 psig

11.3.3. SMAW C Welder Qualification Requirements

The welder shall complete the qualification welds in accordance with Section 11.3.1 with the exception that the pipe outside diameter shall be 6.625 inch. After successful completion of the C welder qualification tests, the welder will be qualified to deposit construction welds with any SMAW welding procedure in accordance with **Table 10** and Section 11.2.

Table 10. C Welder Qualification Ranges for Construction Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Max. MAOP
Downhill	Group 1 or 2	≤ 6.625 inch	All	All	All	125 psig

11.3.4. Oxy-acetylene Construction Welder Qualification Requirements (O Welder)

11.3.4.1. The welder shall complete one butt weld in 2.375 inch outside diameter, 0.154 inch thick API 5L X42 or X52 grade pipe, one butt weld in 2.375 inch outside diameter, 0.218 inch thick API 5L X42 or X52 grade pipe and two butt welds in 1.66 inch outside diameter, 0.113 inch thick API 5L X42 or X 52 grade pipe. All welds shall be welded in the 5G position following WPS 10.

11.3.4.2. At a minimum the joint configuration, including the joint bevel and root opening, travel speed and corresponding flame characteristics shall be monitored to ensure compliance with the corresponding welding procedure.

11.3.4.3. The completed qualification welds shall be inspected in accordance with Section 10.5. After the inspection is completed, the qualification welds shall be destructively tested in accordance with Section 10.4 with the following exceptions.

- The type and number of destructive butt weld test specimens are provided in **Table 11**.
- The destructive test specimens shall be removed from the weld in accordance with **Figure 18**.

Table 11. Type and Number of Oxy-acetylene Welder Qualification Butt Weld Test Specimens

Outside Diamter of Pipe	Number of Specimens					
in	Tensile Strength	Nick Break	Root Bend	Face Bend	Side Bend	Total
< or = 2.375	0	2	2	0	0	4

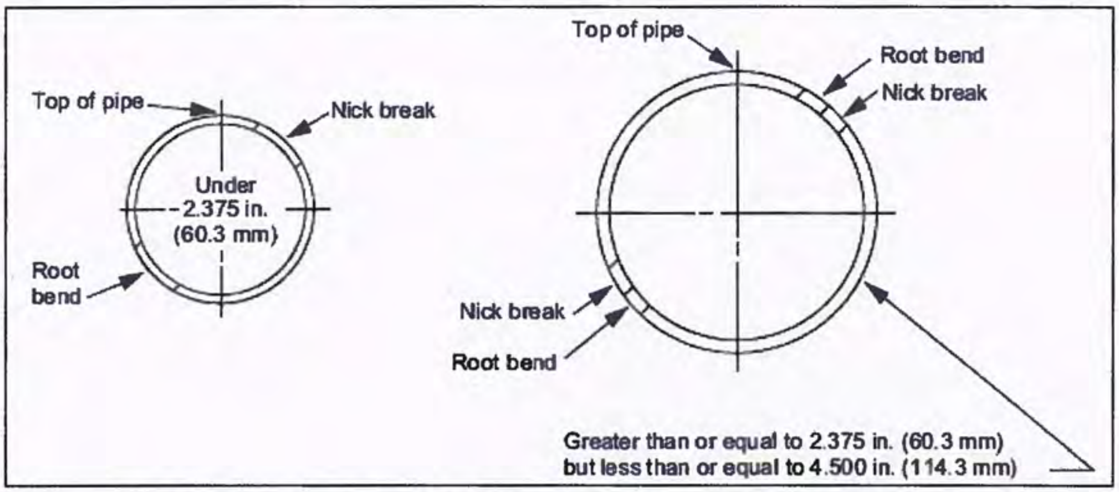

Figure 18. Location of Oxy-Acetylene Welder Qualification Butt Weld Test Specimens

11.3.4.4. After successful completion of the qualification tests, the welder will be qualified to deposit the construction welds following any oxy-acetylene welding procedure in accordance with **Table 10** and Section 11.2. Welders qualified for construction oxy-acetylene welding shall be considered to have the same welder endorsement as the welder's current SMAW construction welder endorsement. If the welder does not have a current SMAW construction welder endorsement then the welder shall be considered a C Welder.

Table 12. Oxy-Acetylene Welder Qualification Ranges for Construction Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints
Uphill	Group 6	≤ 2.375 inch	< 0.188 inch	All	Butt and Lap Fillet Welds
Uphill	Group 6	2.375 inch	0.188 – 0.218 inch	All	Butt and Lap Fillet Welds

11.3.5. GMAW (MIG) Construction Welder Qualification Requirements (M Welder)

11.3.5.1. The welder shall complete the qualification tests in accordance with Section I of Appendix C of CFR Title 49 Part 192, "Qualification of Welders for Low Stress Level Pipe" (See the Appendix of this standard for the test instructions from 192).

11.3.5.2. The qualification work for the MIG welds will be done using a 4.5" diameter steel pipe. This allows the MIG welder to weld on any pipe diameter equal to or less than the 6.625" diameter pipe. The pipe will be 0.188" wall thickness. The pipe will be welded in a fixed horizontal position. The weld must conform to the specifications of the procedure under which the welder is being qualified.

11.3.5.3. The (4) coupons extracted from the butt weld will be subjected to only a root bend test. A welder who successfully passes a butt-weld qualification test under this section shall be qualified to weld on all pipe diameters less than or equal to 12 inches.

11.4. Repair Welder Qualification Requirements (R Welder) (API 1104 21st Ed. Only)

11.4.1. This section was written to conform to Section 10 of the 21st edition of API 1104, though currently neither Section 10 of any edition or the 21st Edition of API 1104 are yet incorporated by reference into CFR 192/195.

11.4.2. The welder shall complete a full-thickness, weld-centerline repair and a fusion-line, cover-pass weld repair for the weld joint type (butt weld or branch groove or fillet weld) to be considered a qualified repair welder. The welder shall follow the repair welding procedure that was qualified in accordance with Section 10.6 for the weld joint type that will require the repair weld. The excavation for all repairs shall be orientated on the bottom of the pipe prior to welding.

11.4.3. At a minimum the joint configuration, including the joint bevel and root opening, travel speed, and corresponding welding parameters shall be monitored to ensure compliance with the corresponding welding procedure.

11.4.4. The completed repair qualification welds shall be inspected and tested in accordance with Section 11.3.1.1, as applicable, with the following exceptions.

- When qualifying the butt weld repairs by destructive testing the total number and type of full thickness butt repair weld test specimens shall be in accordance with **Table 13**.
- There shall only be two nick-break test specimens to qualify the full thickness branch groove repair weld.
- There shall only be one face bend test specimen to qualify the cover-pass, branch groove repair weld in accordance with Section 10.7.

Table 13. Type and Number of Repair Welder Qualification Butt Weld Test Specimens

Repair Type	Tensile Strength	Nick Break [b]	Root Bend	Face Bend	Side Bend	Total (Minimum)
Full thickness	0	2	1	1	0	4
Cover pass	0	2	0	1	0	3

[b] One nick break specimen is taken at the transition between the repair weld end and original weld bead and the second nick break specimen located at the midpoint of the repair weld deposit.

11.4.5. After successful completion of the R welder qualification tests the welder will be qualified to deposit repair welds, following any repair welding procedure for the weld joints and welding process used during the qualification, in accordance with **Table 14** and Section 11.2. Repair depths greater than the depths listed in **Table 14** may be performed with approval from Gas Engineering.

Table 14. R Welder Qualification Ranges for Repair Welding

Qualified Welding Process	Welding process specified in the Repair Welding Procedure
Qualified Welding Direction	Welding direction specified in the Repair Welding Procedure
Qualified Filler Metal Group	Welding direction specified in the Repair Welding Procedure
Qualified Diameter Range	All
Qualified Wall Thickness Range	All
Qualified Positions	All
Qualified Joints	Weld joint specified in the Repair Welding Procedure
Qualified Repair Types	Weld Centerline Repairs (Full and Partial Thickness) Weld Toe Cover Pass Repairs
Qualified Repair Depth	Weld Centerline Repairs with a depth of 0.75 inch Weld Toe Cover Pass Repair with a depth of 0.200 inch

11.5. Live Line (In-Service) Welder Qualification Requirements (IN-A and IN-B Welder)

11.5.1. IN-A Welder Qualification Requirements

11.5.1.1. The welder shall have a current A Welder qualification in accordance with Section 11.3.1. The welder shall complete a sleeve fillet weld and a sleeve long seam weld on a 12.75 inch outside diameter, minimum .250 inch thick API 5L pipe of any grade but shall have a maximum CEPCM of 0.25 or CEIIW of 0.43, as appropriate (See API 5L 9.2 for each formula). The pipe shall be filled with water and the water shall be allowed to flow during welding by welding caps on the pipe. The pipe shall be in the 6G position (inclined 45 degrees from horizontal). The sleeve shall be fitted with a backing bar for the long seam weld.

11.5.1.2. The welder shall follow WPS 200 while depositing the sleeve fillet weld. The long seam weld shall be deposited following any appropriate welding procedure based on the grade of sleeve used. At a minimum the welding heat input, joint configuration, including the joint bevel and root opening, travel speed and corresponding welding parameters shall be monitored to ensure compliance with the corresponding welding procedure.

11.5.1.3. The completed in-service qualification weld shall be inspected and tested in accordance with Section 11.3.1.1, as applicable, with the following exceptions.

- The in-service sleeve fillet weld shall be tested as a branch groove weld, with 4 nick break specimens being taken, per Figure 10 in API 1104.
- The type and number of destructive test specimens for long seam welder qualification are provided in **Table 15**.

Table 15. Type and Number of SMAW Welder Qualification Long Seam Weld Test Specimens

Wall Thickness	Tensile	Number of Specimens				
		Nick Break	Root Bend	Face Bend	Side Bend	Total
≤0.500 in. (12.7 mm)	1	1	1	1	0	4

11.5.1.4. After successful completion of the IN-A welder qualification test the welder will be qualified to deposit in-service welds following any SMAW in-service welding procedure in accordance with **Table 16** and Section 11.2.

