

Specification for Shielded Metal Arc Welding with low hydrogen (Class 7018) electrodes.

Procedure Qualification Record No.: MANGO#2LH-11/9-10/2015

Application: Use this procedure on hot taps, stopple fittings, welded split sleeves, patches and any other welding on lines pressurized to 100 psig or more, on lines with a high flow rate that will quench the weld and cause "sweating" or on lines that contain liquid. Low hydrogen welding methods may need to be used on lines pressurized at less than 100 psig also.

A. PROCESS: The welding shall be done with manual Shielded Metal Arc Welding (SMAW) process.

B. PARENT METALS: The metals shall conform to one of the following specifications:

ASTM: A53, A105, A106, A234 or A192

API 5L: Grade A through X65

Carbon Equivalent Levels of Vintage Pipe (Pre 1973 manufactured pipe)

C. DIAMETER AND WALL THICKNESS: This procedure shall apply to all diameters and wall thicknesses.

D. JOINT DESIGN: For branch connections, the branch shall be beveled so as to allow a full penetration fillet weld to be made. For all sleeve and stopple fitting ends, patches, wear pads, shunts or saddle pads, the bevel shall be a 90° square edge preparation. Butt weld sleeve and stopple fitting side seams shall be beveled 30°, +7.5°, -0° or, if lapped over, a 90° preparation. The leg length fillet welds onto pipe is limited to the wall thickness of the pipe to which it is applied or the thickness of the added material, whichever is smaller with a tolerance of +1/8" - 0". For longitudinal butt welds of full encirclement sleeves, when 100% penetration is required, the root opening (space between abutting edges) should be sufficient. These joints should be fitted with a mild steel back-up strip or suitable tape to prevent penetration of the weld into the carrier pipe. Root Face: 0" minimum to 3/32" maximum. See table 2.0 for each joint design.

E. FILLER METAL: The filler metal shall conform to AWS Classification E-7018.

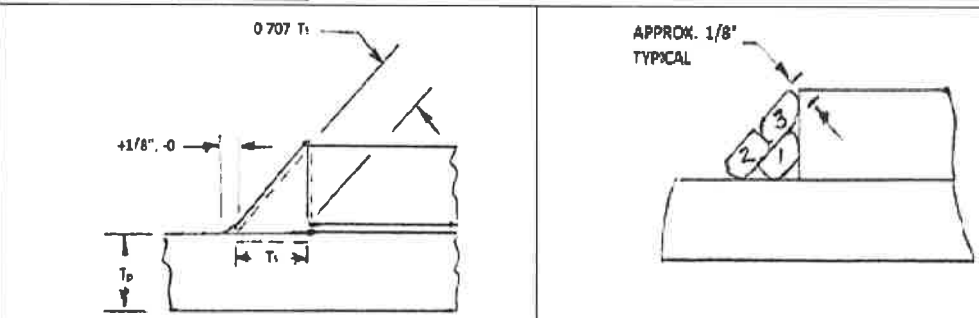
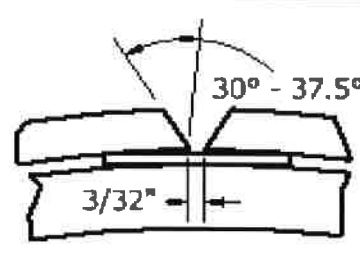
F. SIZE OF ELECTRODE AND NUMBER OF BEADS: Low Hydrogen electrodes will be 3/32" or 1/8" diameters. Only one water tight pass is required on wear pads, wear sleeves and shunts. The minimum number of beads required for all other fillet welds is as follows in Table 1.0.

Table 1.0 Number of Beads

Wall Thickness (Inches)	Minimum Number of Beads
0 - .499	3
.500 - up	4

G. ELECTRICAL CHARACTERISTICS: Use only DC reverse polarity (electrode positive) welding current. See Table 2.0 for each joint design.