Table 16. IN-A Welder Qualification Ranges for In-Service Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Pipeline Operating Conditions
Uphill	Group 3	All	All	All	All In-service Weld Joints	All
Uphill	Group 3	All	0.188 – 0.750 inch	Horizontal, Flat or Overhead	All Long Seams on a Backing Bar	All

11.5.2. IN-B Welder Qualification Requirements

11.5.2.1. The welder shall have a current B Welder qualification in accordance with Section 11.3.2. The welder shall complete a sleeve fillet weld and a sleeve long seam weld on a 8.625 inch outside diameter, minimum .250 inch thick API 5L pipe of any grade but shall have a maximum CEPCM of 0.25 or CEIIW of 0.43, as appropriate (See API 5L 9.2 for each formula). The pipe shall be filled with water and the water shall be allowed to flow during welding by welding caps on the pipe. The pipe shall be in the 6G position (inclined 45 degrees from horizontal). The sleeve shall be fitted with a backing bar for the long seam weld.

11.5.2.2. The welder shall follow WPS 200 while depositing the sleeve fillet weld. The long seam weld shall be deposited following any appropriate welding procedure based on the grade of sleeve used. At a minimum the welding heat input, joint configuration, including the joint bevel and root opening, travel speed and corresponding welding parameters shall be monitored to ensure compliance with the corresponding welding procedure.

11.5.2.3. The completed in-service qualification welds shall be inspected and tested in accordance with Section 11.3.1.1, as applicable, with the following exceptions.

- The in-service sleeve fillet weld shall be tested as a branch groove weld, with 4 nick break specimens being taken, per Figure 10 in API 1104.
- The type and number of destructive test specimens for long seam welder qualification are provided in **Table 15**.

11.5.2.4. After successful completion of the IN-B welder qualification test the welder will be qualified to deposit in-service welds following any SMAW in-service welding procedure in accordance with **Table 17** and Section 11.2. Additionally, the IN endorsements keep the same max MAOP as the equivalent regular endorsement (see **Table 6**).

Table 17. IN-B Welder Qualification Ranges for In-Service Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Pipeline Operating Conditions
Uphill	Group 3	≤ 8.625 inch	All	All	All In-Service Weld Joints	All
Uphill	Group 3	≤ 8.625 inch	0.188 – 0.750 inch	Horizontal, Flat or Overhead	All Long Seams on a Backing Bar	All

11.5.3. IN-C Welder Qualification Requirements

11.5.3.1. The welder shall have a current C Welder qualification in accordance with Section 11.3.3. The welder shall complete a sleeve fillet weld and a sleeve long seam weld on a 6.625 inch outside diameter, minimum .280 inch thick API 5L pipe of any grade but shall have a maximum CEPCM of 0.25 or CEIIW of 0.43, as appropriate (See API 5L 9.2 for each formula). The pipe shall be filled with water and the water shall be allowed to flow during welding by welding caps on the pipe. The pipe shall be in the 6G position (inclined 45 degrees from horizontal). The sleeve shall be fitted with a backing bar for the long seam weld.

11.5.3.2. The welder shall follow WPS 200 while depositing the sleeve fillet weld. The long seam weld shall be deposited following any appropriate welding procedure based on the grade of sleeve used. At a minimum the welding heat input, joint configuration, including the joint bevel and root opening, travel speed and corresponding welding parameters shall be monitored to ensure compliance with the corresponding welding procedure.

11.5.3.3. The completed in-service qualification welds shall be inspected and tested in accordance with Section 11.3.1.1, as applicable, with the following exceptions.

- The in-service sleeve fillet weld shall be tested as a branch groove weld, with 4 nick break specimens being taken, per Figure 10 in API 1104.
- The type and number of destructive test specimens for long seam welder qualification are provided in **Table 16**.

11.5.3.4. After successful completion of the IN-C welder qualification test the welder will be qualified to deposit in-service welds following any SMAW in-service welding procedure in accordance with **Table 18** and Section 11.2. Additionally, the IN endorsements keep the same max MAOP as the equivalent regular endorsement (see **Table 6**).

Table 18. IN-C Welder Qualification Ranges for In-Service Welding

Weld Direction	Filler Metal Group	Outside Diameter Range	Wall Thickness Range	Positions	Joints	Pipeline Operating Conditions
Uphill	Group 3	≤ 6.625 inch	All	All	All In-Service Weld Joints	All
Uphill	Group 3	≤ 6.625 inch	0.188 – 0.750 inch	Horizontal, Flat or Overhead	All Long Seams on a Backing Bar	All

11.6. Approval of Third Party Fabrication Contract Welder Qualifications

11.6.1. Third Party Fabrication Contract welders can be used to weld on NGBU facilities upon review and approval of the contract welder qualifications by a Welder Qualifier. The Third Party Fabrication Contractor Qualification Approval Form provided in Form C of WEL-PR-1000 shall be signed and dated by the Welder Qualifier accepting responsibility of the contract welder's qualifications. Qualifications to either API 1104 or ASME Section IX will be considered as acceptable.

11.7. Welder Qualification Maintenance and Limitations

NOTE: *Welders shall maintain their qualification by having at least one weld destructively or nondestructively tested and found acceptable in accordance with the edition of API 1104 which is referenced in 49 CFR 192 at the time they are testing. Welders shall be tested a minimum of twice per year with the time between test welds not to exceed 7 ½ months.*

11.7.1. The welder qualification maintenance weld shall be deposited following a qualified welding procedure for the process for which the welder was initially qualified. The welder shall deposit the entire qualification maintenance weld. Approved documentation for welder qualification maintenance is either an acceptable non-destructive test report of a production weld or acceptable destructive tests of a test weld in accordance with Sections 10-14, as applicable. If the welder qualification maintenance is based on a non-destructive test report of a production weld then the weld shall be deposited on a NGBU facility.

11.7.2. The welder qualification maintenance weld shall be scheduled by OQ personnel once the Veriforce system sends out a welder qualification expiration notification. Compression station welders shall maintain their welder qualification by destructive testing only.

11.7.3. The required documentation for welder maintenance is provided in Form N of WEL-PR-1000 and shall be filled out by the Welder Qualifier. If a welder fails to maintain their qualification or the interval for testing is exceeded the welder shall re-qualify in accordance with Section 11, as applicable.

11.8. Disqualification of Welders

11.8.1. During qualification, a Welder Qualifier can suspend welding operations of any welder whose ability to deposit an acceptable weld is in question. During construction welding a Welding Inspector or Welder Qualifier can suspend welding operations of any welder whose ability to deposit an acceptable weld is in question. Any welder who has more than two cutouts on any one job, the welder will be disqualified and will be asked to requalify at a later date. Any welder can be asked to requalify at any time if NGBU has any concern about the welder's competence or skill. Welder Certificates can only be pulled by a Welder Qualifier.

11.8.2. Consequences of failing a welder qualification test are covered in NGBU's Operator Qualification Plan. A welder who fails a qualification test because of an unavoidable condition or conditions beyond the welder's control, the welder may be given a second opportunity to qualify with approval from NGBU Technical Training and Operator Qualification.

11.9. Documentation and Recordkeeping Requirements for Welder Qualifications

NOTE: *It shall be the responsibility of a Welder Qualifier to approve welders in accordance with this standard, review test results, confirm the acceptability of the welder's qualification, maintain qualification documentation, and maintain a list of qualified welders.*

11.9.1. Each welder qualification record must be recorded in sufficient detail on the forms provided in Form D through Form L of WEL-PR-1000, as applicable, and shall include the qualification test results.

11.9.2. New NGBU welders with previous documented experience can begin at any welder endorsement as determined and approved by the Welder Qualifier.

12. Weld Inspection Practice

Details on weld inspection practice may be found in:

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding
- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines
- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation

13. Contact

Gas Engineering

14. Appendices

Appendix A: Appendix C to Part 192—Qualification of Welders for Low Stress Level Pipe

15. Signature

Reviewed and approved by:

Randy L Bost

Randy L Bost (Apr 30, 2019)

16. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this Standard: • CM-ST-2170 *Fabrication* • CM-PL-4000 *PNG Welding Manual, Sections 4.3.6, 4.3.7, 4.4, and 4.5*	Members of Work Process Integration Team
1	04/11/2019	• Minor edit in Section 10.3 to add clarity	Policies & Procedures Team
2	05/01/2019	Revised the "WHO" section, added Gas Engineering, Gas Field Operations, and Technical Field Operations Added references for region specific procedures on sections: • 10.6.1 - Qualification of Repair Butt Welding Procedures • 10.6.2 - Qualification of Repair Branch Groove or Fillet Welding Procedures • 10.7.4 - Qualification and Testing of In-Service Welding Procedures • 12 - Weld Inspection Practice	Work Process Integration Team

		Legacy Documents incorporated into this Standard: • GD55.505-1 Welding Qualifications • GD55.512-1 Limitations of Welders and Welding Processes • 6.1.1 Preparation Of Coupons For Tensile, Nick Break & Guided Root Bend Tests	

Appendix: A Appendix C to Part 192—Qualification of Welders for Low Stress Level Pipe

I. *Basic test.* The test is made on pipe 12 inches (305 millimeters) or less in diameter. The test weld must be made with the pipe in a horizontal fixed position so that the test weld includes at least one section of overhead position welding. The beveling, root opening, and other details must conform to the specifications of the procedure under which the welder is being qualified. Upon completion, the test weld is cut into four coupons and subjected to a root bend test. If, as a result of this test, two or more of the four coupons develop a crack in the weld material, or between the weld material and base metal, that is more than $\frac{1}{8}$ -inch (3.2 millimeters) long in any direction, the weld is unacceptable. Cracks that occur on the corner of the specimen during testing are not considered. A welder who successfully passes a butt-weld qualification test under this section shall be qualified to weld on all pipe diameters less than or equal to 12 inches.

(...)

III. *Periodic tests for welders of small service lines.* Two samples of the welder's work, each about 8 inches (203 millimeters) long with the weld located approximately in the center, are cut from steel service line and tested as follows:

(1) One sample is centered in a guided bend testing machine and bent to the contour of the die for a distance of 2 inches (51 millimeters) on each side of the weld. If the sample shows any breaks or cracks after removal from the bending machine, it is unacceptable.