Table 2.0 Joint Design, Electrode and Electrical Characteristics

Joint Design: <u>Fillet Weld</u>						
						
Electrode and Electrical Characteristics: Fillet Weld						
Bead	Electrode Size, In.	Electrode	Voltage Range	Amperage Range	Minimum Heat Input kJ/Inch	Travel Speed Range ipm
Root	3/32"	E7018	21 – 31	88 -109	14	3 – 9
Cover	3/32"	E7018	20 – 31	84 - 113	14	3 – 9
	1/8"	E7018	19 – 28	111 - 133	14	3 – 9
Joint Design: <u>Groove Weld</u>						
						
Electrode and Electrical Characteristics: Groove Weld						
Bead	Electrode Size, In.	Electrode	Voltage Range	Amperage Range	Minimum Heat Input kJ/Inch	Travel Speed Range ipm
Root	3/32"	E7018	21 - 29	78 -97	14	3 – 9
Hot Pass	3/32"	E7018	21 - 28	77 - 97	14	3 – 9
Cover	3/32"	E7018	21 - 27	77 - 105	14	3 – 9

Heat Input(kJ/in) =(Amps x Volts x 60) / [Travel Speed(in/Min) x 1000]

H. DIRECTION OF WELDING: Welding shall proceed upward from the bottom center, or any point on the side to the top center.

I. NUMBER OF WELDERS: One welder may complete the entire weld.

- J. SPEED OF TRAVEL: The speed of travel for all passes shall be within the ranges shown in Table 2.0.
- K. TIME LAPSE BETWEEN PASSES: The time lapse between the completion of the root bead or first pass and the start of the second pass shall not exceed 5 minutes. All welds started should be welded continuously without interruption until they are completed.
- L. TYPE OF LINE UP CLAMP: For branch connections, line up clamps are not normally used but the use of spacing tools will help maintain proper bevel spacing. For sleeves, stopple fittings, patches and wear pads, a method of holding them in intimate contact with the pipe is required. Various devices such as "C" clamps or hydraulic jacks and chains are suggested. Saddle pads and shunts can usually be properly tacked while held by hand.
- M. REMOVAL OF LINE UP CLAMPS: If an external clamp is used, it shall remain in place until 50% of the longitudinal root beads are complete.
- N. CLEANING: Remove all rust, dirt, and foreign matter from the bevel surface and the area on the outside of the pipe where welding will take place and that will be covered by the sleeve, patch, etc. After cleaning, check the fit before tacking in place. Grind the bead and remove the slag, especially in areas of undercut, with power tools before applying the successive beads. Clean the finished weld and adjacent areas of all slag, smoke and weld spatter.
- Note: To prevent the tendency of low hydrogen electrodes to undercut, deposition of filler metal shall be closely controlled. Ensure that undercut notches are cleaned or ground out to prevent burying slag with successive passes. If, after completion of the last bead, any such defect exists, it shall be repaired.
- O. WELDING SEQUENCE: For split sleeves and stopple fittings, weld side seams on an alternating basis, then weld one end completely and then the other end. For saddle pads, weld the pad to the run pipe first and then to the branch pipe. For split tees or full encirclement saddles, weld the longitudinal seams on an alternating basis, then the circumferential fillet welds. Reference API 1104, Appendix B, Figures B-6 thru B-11.
- P. HANDLING OF ELECTRODES: The handling of Electrodes shall follow the AWS Standard D1.1
- Q. PREHEAT/POST HEAT: Preheat shall be required when the ambient or parent metal temperature is below 40°F or if moisture is present on the parent metal. The pipe shall be preheated evenly around the pipe circumference. The preheat temperature shall be 250°F for 3" on both sides of the weld. The preheat temperature shall be monitored and maintained before and during welding. Post weld heat is not required.



## DBI, Inc. Quality Inspection and Consulting Services

*Reliable...Responsive...Resourceful...Proactive*

Customer:	Mango	Project Location:	DBI, Shop Overland Park, KS
PO #:		Inspection Standards:	API 1104
Project:	Mango Welding Procedure No. 2 LH Qualification	Project Specification:	
DAILY PROJECT REPORT & REMARKS/DEFICIENCIES/CORRECTIVE ACTIONS			

DATE	INSPECTION RESULTS
11-9-15	<p>Hardness testing was performed on the heat affected zone of the carrier pipe with an Equitip rebound type hardness tester. Results were converted to HV. Results are as follows:</p> <p>FB-1 : 161HV, 168HV, 166HV FB-2 : 182HV, 183HV, 180HV FB-3 : 164HV, 163HV, 166HV FB-4 : 177HV, 181HV, 175HV</p>

DBI Incorporated certifies that the above tests and or field services have been performed and the results reported herein. This report does not relieve the fabricator/erector of the responsibility to comply with the appropriate plans and specifications.

**INSPECTOR:** Max Kendall

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF DBI, INC.

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## In-Service test record Mango 2

Welder	Weld __7:30 Groove__3/32" E7018__							
Pass	Root	Root	Fill	Fill	Cover			
Amperage	83	95	79	79	80			
Voltage	22	24	21	23	22			
Time	42	54	61	60	59			
Distance	3	4.5	4.75	4	3.25			
Travel speed	4.28	5	4.75	4	3.3			
KJ per inch	26	27.36	20.9	27	32			
Welder	Weld __1:30 Groove__3/32" E7018__							
Pass	Root	Root	Fill	Fill	Cover	Cover	Cover	
Amperage	78	108	91	83	89	97	81	
Voltage	22	24	22	21	22	22	22	
Time	50	51	60	46	53	54	49	
Distance	3.5	6	7.75	3.75	2.75	4.5	3.25	
Travel speed	4.2	7	7.75	4.8	3.1	5	3.9	
KJ per inch	24.5	22.21	15.499	21.78	37	25.60	27.41	
Welder	Weld __Fillet__ Bottom__3/32" E7018__							
Pass	Root	Root	Root	Fill/Cap	Fill/Cap			
Amperage	86	87	81	94	91			
Voltage	22	22	22	22	22			
Time	45	56	64	48	54			
Distance	3.75	6.5	5.75	4	4.75			
Travel speed	5	6.9	5.3	5	5.2			
KJ per inch	23.7	16.64	20.17	24.8	23.1			

## In-Service test record Mango 2

Welder	Weld _Fillet_Top_3/32" E7018_____				Weld_Fillet_Top_ 1/8" E7018_____			
	Root	Root	Cover	Cap	Cover			
Pass								
Amperage	85	78	89	78	115			
Voltage	22	20	22	22	21			
Time	50	56	45	61	60			
Distance	4	3	3.25	3.75	5			
Travel speed	4.8	3.2	4.3	3.6	5			
KJ per inch	23.375	29.25	27.32	28.6	28.98			

Average Travel in/min(Dis ÷ Sec x 60 = IPM)

Heat input (kJ/in)=(Amps x Volts x 60/[Travel Speed (in./Min) x 1000]

## In-Service test form MANGO 2

Welders Name:				Employee Number:					
Pipe Diameter:				Wall Thickness:					
Carrier Pipe Heat Number:				Sleeve Heat Number:					
Machine Type:									
<b>Welder</b>	<b>Weld _____</b>					<b>Weld _____</b>			
Pass	Root	Hot	Filler	Cap		Root	Hot	Filler	Cap
Amperage									
Voltage									
Time									
Distance									
Travel speed									
KJ per inch									
<b>Electrode and Electrical Characteristics: Groove Weld</b>									
Bead	Electrode Size, In.	Electrode	Voltage Range	Amperage Range	Minimum Heat Input kJ/Inch	Travel Speed Range ipm			
Root	3/32"	E7018	21 - 29	78 - 97	14	3-9			
Hot Pass	3/32"	E7018	21 - 28	77 - 97	14	3-9			
Cover	3/32"	E7018	21 - 27	77 - 105	14	3-9			
<b>Electrode and Electrical Characteristics: Fillet Weld</b>									
Bead	Electrode Size, In.	Electrode	Voltage Range	Amperage Range	Minimum Heat Input kJ/Inch	Travel Speed Range ipm			
Root	3/32"	E7018	21 - 31	88 - 109	14	3-9			
Cover	3/32"	E7018	20 - 31	84 - 113	14	3-9			
	1/8"	E7018	19 - 28	111 - 133	14	3-9			

Average Travel in/min(Dis ÷ Sec x 60 = IPM)

Heat input (kJ/in)=(Amps x Volts x 60/[Travel Speed (in./Min) x 1000]