(2) The ends of the second sample are flattened and the entire joint subjected to a tensile strength test. If failure occurs adjacent to or in the weld metal, the weld is unacceptable. If a tensile strength testing machine is not available, this sample must also pass the bending test prescribed in subparagraph (1) of this paragraph

Table of Contents

1. Purpose

To comply with PHMSA regulations, the Duke Energy Natural Gas Business Unit (NGBU) has established this Standard to facilitate regulatory compliance and support safe, reliable operations.

The Construction Field Welding & Fabrication standard exists to provide the best practices, guidance, and responsibilities for the field welding of steel pipelines, both new construction and in-service applications, steel pipe repair, weld repair, and fabrication (based on industry standards, manufacturers' specifications, company experience, and other relevant factors). This standard was created so that pipelines are welded on and constructed for safe operation, and the risk of future pipeline failure is minimized.

2. Governing Code and References

Welding shall conform to the provisions of this section, the applicable Subparts specified in the U.S. Department of Transportation's Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standard (49 CFR Parts 192 and 195), WEL-ST-1000 Duke Energy Natural Gas Business Unit (NGBU) Welding Standard, and the following construction welding codes as applicable.

- The latest edition of API Standard 1104 "*Welding of Pipelines and Related Facilities*," as listed in 49 CFR Parts 192/195 or
- The latest edition of ASME Section IX B&PVC "*Welding and Brazing*" as listed in 49 CFR Parts 192/195.

3. State Specific Requirements

N/A

4. Environmental Information

Refer to the Environmental Health and Safety Handbook or contact Duke Environmental Support at 1-800-527-3853.

5. Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

6. Standard Summary

The Construction Field Welding & Fabrication standard provides guidance and responsibilities for the field welding of steel pipelines, both new construction and in-service applications, steel pipe repair, weld repair, and fabrication practice (based on industry standards, manufacturers' specifications, company experience, and other relevant factors).

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7. Safety Requirements

At Duke Energy, Health and Safety is a Core Company Value. Employees and contingent workers are responsible for maintaining the highest regard for safety while planning and conducting work. Employees and contingent workers are also responsible for ensuring a safe work environment exists for themselves, their coworkers and their surrounding community.

7.1. Combustible Gas Mixtures

Prior to welding a thorough check of the surrounding area shall be made to determine the possible presence of a combustible gas mixture. Welding shall begin only when safe conditions are indicated.

7.2. Personal Protection Equipment (PPE)

All personnel shall wear all required personal protection equipment (PPE). Note that there may be regional, state-level specific PPE regulatory requirements that must be adhered to, as well as differences in PPE requirements due to union contracts. The area where welding is to occur shall have adequate ventilation.

7.3. Fire Prevention

Precaution shall be taken at all times to prevent fires. When conditions exist that are conducive to fires, and if required by governmental agencies, installer shall provide fire-fighting materials and equipment at the job site which are acceptable to the NGBU Representative.

7.4. Ground Wires

Clamps shall be used to attach ground wire. Clamps shall be attached in a manner to prohibit any arcing at the attachment location. Ground wires shall not be tacked to the pipe.

Icon Key:

NOTE: *This icon raises awareness to important non-safety related information.*

Keys to Life: *This icon references Duke Energy's "Keys to Life" safety information to note significant or life threatening hazards and related precautions to be taken. A link to the Keys to Life Gas Operations document is* provided here. Additional links may exist in the document.

CAUTION: This icon identifies possible safety hazards and/or serves as a reminder to take necessary precautions.

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8. Skidding/Cribbing

Pipe skidding shall be in the form of cribs spaced to adequately support the pipe. Skids shall be made of hardwoods with dimensions (h x w x l) four (4") inches by six (6") inches by four (4') feet or equivalent. Softwoods such as landscape timbers or pine 4x4's are not allowed. Crotched cribs shall be installed at the start of each section and thereafter at a minimum of one every tenth joint on single random lengths (single joints) and every fifth joint on double random lengths (double joints). Crotched cribs shall also be installed at all overbends and side bends. For pipe smaller than twenty (20") inch OD, semi-cribs may be used except that a full crotched crib shall be installed at the start of each section (every 400 feet minimum and at all overbends and side bends). Installer shall provide tie off equipment or device deadman as deemed necessary by terrain or the NGBU Representative.

Skidding of the line after completion of the root bead (and hot pass when applicable) shall be performed in a manner that will minimize stress on the weld and render the line safe for workers.

When, in the opinion of the NGBU Representative, the skidding has become unsafe due to movement caused by temperature changes or for any reason, the installer shall re-skid such sections to render them safe.

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9. Qualification of Welding Procedure Specifications and Welders

9.1. Welding Procedure Specification Qualifications

9.1.1. All welding shall conform to NGBU's welding procedures found in WEL-PR-1010. Specific welding procedures will be furnished to installer prior to the start of construction. In lieu of or in the absence of these procedures, installer may propose welding procedures developed or used by installer; however, all procedures proposed by installer shall be submitted for approval. NGBU will recommend welding procedures for peculiar or uncommon materials when requested by installer. A written record of the welding procedure, approved by NGBU, shall be retained by NGBU. Installer shall assume liability and be responsible for the adaptation of his welding techniques to the welding procedures furnished and/or approved by NGBU.

9.1.2. Automatic welding process shall be permitted with the express permission of Gas Engineering and with prior procedure qualification. NGBU reserves the right to withdraw such permission if the weld quality does not meet NGBU standards.

9.1.3. With prior procedure approval, the installer may use semi-automatic CO, gas metal arc, gas tungsten arc, shielded metal arc or a combination of CO, gas metal arc or gas tungsten arc for the root pass and shielded metal arc for the remaining passes.

9.1.4. Any changes in non-essential variables as defined in the applicable welding code shall only be made upon agreement between the Welding Procedure Qualifier and installer. Changes in essential variables shall require a new procedure to be qualified.

9.2. Welder Qualifications

Welders shall be qualified in accordance with WEL-ST-1000.

9.3. Qualification Materials and Equipment

NGBU shall furnish the pipe used for testing Duke Gas Welders. The contractor shall furnish and be responsible for all labor, materials, and equipment, as applicable, associated with their welder testing. Testing equipment shall be approved by the NGBU Representative.

10. Construction Field Welding Practice

10.1. Welding Equipment

CAUTION: *All welding equipment shall be of a size and type suitable for the work and shall be maintained in a condition that ensures acceptable welds, continuity of operation, and safety of personnel. Equipment that does not meet these requirements shall be repaired or replaced.*

10.1.1. Arc welding equipment shall be operated in accordance with the amperage and voltages ranges specified in the welding procedure. Gas welding equipment shall be operated in accordance with the flame characteristics and tip sizes specified in the welding procedure.

10.2. Storage and Handling of Welding Electrodes

10.2.1. Filler metals and fluxes shall conform to the appropriate American Welding Society (AWS) specification.

10.2.2. Filler metals and fluxes shall be stored and handled to avoid damage to them and to the containers in which they are shipped. Filler metals and fluxes that show signs of damage or deterioration shall discarded.

10.2.3. Pieces of welding rod are to be placed in a container immediately after use by installer at the time the pipe is welded. They shall be removed from the pipeline right-of-way and disposed at an appropriate location. Under no condition shall the welding rod be placed into an open ditch or left to lay along the right-of-way.

10.2.4. Cellulosic SMAW Electrodes (EXX10 type)

Prior to use cellulosic electrodes shall be stored in unopened containers and shall be handled in a manner to avoid damage to the coating. During use, the opened container shall be protected to ensure the coating is not damaged and there is not an excessive loss or absorption of moisture to the coating.

10.2.5. Low-hydrogen SMAW Electrodes (EXX18 type)

Prior to use low-hydrogen electrodes shall be stored in unopened containers and shall be handled in a manner to avoid damage to the coating. During use, the opened container shall be protected to ensure the coating is not damaged and there is no excessive absorption of moisture to the coating. Low-hydrogen electrodes have a manufacturer recommended exposure limit, which must be strictly followed. The low-hydrogen electrodes that have exceeded the manufacturer recommended exposure limit must be stored in a rod oven between 250 - 300□F. Upon removal from the rod oven, they must be used within 4 hours or discarded. It is recommended that welders purchase rods in 1, 5 or 10-pound packs to minimize the risk of exceeding the manufacturer recommended exposure limit.

10.3. Storage and Handling of Welding Gases

CAUTION: *Shielding gases shall be kept in the containers in which they are supplied, and the containers shall be stored away from extremes of temperature. Gases shall not be field intermixed in their containers. Gases of questionable purity and those in containers that show signs of damage shall not be used.*

10.4. Protection from Weather

CAUTION: *Welding shall not be done when the weather conditions could adversely affect the weld quality.*

10.4.1. Such weather conditions include but are not limited to rain, snow or high winds, unless such welding operations can be properly protected by the use of windshields or other shelter. Shelters could be used to permit welding in adverse weather conditions as long as the weld region is adequately protected. The Welding Inspector shall be the sole authority as to the conditions under which welding may be performed.

10.4.2. Additional precautions shall be taken to prevent excess heat loss when welding in cold weather conditions, strong winds or a combination of these two factors. Such precautions include the use of windscreens or increasing the minimum preheat temperature specified in the welding procedure with approval by a Welding Inspector.

10.5. Joint Preparation

10.5.1. Acceptable Welding Joint Types

Butt weld joint types for equal wall thickness joints are shown in **Figure 1**. Butt weld joint types for unequal wall thickness joints are shown in **Figure**

2. For unequal wall thickness, joints Figure 2b or Figure 2f are preferred. Branch groove weld joint types and minimum dimensions for fillet welds used in branch connections are shown in **Figure 3**. The minimum dimensions for fillet welds used for welding socket-welded joints are shown in **Figure 4**. The pipe ends shall be beveled by machine tool or oxygen cut with grinding.

10.5.2. Pipe Bevels

Pipe ends shall be beveled in accordance with the specific WPS being used. Field bevels of pipe ends shall be made by means of machine tools, a beveling machine using an oxy-acetylene cutting torch or other approved method in a manner to the satisfaction of the Welding Inspector. Bevels shall be thoroughly cleaned of any rust and foreign materials and free of deformities that may be injurious to the weld. Foreign materials and deformities shall be removed by hand filing or power tools. The Welding Inspector shall approve prior to its use, any solvents used for the removal of foreign materials.

10.5.3. Joint Cleaning

Prior to being aligned and welded into the line, each pipe joint, fitting or valve shall be thoroughly inspected and, if required, the welding surface swabbed from both internal and external surfaces of the pipe to a distance of six (6) inches from each side of the proposed weld to remove any conditions that may be detrimental to the weld. These conditions include, but are not limited to laminations, tears, scale, slag, grease, paint, moisture, dirt, snow, or ice. The bevel faces shall be relatively smooth and uniform. If, in the opinion of the Welding Inspector, conditions warrant internal swabbing to accomplish the removal of such debris and undesirable materials, installer shall provide the equipment and labor required.

No two-weld beads shall be started at the same location on the weld. All scale or slag shall be removed from each pass before the next pass is made. Cleaning shall be done with hand or power tools as directed by the Welding Inspector. Surface porosity and weld starts shall be ground prior to depositing subsequent passes.

Power wire brushing shall be used to clean the hot pass immediately after completion. All filler passes and the cover pass shall be cleaned by power wire brushing or as specified by the Welding Inspector. As a clarification, welding helpers may assist the welder by brushing and/or grinding the weld, but only the qualified welder is allowed to perform the actual welding of the joint.

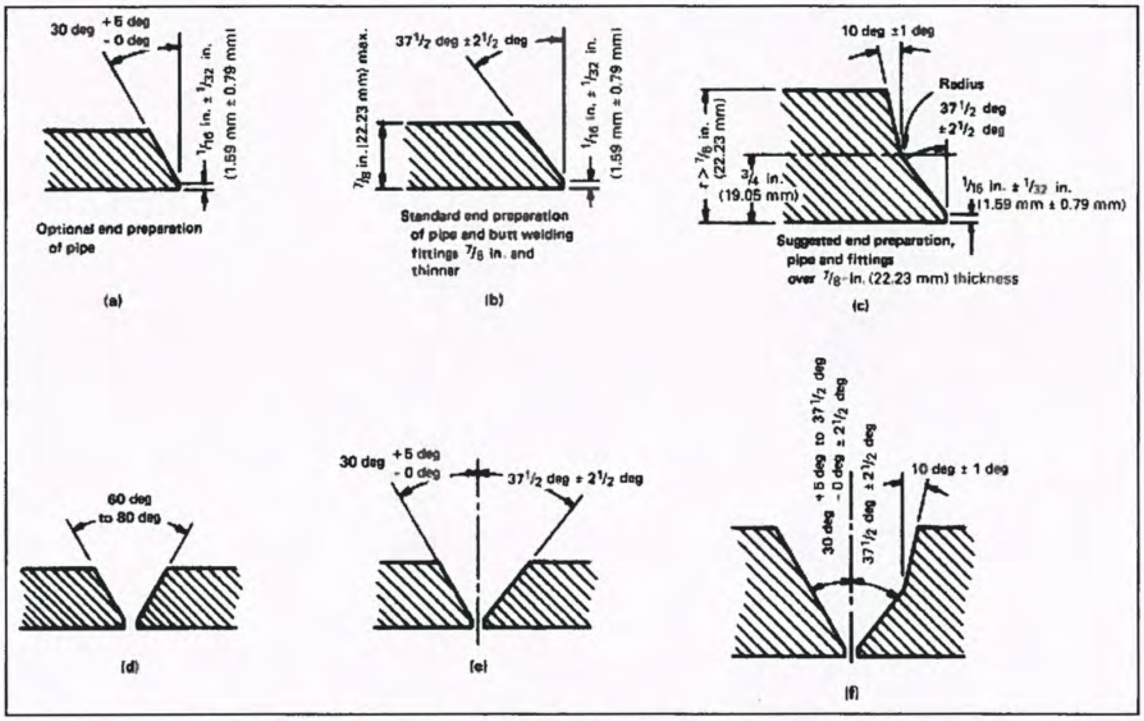
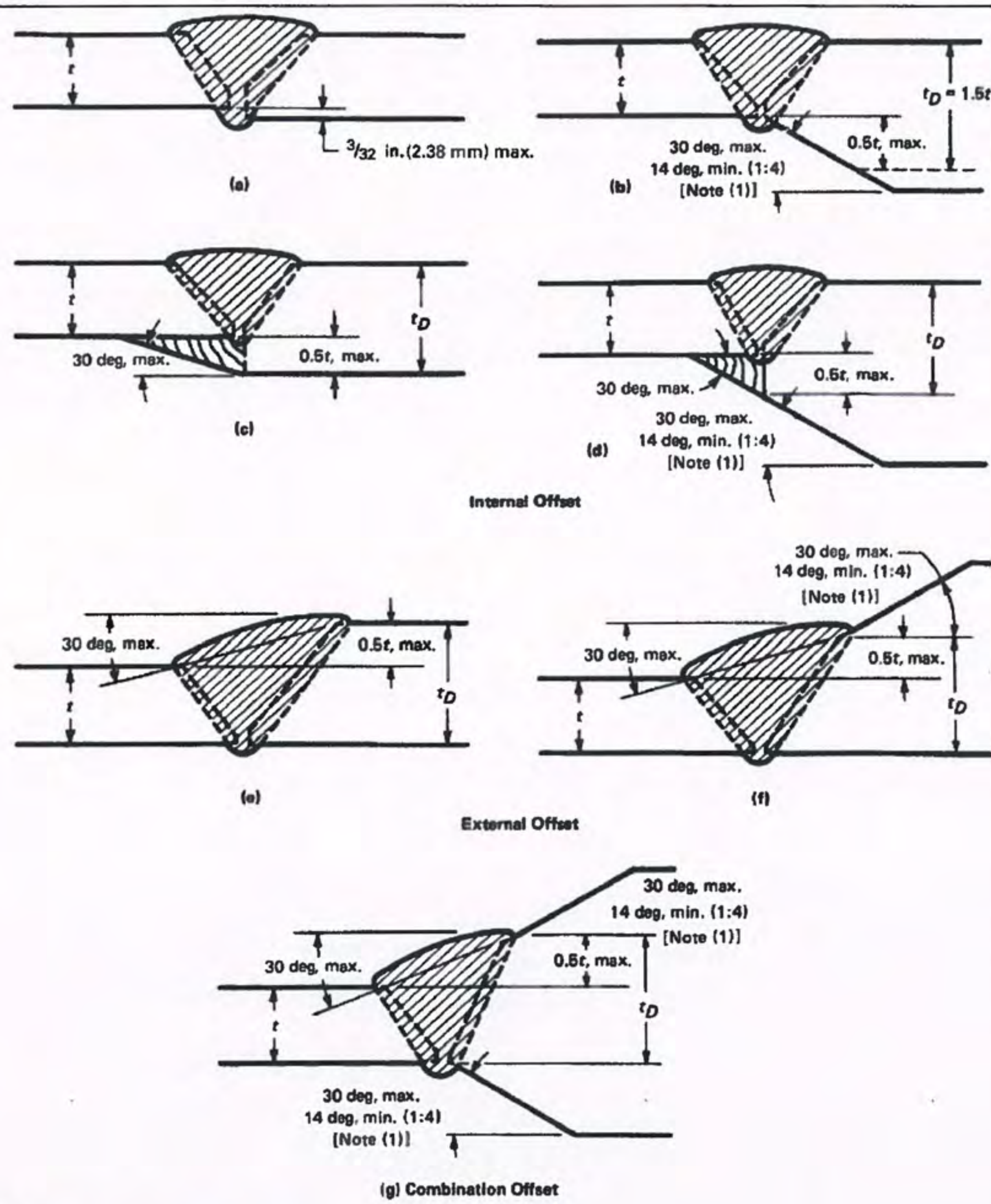
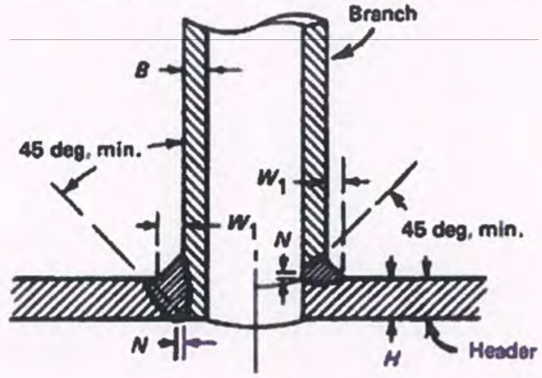


Figure 1. Butt Weld Joint Types for Equal Wall Thickness Components

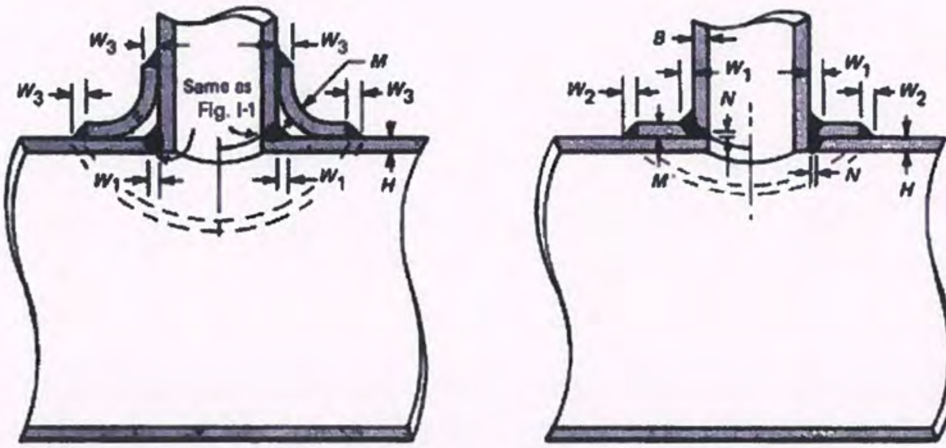


NOTE:
(1) No minimum when materials joined have equal specified minimum yield strengths.