## Procedure Qualification Data Report

Procedure Qualification Record No. MANGO#2LH-11/10/2015

Date: 11-10-2015

Welding Procedure Number Followed <b>MANGO Welding Procedure NO. 2 - LH Rev. 11/5/15</b> All Diameters · All Wall Thicknesses · ≤ X65 and Vintage Pipe									
Date:	11/9/2015	Welder's I.D. Mark:		MR					
Welder:	Michael Ruiz	Employee # :		6626					
Contractor/Company:	JF Construction	Test Location:		DBI Shop, Overland Park, KS					
Certifying Company:	DBI, Inc.								
<b>Test Pipe/Fitting Material and Test Conditions for Welder Qualification</b>									
Ambient Test Temp.:	60 deg. F	Weather condition	Indoors	Type of Machine:	Lincoln SAE 300				
Test Pipe Material Grade:	UNS1021			Sleeve Material Grade:	UNS1021				
Test Pipe Dia. / W. T.:	12" / 0.250"			Sleeve Material WT.:	0.250'				
Direction of Welding:	Uphill			Direct Current Reverse Polarity /EP					
Position of Test Weld Sample:	45° Angle Seam @ 1:30 & 7:30								
Initial Qualification Test Conducted with Water Flowing Through Test Pipe : Yes/ .75 Gallons per minute									
<b>Welding Parameters and Electrical Characteristics</b>									
Pass No.	Process	Filler Material		Electrical Characteristics		Minimum Heat Input (kJ/in)	Time Between Passes	Travel Speed (IPM)	Cleaning Method
		Size	Classification	Amperage Range	Voltage Range				
<b>Seam Weld Side 1 (7:30)</b>									
1	SMAW	3/32"	E7018	21-29	78-97	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	21-28	77-97	14	1 min	3-8	Power Brush
3	SMAW	3/32"	E7018	21-27	77-105	14		3-8	Power Brush
4									
5									
<b>Top Fillet Weld Side 1</b>									
1	SMAW	3/32"	E7018	21-31	88-109	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	20-31	84-113	14	1 min	3-8	Power Brush
3	SMAW	1/8"	E7018	19-28	111-133	14		3-8	Power Brush
4									
5									
<b>Bottom Fillet Weld Side 1</b>									
1	SMAW	3/32"	E7018	21-31	88-109	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	20-31	84-113	14	1 min	3-8	Power Brush
3	SMAW	1/8"	E7018	19-28	111-133	14		3-8	Power Brush
4									
5									

Preheat: \_\_\_\_\_ None \_\_\_\_\_ Postheat: \_\_\_\_\_ None \_\_\_\_\_

☐ Check here if voltage is measure across the terminals of welding machine

Note: Heat Input (kJ/in) = (Amps x Volts x 60) / [Travel Speed (in/Min) x 1000]



## Procedure Qualification Data Report

Procedure Qualification Record No. MANGO#2LH-11/10/2015

Date: 11-10-2015

Welding Procedure Number Followed									
<b>MANGO Welding Procedure NO. 2 - LH Rev. 11/5/15</b>									
All Diameters · All Wall Thicknesses · ≤ X65 and Vintage Pipe									
Date:	11/9/2015	Welder's I.D. Mark:		MR					
Welder:	Michael Ruiz	Employee # :		6626					
Contractor/Company:	JF Construction	Test Location:		DBI Shop Overland Park KS					
Certifying Company:	DBI Inc.								
<b>Test Pipe/Fitting Material and Test Conditions for Welder Qualification</b>									
Ambient Test Temp.:	Weather condition			Type of Machine:		Lincoln SAE 300			
Test Pipe Material Grade:	UNS1021 Vintage			Sleeve Material Grade:		UNS1021 Vintage			
Test Pipe Dia. / W. T.:	12" x .250"			Sleeve Material WT.:		0.250"			
Direction of Welding:	Uphill			Direct Current Reverse Polarity /EP					
Position of Test Weld Sample:	45° Angle Seam @ 1:30 & 7:30								
Initial Qualification Test Conducted with Water Flowing Through Test Pipe : Yes/.75 Gallons per minute									
<b>Welding Parameters and Electrical Characteristics</b>									
Pass No.	Process	Filler Material		Electrical Characteristics		Minimum Heat Input (kJ/in)	Time Between Passes	Travel Speed (IPM)	Cleaning Method
		Size	Classification	Amperage Range	Voltage Range				
<b>Seam Weld Side 2</b>									
1	SMAW	3/32"	E7018	21-29	78-97	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	21-28	77-97	14	1 min	3-8	Power Brush
3	SMAW	3/32"	E7018	21-27	77-105	14		3-8	Power Brush
4									
5									
<b>Top Fillet Weld Side 2</b>									
1	SMAW	3/32"	E7018	21-31	88-109	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	20-31	84-113	14	1 min	3-8	Power Brush
3	SMAW	1/8"	E7018	19-28	111-133	14		3-8	Power Brush
4									
5									
<b>Bottom Fillet Weld Side 2</b>									
1	SMAW	3/32"	E7018	21-31	88-109	14	1 min	3-8	Power Grind
2	SMAW	3/32"	E7018	20-31	84-113	14	1 min	3-8	Power Brush
3	SMAW	1/8"	E7018	19-28	111-133	14		3-8	Power Brush
4									
5									