Figure 2. Butt Weld Joint Types for Unequal Wall Thickness Components



GENERAL NOTES:
(a) When a welding saddle is used, it shall be inserted over this type of connection.
(b) $W_1 = 3B/8$, but not less than $1/4$ in. (6.35 mm).
(c) $N = 1/16$ in. (1.59 mm) min., $1/8$ in. (3.18 mm) max., unless back welded or backing strip is used.



Saddle   Pad

W_1 min. = $3B/8$, but not less than $1/4$ in. (6.35 mm)
W_2 min. = $M/2$, but not less than $1/4$ in. (6.35 mm)
W_3 min. = M, but not greater than H
N = $1/16$ in. (1.59 mm) min., unless back welded or backing strip is used

GENERAL NOTES:
(a) All welds to have equal leg dimensions, and a minimum throat = 0.707 × leg dimension.
(b) If M is thicker than H, the reinforcing member shall be tapered down to the header wall thickness.
(c) Provide hole in reinforcement to reveal leakage in buried welds and to provide venting during welding and heat treatment [see para. 831.4.1(h)].

Figure 3. Branch Groove Weld Joint Types with or without Reinforcement

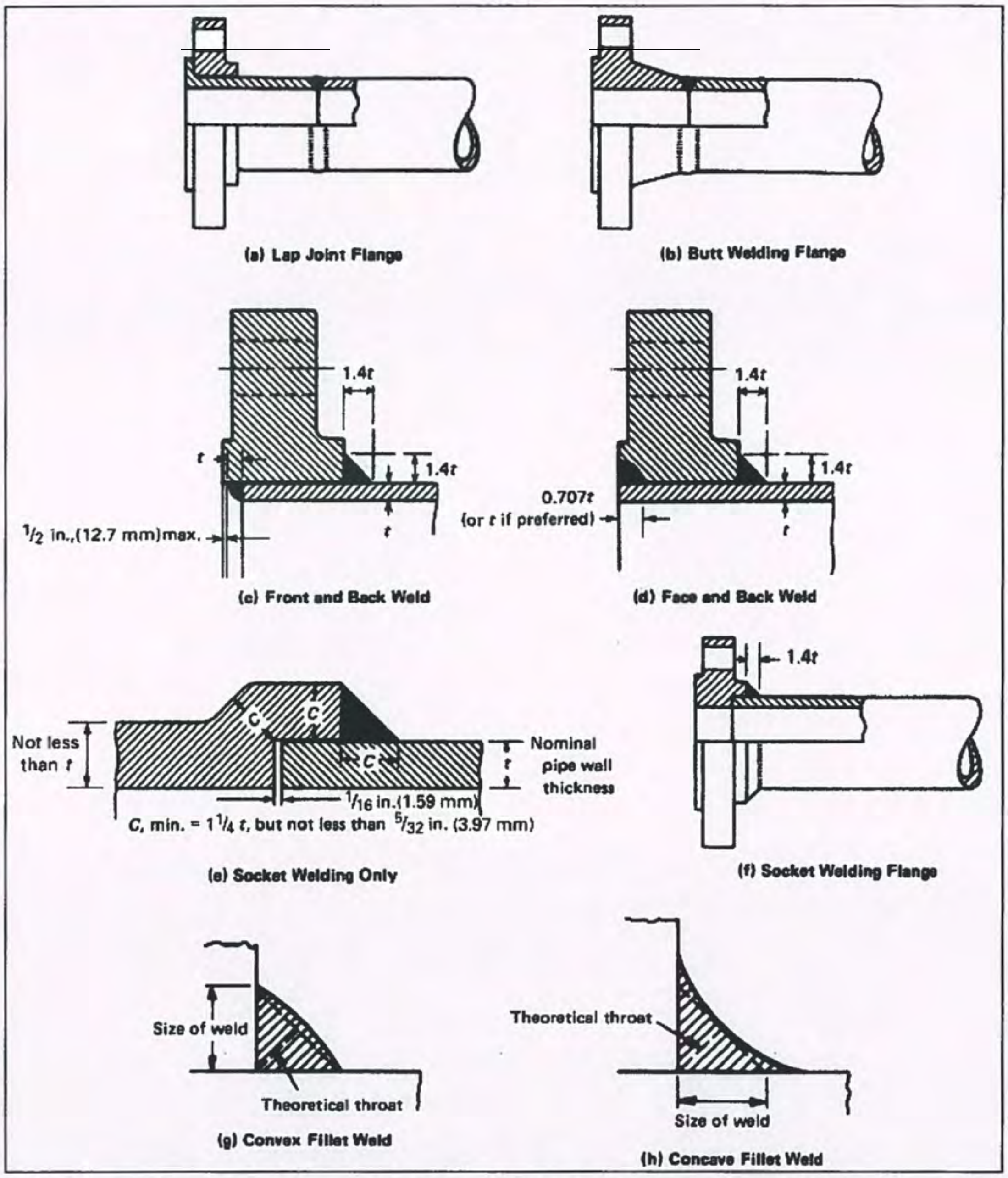


Figure 4. Recommended Attachment Details for Flanges and Socket Welds

10.6. Joint Fit-Up

10.6.1. Joint Alignment and Fit-Up

The pipe or fitting shall be aligned to provide the most favorable condition for depositing the root bead. The space between abutting pipe ends shall be such as to ensure complete penetration of the weld without burn-through. The alignment of abutting pipe ends shall be such as to minimize the offset between joining surfaces. For pipe of the same nominal wall thickness, the offset, or misalignment, shall not exceed 1/16 inch. Any greater offset or misalignment caused by dimensional variations shall be equally distributed around the circumference of the pipe. The alignment must be preserved until as much of the root bead as practical has been deposited; minimum is 50% of the root bead. A spacing tool can be used to maintain the proper root gap during welding.

Longitudinal welded pipe seams shall be located in the top quarter of the pipeline. Seams in adjacent sections of pipe shall be on opposite sides of the top center, when practical, and shall be separated by at least six (6) inches. Welding Inspector may approve exceptions for bends and short fabricated assemblies.

Hammering of pipe to obtain proper lineup prior to welding shall be held to a minimum. When used, the faces of metal hammers used to strike the pipe shall be nickel overlaid (AWS A5.15, Class Eni-Cl, such as Ni-Rod by Huntington Alloys or Softwell 99Ni by Lincoln Electric). Copper or brass hammers shall not be used to strike the pipe.

10.6.2. Alignment Clamps

Line clamps should be used to improve the pipe alignment. When using internal line up clamps the root pass shall be completely deposited prior to clamp removal. An internal line-up clamp shall be considered for pipe 20 inch O.D. and larger except for fabrication and tie-in welds or where the Welding Inspector specially authorizes use of an external line-up clamp. The internal lineup clamps shall be pneumatic and shall be equipped with fiber or rubber rollers so that the internal coating on pipe, if so furnished, will not be scratched or marred in any way.

When using external line up clamps where it is not possible to completely deposit the root pass, then the root pass shall encompass equally spaced segments around the circumference of the pipe and be an aggregate length of at least 50% of the pipe circumference prior to removal of the external line up clamp.

Movement or hammering of pipe during stringer bead welding shall be prohibited, except as approved by the Welding Inspector. When required by the Welding Inspector, internal or external line up clamps shall be held in place until the root pass has been completed. Otherwise, after the alignment clamps are removed the weld joint shall remain in the fixed position until the root and hot pass are complete. Any deflections shall be kept at a minimum when placing the weld joint on skids.

Firing line welders will be no more than 5,000 feet from the pipe gang unless otherwise approved by the Welding Inspector.

10.6.3. Tack Welds

Tack welds shall be used to ensure a proper joint configuration. Tack welds shall be limited to only the root region and shall be equally spaced into four separate quadrants. Prior to depositing the root bead, tack welds shall be ground at the start and stop locations to ensure a smooth transition and proper tie-in. Tacks welds shall be deposited following the welding procedure used to deposit the construction weld.

10.6.4. Tie-In Welds

Tie-in welds tend to experience higher levels of restraint and misalignment. Care shall be taken to ensure proper fit up including an acceptable amount of high low in accordance with Section 10.6.1. During welding, the pipe shall be properly supported from the start of making the root pass until the weld is completed. In addition to ensuring proper alignment and support the weld shall be deposited with a minimum preheat temperature of 200°F in accordance with Section 10.15.

10.7. Pipeline Clearance

A clearance of at least sixteen (16") inches should be provided in all directions from the weld joint when pipe is welded above the ground or in the trench. Any deviation from this rule shall be at the discretion of the welder. When welding in a trench, bell holes shall be of sufficient size to prevent undue restraint on the welder and provide access around the entire circumference of the pipe.

10.8. Welder Information

10.8.1. Procedure Access for Welders

Each welder qualified to work on the project shall have access to a copy of each welding procedure to be used in the performance of the work.

10.8.2. Number of Welders

For pipe sizes with an outside diameter less than or equal to 12.75 inch one or two welders may be used to complete the weld. For pipe sizes with an outside diameter greater than 12.75 inch a minimum of two welders shall be used to complete the weld.

10.9. Oxy-acetylene Welding Process Limitations

Oxy-acetylene welding (OAW) shall be limited to pipe with a maximum outside diameter of 2.375 inches.

10.10. Welding onto Threads

NGBU does not permit seal welding onto any pipe threads unless any of the following exceptions apply:

- The threads are below grade
- The joint is not to be unscrewed/unthreaded for safety reasons.

When seal welds are made, the welds shall not be considered as contributing to the strength of joints. Additionally, seal welds shall be made with low hydrogen electrodes under 125 psig.

10.11. Welding onto Different Strength Materials

When welding materials with different strength levels the welding procedure qualified to the highest strength material shall be used.

10.12. Time Between Passes

NOTE: *After the root pass has been completed, a second bead or "hot pass" shall be welded so that the elapsed time between passes shall not exceed the specified length of time in the Welding Procedure being used.*

10.13. Chill (Backing) Rings

The use of chill rings (backing rings) for welding is prohibited without the consent of the Welding Inspector.

10.14. Specific Pass Requirements

10.14.1. Root Pass (Stringer Bead)

Installer shall clean and contour grind the root pass to remove undercutting, rough surface and other defects, as follows:

10.14.1.1. A 1/8" thick grinding wheel shall be used to prepare the surface for welding the root pass when stick electrode size is 1/8" diameter or less

10.14.1.2. A 5/32" or 3/16" thick grinding wheel shall be used when the root pass is welded with CO_2 gas metal arc process or when using stick electrodes with a diameter greater than 1/8".

Skating technique shall not be used in root pass welding and the welding speed shall be as specified in the qualified procedure.

Grinding shall be required for all starts, stops and convex surfaces when the root bead is made using CO_2 gas metal arc process.

Burn through areas shall be feathered before welding (filling).

10.14.2. Filler and Finish Beads

The number of filler passes shall be such that the groove formed by the pipe bevel is completely filled and flush with the outside surface of the materials being joined.

NOTE: *At no point shall the crowned surface be below the outside surface of the pipe, nor should it be raised above the parent metal by more than 1/8 inch ± 1/16 inch. The width of the cover pass should be approximately 1/8 inch greater than the width of the original groove.*

Weld metal of all passes shall be thoroughly fused to previously deposited metal and to the parent metal of the pipe. The completed weld shall be thoroughly brushed and cleaned.

10.15. Preheat and Interpass Temperature Requirements

Preheating may be accomplished by any suitable methods provided the temperature is uniform and does not fall below the minimum temperature specified in the welding procedure. The preheat temperature shall be checked by any suitable means to ensure the temperature is maintained during the welding operation. The temperature shall be checked at a minimum distance of 2 inches from the center of the weld groove on both sides of the groove and equally spaced around the circumference.

When dissimilar materials are welded that require different preheat temperatures the highest preheat temperature shall be used

10.16. Stress Relieving Requirements

Stress relieving shall be applied in accordance with code requirements and as specified in the welding procedure. When stress relieving is required, stress relieving may be accomplished by any suitable means provided the required temperature is uniform and remains within the range specified in the welding procedure. The stress relieving temperature and time shall be checked by any suitable means to ensure the proper stress relieving cycle has been accomplished.

10.17. Pup Joints

The Installer shall promptly collect, clean, rebevel, haul ahead and weld into the pipeline all useable "pup" joints. Acceptable pup joint lengths are as follows:

10.17.1. For above ground piping, a minimum of 1.5 times the outside diameter (1.5*OD) is acceptable.

10.17.2. For below ground piping, a minimum of either 1.5 times the outside diameter (1.5*OD) or 3 feet, whichever is longer, is acceptable.

10.17.3. Pups shorter than described above in 10.17.1 and 10.17.2 shall not be used for line welding without prior approval of the Gas Engineering.

Where joints of pipe are cut, the installer shall ensure that the pipe stencil information from the parent joint are transferred to the cut end or ends of the parent joint, as well as to both ends of all pups resulting from the cutting. Pipe information from the stencil shall be transferred to both ends of each pup joint immediately after it has been cut from any joint of pipe. The parent joint shall also be left with the pipe-stencil identification numbers on both ends.

10.18. Welding on Magnetized Pipelines

Welding onto magnetized pipe can result in arc blow. Arc blow can affect the welder's ability to deposit a satisfactory weld leading to increased repairs. Magnetic field tends to be higher in the weld joint root opening therefore the greatest risk of arc blow will be when depositing the root pass. Magnetism is measured in Gauss and shall be measured with a Gauss meter probe (Hall-effect Gauss meter). The Gauss level produced when joining two pipe sections together is generally 10 times higher than with the pipe sections separated. For example, two pipe sections averaging 8 Gauss will result in a magnetism of 80 Gauss when butted together. The effect of the magnetism has on the welding arc is dependent on the strength of the field. The relative field strength and associated welding problems are:

- 20 Gauss and below – Welding can take place without concern
- 21 – 30 Gauss – The welding arc may be affected by magnetism
- 31 – 100 Gauss – The welding arc will likely be affected by magnetism, but may be manageable by the welder depending on their level of skill, amperage, arc length, diameter, and joint design
- 100 Gauss and above – The welding arc will be affected by magnetism and demagnetization efforts need to be taken to reduce the magnetic field.
- 150 – 300 Gauss – Serious weld defects are likely, including weld induced cracked welds.
- 300 Gauss and above – Welding will seem almost impossible at times combined with severe weld defects

NOTE: *When an excessive magnetic field is present, the magnetized pipe shall be demagnetized according to the procedure WEL-PR-1030 Demagnetization of Pipe.*

10.19. Arc Burns

All arc burns shall be cut out and replaced by a new pipe section, except when allowed below. When removal of an arc burn is not practical on in-service piping, then the arc burn shall be repaired in accordance with OM-PL-8020. The area shall be inspected by using a suitable etchant (dilute nitric acid, ammonium persulfate solution, etc.) to ensure complete removal of the heat-affected zone of the arc strike. The ground area shall be inspected by MT to ensure there are no weld-induced cracks in the arc strike area. The remaining pipe wall thickness shall be measured to ensure the remaining wall is adequate for the pipeline design.

10.20. Numbering and Identification of Welds

10.20.1. Installer shall consecutively number welds completed during each day with a grease free crayon to ensure an accurate count. Each welder shall mark his welds or portions of welds using chalk or grease free crayon. The use of a keel will not be permitted.

10.20.2. Each welder shall identify the welder's work. The welder's identification shall be recorded on the inspection report.

10.20.3. The Welder ID will consist of the welder's Employee ID.

10.21. Completing Welds

For production welding of mainline pipelines up to and including 0.500" wall thickness, the preference is for a weld to be completed by the end of the production day in which the weld was started. If circumstances such as weather prevent this from being done, the contractor may request an extension to complete the weld by the end of the following, successive production day provided the root bead and hot pass have been completed. In extenuating circumstances, such as not being able to access the R.O.W., the contractor may request additional hold time not to exceed 48 hours, unless approved by Gas Engineering, from when the root bead and hot pass were deposited. All extensions must be approved by the chief welding inspector.

In cases where hold times are extended, the contractor shall wrap each weld in ceramic blankets to slow cooling. In addition, when welding resumes each unfinished weld shall be preheated to at least 200 °F. Tie-in welds are an exception in that once the weld is started, successive weld layers shall be deposited without delay, and each weld finished the same day it was started.

11. In-Service Field Welding Practice

11.1. General

11.1.1. *In-service welding shall be performed in accordance with the prior section, "Construction Field Welding Practice", as applicable, in addition to the requirements listed in this section.*

CAUTION: *All welders performing in-service welding shall be familiar with the safety precautions associated with cutting and welding on piping that contains or has contained natural gas or liquids.*

11.1.2. Tap connections shall be located so that they do not intersect a longitudinal or girth weld.

11.1.3. All in service welds shall be made using a low hydrogen electrode with the following exceptions:

11.1.3.1. If the pipe is less than or equal to 2.375" O.D. and has a wall thickness less than or equal to 0.188", then a qualified cellulosic procedure may be used.

11.1.3.2. If the pipe has a wall thickness of less than or equal to 0.188" and the pressure is less than 25 psig, then a qualified cellulosic procedure may be used.

11.2. Operating Conditions

The pipeline operating conditions shall be confirmed prior to in-service welding to ensure that there is a minimal risk of burning through the pipeline and the minimal occurrence of hydrogen cracking. Both risks shall be evaluated in selecting the appropriate In-Service Welding Procedure

11.2.1. Hydrogen Cracking Risk

The risk of hydrogen cracking can be controlled by determining the cooling conditions of the operating pipeline. The cooling conditions of the pipeline can be determined by measuring the heat sink capacity. The heat sink capacity measurement consist of heating a small circle of the pipe wall to a temperature between and measuring the time it takes for the pipe line to cool between 250°C to 100°C. The time it takes to cool from 250°C to

100°C is the heat sink capacity time and shall be compared to the heat sink capacity time reported on the in-service welding procedure. The specific procedure that shall be used for measuring the heat sink capacity is provided in the procedure WEL-PR-1040 *Heat Sink Capacity Measurement*.

11.2.2. Burn-Through Risk

Burn-through risk is not a significant risk when welding attachments onto a pipeline with a minimum wall thickness of 0.25 inch. If the wall thickness reading is less than the API 5L tolerances for wall thickness for the pipeline (**Table 1**), then a burn through risk shall be evaluated by Gas Engineering.

Table 1. API 5L Wall Tolerances, 45th edition.

Wall thickness t mm (in)	Tolerances [a] mm (in)
SMLS pipe [b]	
≤ 4,0 (0.157)	+ 0,6 (0.024) − 0,5 (0.020)
> 4,0 (0.157) to < 25,0 (0.984)	+ 0,150 t − 0,125 t
≥ 25,0 (0.984)	+ 3,7 (0.146) or + 0,1 t, whichever is the greater − 3,0 (0.120) or − 0,1 t, whichever is the greater
Welded pipe [c,d]	
≤ 5,0 (0.197)	± 0,5 (0.020)
> 5,0 (0.197) to < 15,0 (0.591)	± 0,1 t
≥ 15,0 (0.591)	± 1,5 (0.060)

a If the purchase order specifies a minus tolerance for wall thickness smaller than the applicable value given in this table, the plus tolerance for wall thickness shall be increased by an amount sufficient to maintain the applicable tolerance range.

b For pipe with $D \geq 355{,}6$ mm (14.000 in) and $t \geq 25{,}0$ mm (0.984 in), the wall-thickness tolerance locally may exceed the plus tolerance for wall thickness by an additional 0,05 t, provided that the plus tolerance for mass (see 9.14) is not exceeded.

c The plus tolerance for wall thickness does not apply to the weld area.

d See 9.13.2 for additional restrictions.