Preheat: \_\_\_\_\_ None \_\_\_\_\_ Postheat: \_\_\_\_\_ None \_\_\_\_\_

☐ Check here if voltage is measure across the terminals of welding machine

Note: Heat Input (kJ/in) = (Amps x Volts x 60) / [Travel Speed (in/Min) x 1000]

Welding Procedure Number Followed						
<b><u>MANGO Welding Procedure NO. 2 - LH Rev. 11/5/15</u></b>						
All Diameters · All Wall Thicknesses · ≤ X65 and Vintage Pipe						
Date:	11/9/2015	Welder's I.D. Mark:	MR			
Welder:	Michael Ruiz	Employee # :	6626			
Contractor/Company:	JF Construction	Test Location:	DBI Shop Overland Park KS			
Certifying Company:	DBI, Inc.					
<b>Test Pipe/Fitting Material and Test Conditions for Welder Qualification</b>						
Ambient Test Temp.:	Weather condition		Type of Machine:	Lincoln SAE 300		
Test Pipe Material Grade:	Vintage Pipe (Pre 1973)		Sleeve Material Grade:	Vintage Pipe (Pre 1973)		
Test Pipe Dia. / W. T.:	12-3/4" OD / .250"		Sleeve Material WT.:	.250"		
Direction of Welding:	Uphill		Direct Current Reverse Polarity /EP			
Position of Test Weld Sample:	45° Angle Seam @ 1:30 & 7:30					
Qualification Test Conducted with Water Flowing Through Test Pipe : Yes/ .75 Gallons per minute						
<b>Destructive Test Results per API 1104, Twentieth Edition, Appendix B</b>						
<b>Seam Weld</b>						
<b>Tensile Tests</b>						
<b>Specimen</b>	<b>Width</b>	<b>Thickness</b>	<b>Area</b>	<b>Max Load (Lbs.)</b>	<b>U.T.S.</b>	<b>Fracture Location</b>
T-1	0.995	0.221	0.219	16,000	73,059	Ductile Base Metal
T-2	0.936	0.214	0.200	16,000	80,000	Ductile Base Metal
<b>Face Bend Tests      Root Bend Test      Nick-Break Tests</b>						
<b>Specimen</b>	<b>Results</b>	<b>Specimen</b>	<b>Results</b>	<b>Specimen</b>	<b>Results</b>	
FB-1	Accept	RB-1	Accept	NB-1	Accept	
FB-2	Accept	RB-2	Accept	NB-2	Accept	
<b>Fillet Weld Nick-Break Tests      Macro Test      (24 Hour)Face Bend Tests</b>						
<b>Specimen</b>	<b>Results</b>	<b>Specimen</b>	<b>Results</b>	<b>Specimen</b>	<b>Results</b>	
NB-1	Accept	MT-1	Accept	FB-1	Accept	
NB-2	Accept	MT-2	Accept	FB-2	Accept	
NB-3	Accept	MT-3	Accept	FB-3	Accept	
NB-4	Accept	MT-4	Accept	FB-4	Accept	
All of the above tests were conducted in accordance with and meet the requirements of API 1104, Twentieth Edition, and DOT Part 192 and Part 195						
Tested by: <u>Max Hamdall</u> <span style="float: right;"><b>See Additional Page for Hardness Results</b></span>						
Acceptable Date: <u>11/10/2015</u> Unacceptable Date: _____						