Monitoring welding heat input is essential to the success of in-service welding applications. The welding heat input can be monitored by one of two methods. The first method requires the use of hand held meters, which monitor the amperage and voltage during welding and a stopwatch and tape measure to measure the welding speed in inches per minute. Once the amperage, voltage, and welding speed are known the heat input can be calculated by the following equation. The calculated heat input shall be compared to the required minimum heat input recorded on the in-service welding procedure to ensure compliance.

Heat Input = Amps * Volts * 60/Travel Speed (i.p.m.)/1000

The second method uses a run-out ratio which is based on the relationship of the between the total energy produced during welding and the amount of energy required to melt a specific volume of welding electrode. The run-out ratio is the length of weld divided by the length of electrode consumed and the relationship between the run-out ratio and the corresponding welding heat input is illustrated in **Figure 5**. The calculated run-out ratio shall be compared to the maximum run-out ratio recorded on the in-service welding procedure to ensure compliance.

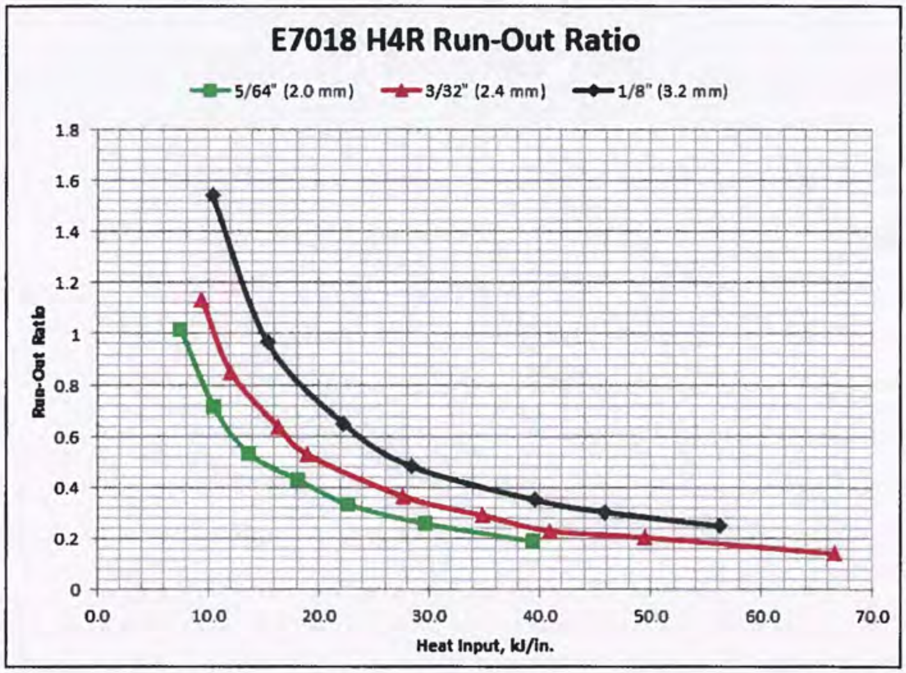


Figure 5. Run-out Ratio for Controlling Welding Heat Input for In-service Welding Applications

11.3. Chemical Composition Determination

11.3.1. The chemical composition of the operating pipeline and the fittings to be welded should be determined prior to in-service welding. If it is impractical to determine the chemical composition of the material prior to welding, then the welding procedure shall be based on the assumed highest chemical composition.

11.3.2. The chemical composition could be determined from mill test reports, portable chemical analysis equipment, by removing a sample of the material to be welded and sending the sample to a laboratory or other means approved by Gas Engineering. When removing a sample material for a laboratory analysis the total volume of material should be between 10 and 20 grams. If the hot-tap reinforcement or repair sleeve straddles a pipeline butt weld, then a material sample shall be removed from both pipe joints. The area where the material is to be removed shall be inspected to ensure there is sufficient wall thickness and located on a portion of the pipeline that will be removed by the hot-tap coupon or covered by the hot-tap reinforcement or repair sleeve. The remaining wall thickness of the pipeline, after material removal, shall not be less than nominal wall thickness minus the mill tolerance. Prior to sending the material to the lab the material shall be evaluated to ensure no foreign material is present that could affect the chemical composition analysis.

11.4. Pipe Seam Inspection

11.4.1. When an in-service welding application requires welding over the pipeline seam the seam shall be inspected to ensure there are no defects present. If defects are present, the design or location of the component to be welded onto the operating pipeline shall be re-evaluated.

11.5. Ultrasonic Wall Thickness Measurement

11.5.1. The pipeline wall thickness shall be confirmed by ultrasonic inspection prior to in-service welding. Wall thickness measurements shall be made every 20 degrees around the weld area circumference to ensure adequate wall thickness and no pipe body defects are present (e.g., laminations). If the wall thickness is less than expected the probability of burning through the pipeline shall be re-evaluated in accordance with Section 11.2.2. If laminations are detected, then the location of the in-service weld shall be moved to a defect free area.

11.6. Joint Cleaning

11.6.1. Pipeline coatings shall be removed a distance at least equal to the cutback on new pipe of the same diameter. Power or hand tools may be used for coating removal with power tools being preferred. Chisels shall not be used for coating removal.

11.7. Sleeve or Branch Reinforcement Fit-Up

11.7.1. The gap between the hot-tap reinforcement or repair sleeve shall not be so excessive to require the welder to alter the welding technique to deposit the weld.

11.8. Welding Sequence

11.8.1. The hot-tap reinforcement or repair sleeve long seams shall be welded first. Once the long seams are completed and allowed to cool, then one circumferential fillet weld shall be completed prior to welding the second circumferential fillet weld.

11.9. Long Seam Welding

11.9.1. All hot-tap reinforcements or repair sleeve long seams that are in contact with the pipeline shall be welded with a backing bar. The only exceptions to this requirement are Mueller split-fittings and Type A reinforcement sleeves for which all long seam welds shall be deposited following a qualified welding procedure. If the welding procedure is qualified using cellulosic (EXX10) type electrodes, etc., then a minimum preheat temperature of 200°F shall be used unless the qualified welding procedure specifies a higher minimum preheat temperature.

11.10. Circumferential Fillet Weld Sizes

11.10.1. The circumferential fillet welds of hot-tap reinforcement or Type B repair sleeves shall meet the requirements specified in **Figure 6** .

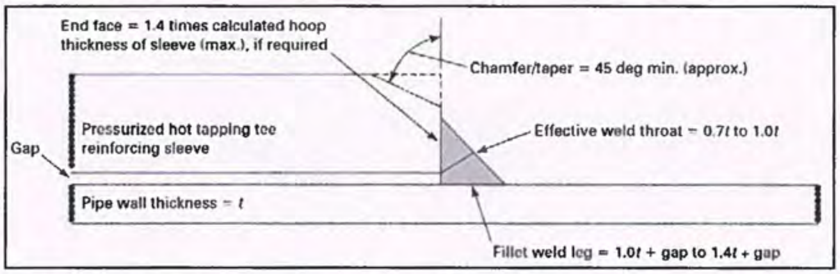


Figure 6. Fillet Weld Size Requirements for Hot-tap Reinforcement Connections and Type B Reinforcement Sleeves

11.11. Inspection Delay Time

A minimum of 24 hours shall elapse prior to inspecting all in-service welds when inspection is required by:

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding
- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines
- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation - unless waived by Gas Engineering. See CM-FM-4000A.

11.11.1. Pipeline Support Prior to Backfill

Prior to backfilling, the exposed pipeline shall be adequately supported so as not to allow additional stresses to be induced onto the in-service weld (e.g., soil induced loading or bending loads).

12. Weld Inspection and Acceptability

Welds shall be examined and found acceptable in accordance with API 1104 and:

For OH/KY:

- Gas Standard 6.2 - Inspection of Pipeline Welding

- GD55.500 - Visual and Radiographic Weld Inspection on Steel Pipelines
- GD60.738 - Welding Inspection Visual
- GD60.739 - X-Ray Report – Daily Completion

For NC/SC/TN:

- CM-ST-2180 - Non-Destructive Evaluation

13. Repair of Steel Pipe and Weld Repair Criteria

13.1. General Repair Requirements

13.1.1. Weld defects may be identified on-site by either the Welding Inspector or the NDT Inspection Personnel. Weld quality shall meet the requirements of API 1104, any weld not meeting that acceptance criteria shall be cut out or repaired.

13.1.2. In addition to requirements within this standard, additional specifications for the repair of welding defects shall be in accordance with OM-PL-8000.

13.1.3. Only single repairs are allowed. Repairs of repairs (multiple repairs) are not allowed.

13.1.4. Documentation of all weld repairs shall be on the daily weld examinations report. All repairs shall be performed in accordance with this section.

13.1.5. Pipe showing laminations beyond those accepted in the latest edition of API Line Pipe Specification 5L shall not be used in the pipeline or the compressor station. Pipe showing split ends or other defects shall be removed from the line as directed by the Welding Inspector.

13.2. Authorization for Repair

13.2.1. The Welding Inspector shall authorize and witness the repair of defects (except cracks) in the root, hot pass and filler beads.

13.2.2. Any weld having a weld-induced crack shall be cut out and replaced. Any weld that shows evidence of repair work having been done without authorization by the Welding Inspector may be rejected.

13.2.3. Repairs may be made to pin holes and undercuts in the cap pass without authorization but the repaired weld must meet with the approval of the Welding Inspector. Pin holes in the final cap must be repaired by recapping. Stripping or spot welding is not allowed.

13.3. Repair of Steel Pipe

13.3.1. Installer shall remove all defects in the unwelded pipe or welded pipeline that meet or exceed the following requirements. A defect shall include:

13.3.1.1. Any gross deformation in or near a beveled end that is to be welded which causes an unweldable joint.

13.3.1.2. Any dent occurring in 12-3/4" OD or smaller pipe that is greater than 0.250" deep, and one-half (1/2) the pipe diameter long in any direction or judged unacceptable by Welding Inspector. The depth shall be determined by the gap between the lowest point of the defect and the original contour of the pipe.

13.3.1.3. Any dent occurring in >12-3/4" OD pipe that is deeper than 2% of the nominal diameter and 1/2 of the pipe diameter in any direction or judged unacceptable by Welding Inspector.

13.3.1.4. Any dent containing a stress concentrator, such as a scratch, gouge or groove.

13.3.1.5. Any dent affecting a longitudinal or girth weld.

13.3.2. Installer shall remove the damaged portion by cutting it out as a cylinder. Any defect caused by the installer shall be removed by the installer. Repair by insert patching or pounding out is prohibited.

13.4. Repair of Construction Welds

13.4.1. Any weld defect that exceeds the acceptability requirements of API 1104 shall be ground out to sound material. When approved by the Chief Welding Inspector, carbon air arc gouging is allowed. All slag and scale shall be removed by wire brushing. If the defect is only located in the cap pass or root pass of the weld, then it may be repaired by grinding. The total number of grinding repairs and the individual length of grind repairs is not limited but shall conform to the following criteria.

- Free of undercut and other imperfections
- Provide a smooth transition between the ground area and the weld and the pipe surface
- Maintain the minimum wall and weld thickness requirements. If the minimum wall and weld thickness is not known, the grinding depth is limited to the excess root or cap pass reinforcement.

13.4.2. After the grinding is complete, the excavation shall be inspected to ensure that the entire defect has been removed. If the excavation exceeds the limits stated previously, then a repair weld shall be deposited. When repair welding is required, the excavation shall allow a smooth transition with properly sloped sides and ends to permit the repair welder to deposit a sound weld. If the repair requires more than a single pass, then the groove sides shall be ground back to pipe material to ensure that the repair weld is not deposited in previously deposited weld metal except for the root region. The appropriate repair welding procedure shall be based on the following criteria.

- All repairs shall follow the original welding procedure to deposit the repair weld with the additional requirement of a minimum preheat temperature of 200°F in accordance with Section 10.15.
- All other repair welds shall be deposited by a qualified repair welder in accordance with Section 11.4 of WEL-ST-1000 and following a qualified repair welding procedure in accordance with Section 10.6 of WEL-ST-1000.

NOTE: *The minimum weld repair length shall be 2 inches and the total weld repair length shall be specified by a Welding Inspector. Upon completion, the repair weld shall be allowed to air cool prior to inspection in accordance with Section 14.4.3.*

13.4.3. Weld repairs on the same construction weld, at different circumferential locations, are permitted as long the distance between adjacent weld repairs is not less than two (2) inches. Repair of a defect in a previously repaired area on the same weld at the same circumferential location are not allowed under any circumstances and shall be cut out. Weld induced cracks are not permitted and shall be cut out. All repaired areas shall be radiographed or inspected by the same means previously used to find the defect.

13.5. Repair of In-Service Welds

13.5.1. This section does not cover welds that need to be repaired when discovered during routine O&M inspection. Such repairs shall follow the requirements of OM-PL-8000. Prior to welding the wall thickness shall be measured in accordance with Section 11.5 to ensure there is no increased risk of burning through the pipeline.

13.5.2. A qualified in-service welder can follow the original in-service welding procedure to deposit the repair in-service weld. The minimum weld repair length shall be two (2) inches and the total weld repair length shall be specified by a Welding Inspector. Weld induced cracks are not permitted and shall be cut out. Upon completion, the repair weld shall be allowed to air cool prior to inspection (in accordance with Section 13.6).

13.6. Weld Repair Inspection Requirements

13.6.1. Repairs shall be considered acceptable when the repair area meets the acceptance criteria in accordance with API 1104.

14. Fabrication

14.1. General

14.1.1. All materials that are to be or have been fabricated into assemblies or are to be welded directly into the line shall be handled in such a manner as to prevent damage. When lifting lugs are provided on a component, only those lugs may be used for lifting of that component. All materials shall be handled or stored so that they are not sitting in mud or water and shall be adequately skidded where necessary to prevent such occurrence.

14.1.2. The installer shall ensure that all assemblies are fabricated so that they will fit correctly into the pipeline or other assemblies. The installer shall note that some adjustments to the dimensions shown on construction drawings are normally required to compensate for variations in terrain, depth of cover and alignment of existing facilities when applicable.

14.1.3. Unless constructed in place, tie-overs should normally be fabricated with each leg at least 18 inches longer than shown on the drawing to allow for fit-up. Alignment of parts and prefabricated sections shall be performed with a minimum use of mechanical force.

14.1.4. Pipe, valves, and fittings shall be fabricated within plus or minus 1/16" of deviations from the dimensions, locations, and positions shown on furnished drawings. All fabrication changes will be approved by the Gas Engineering Representative prior to the start of fabrication.

14.1.5. Drawings shall be used as a guide to prefabrication with the installer fully utilizing field measurements and random lengths to prevent over-fabrication.

14.1.6. Installer shall install high point vents and low point drains as approved by the Gas Engineering Representative to facilitate hydrostatic testing unless otherwise provided for on the drawings.

14.1.7. Prior to the attachment of pipe to the weld ends of a ball valve (12" and larger), suitable tape shall be applied in the bore of the valve, covering the whole circumference at each end of the valve bore. When preheating and welding on valve ends, installer shall protect valve seat areas from heat damage by covering seat area openings on the inside of the valve. Options for protecting the seat include, but are not limited to, one of more of the following: heat resistant tape and damp gunnysacks.

14.1.8. Reinforcing saddles shall be installed with a snug fit and in no case with a gap greater than 1/8 inch.

14.1.9. Wrought steel welding elbows and transverse segments of these elbows shall not be used for changes in direction of steel pipe that is 2 inches or more in diameter unless the arc length, as measured along the crotch is at least 1 inch. Any fittings that will be trimmed must be segmentable.

14.1.10. Prior to being welded into any assembly, all flanges shall be inspected for possible damage to the "raised face". Nicks or gouges are not acceptable and shall, when detected, be brought to the attention of the Welding Inspector so that remedial action can be taken. Flanges shall be protected at all times (except at time of two-holing) preferably with plastic covers or temporary plywood blind flanges either bolted or wired in place. Grounding of the welding work connections to flanges is not permitted.

14.1.11. All flanges shall be installed with the imaginary intersecting line between the top two bolt holes in a vertical plane ("two-holed") unless otherwise specified on the drawings. At the time of alignment, the face of flanges shall be "wire brushed" clean, free from dirt, grease or rust. A final inspection shall be made at this time to ensure that no damaged flanges are installed into the pipeline system. Flanges shall be brought into parallel and lateral alignment with bolt holes lined up. If the flanges cannot be aligned precisely, the bolts on the side having the greater opening shall be tightened first until the flanges have been perfectly mated. The bolts shall then be tightened in an accepted sequence.

14.1.12. Only new gaskets shall be used. Gaskets with protrusions, depressions or any other surface defects shall be discarded. Under no circumstances shall a gasket be lubricated.

14.1.13. Nuts and bolts shall be inspected for possible defects. Any nut or bolt having burrs, nicks, metallic slivers, severe galling or pitted threads or incomplete threads shall be discarded. At the time of installation, threads and nut faces shall be lubricated. Threads of bolts shall be evenly distributed across the width of the connection such that the same number of threads extend past the nut on each side.

14.1.14. Upon being welded into a fabricated assembly, all valves supplied without operators shall have a covering placed over the open end of the torque-tube to prevent ingress of rainwater, snow, ice, or debris. Heavy-duty garbage bags or similar NGBU approved material shall be firmly affixed and left in place until the operator is available for installation.

14.1.15. After completion of the welding process, debris and any welding spatter shall be thoroughly cleaned from the bore of the valve and attached pipe by wire brushing and vacuuming. Afterwards, the tape shall be removed.

14.1.16. Recycled and/or trimmed fittings may be used in the fabrication of piping systems if they have not been excessively trimmed causing mismatching of wall thickness, misalignment of piping, or weakening of the fitting. Any fittings that will be trimmed must be segmentable.

14.2. Backwelding

14.2.1. Installer may be required to backweld all welds on fittings and/or valves twenty (20) inches in outer diameter and larger, and on smaller sizes where practical, when it is required to meet the butt-weld joining type, as shown in Figure 2. Installer shall further be required to backweld all pipe welds where the difference in nominal wall thickness between adjacent pipes is greater than 3/32" inch unless an alternate method is approved by the Gas Engineering.

14.2.2. Backwelding of the fittings and/or valves shall be performed immediately after the completion of the stringer bead, prior to grinding, and before the pipe has an opportunity to cool. The filler pass conditions of the WPS being used for the original weld shall be used to perform the backwelding.

14.2.3. Backwelding shall not be permitted to repair a root pass defect discovered after final inspection of the completed weld.

14.2.4. Backwelding shall only be performed after adequate ventilation has been ensured.

14.3. Weld Completion

14.3.1. In order to prevent cracking, care shall be taken by the installer in welding fitting materials with a wall thickness in excess of 0.500". The entire weld area shall be preheated to a minimum of 200 °F metal temperature for a distance of three (3) inches on each side of the weld area before welding commences. This minimum temperature shall be maintained at the weld throughout the welding period.

NOTE: _In-service welding and fabrication work such fitting welds, valves and other thick wall weldments with a wall thickness greater than 0.500" shall be treated the same as tie-in welds; once a weld is started, it must be completed without delay and_ *each weld finished the same day it was started.*

14.3.2. The metal temperature shall be checked using temperature indicator crayons opposite to the side on which the preheat is being applied when practical.

15. Contact

Gas Engineering

16. Signature

Reviewed and approved by:

Randy L Bost
Randy L Bost (Apr 30, 2019)

17. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this Standard: • CM-ST-2170 *Fabrication* • CM-PL-4000 PNG Welding Manual, Sections relating to welding procedures only.	Members of Work Process Integration Team
1	05/01/2019	• Revised the "WHO" section, added Gas Engineering, Gas Field Operations, and Technical Field Operations • Added references for region specific procedures on sections: ▪ 11.11. Inspection Delay Time ▪ 12 - Weld Inspection & Acceptability • Corrected referenced document on section 10.19 Arc Burns	Work Process Integration Team