

PIPELINE WELDING PROCEDURE SPECIFICATION

Petro-Line Construction Ltd.
608 - 21 Avenue
Nisku, Alberta
T9E 7Y1

WPS No: PLC-218

Scope: This welding procedure specification details the procedure to be followed for production field butt and repair welding of pipe and/or components required by CSA Standard Z662, Oil and Gas Pipeline Systems.

Normative References: This welding procedure specification was prepared in accordance to CSA Z662-03 and incorporates by undated references, provisions from other publications. Revision to this specification is not required unless subsequent referenced code and or specification additions include changes to essential welding variables.

Service Restrictions: Sweet or Sour
Temperature Restrictions: Notch Toughness Tested to -20°C (-4°F)

1. **WELDING PROCESS & METHOD**
Shielded Metal Arc Welding (SMAW) - manual method.
2. **BASE MATERIAL**
 - a) **Composition:** This specification applies to pipe and/or component material manufactured in accordance with, or listed as "Acceptable Alternative Materials" in any of the following standards:
 - CSA Z662, Oil and Gas Pipeline Systems
 - CAN/CSA-Z245.1, Steel Line Pipe
 - CAN/CSA-Z245.11, Steel Fittings
 - CAN/CSA-Z245.12, Steel Flanges
 - CAN/CSA-Z245.15, Steel Valves
 - b) **Pipe Grades:** 386 MPa (SMYS) or less
 - c) **Wall Thickness Qualified:** 1.5 to 13.5 mm (0.059 to 0.531 in.) inclusive
 - d) **Pipe Diameters Qualified:** 323.9 mm (12.75 in.) O.D minimum
3. **FILLER METAL CLASSIFICATION & SIZE**
 - a) **Root Pass:** E6010; 3.2 or 4.0 mm (1/8 or 5/32 in.)
 - b) **Hot Pass:** E7010-P1; 3.2, 4.0 or 5.0 mm (1/8, 5/32 or 3/16 in.)
 - c) **Fill Pass(es):** E7010-P1; 4.0 or 5.0 mm (5/32 or 3/16 in.)
 - d) **Cap Pass(es):** E7010-P1; 4.0 or 5.0 mm (5/32 or 3/16 in.)

4. JOINT GEOMETRY

- a) Joint Type: Groove - Single Vee Butt
- b) Bevel Angle: 30°, +6° / -1.5°
- c) Root Face: 1.6 mm (1/16 in.), +/- 0.8 mm (1/32 in.)
- d) Root Gap: 1.6 mm (1/16 in.), +/- 0.8 mm (1/32 in.)

The surfaces to be welded shall be smooth, uniform, free of fins, laminations, tears, scale, slag, grease, paint or other foreign matter, which may adversely affect the welding.

5. POSITION & DIRECTION OF WELDING

- a) Position: Pipe horizontal, rolled or fixed position
- b) Direction of Welding: Vertical down

6. PREHEATING, INTERPASS TEMPERATURE & CONTROLLED COOLING

- a) Butt Welds: A minimum preheat temperature of 66°C (150°F) shall be applied to an area at least 50.8 mm (2.0 in.) on each side of the weld joint for its entire circumference prior to welding.
- b) Repair Welds: A minimum preheat temperature of 120°C (250°F) shall be applied to an area at least 150 mm (6.0 in.) from any point to the area to be repaired.

If the interpass temperature falls below the minimum preheat temperature, the entire weld joint shall be heated to the minimum preheat temperature prior to starting the next weld pass.

The maximum interpass temperature shall not exceed 177°C (350°F). Preheating may be applied by oxy-fuel torch, propane torch, electrical induction coils or any other method approved by the owner. Temperature of the joint shall be verified using temperature indicating crayons, thermocouples, pyrometers or other suitable method.

Where applicable, precautions shall be taken through the use of insulating covers or other means to control the cooling rate of the weld after any pass.

7. POSTWELD HEAT TREATMENT

Welds prepared in accordance with this specification shall not be subjected to postweld heat treatment.

8. ELECTRICAL CHARACTERISTICS

- a) Current Type: Direct current, reverse polarity
- b) Voltage, amperage & travel speed: See Table #1
- c) Heat Input: See Table #1

9. TECHNIQUE

- a) Minimum number of root & second pass welders: One
- b) String or Weave Bead: Root & Hot Pass: String, Fill & Cap: String or Weave
- c) Number of Weld Layers: Three layers minimum

9. **TECHNIQUE** continued
- d) Type of line-up clamp & removal: Internal line-up clamps shall be used wherever practicable and shall not be removed until the root bead has been completed. When external line-up clamps are used, the root bead shall be uniformly spaced around the circumference of the joint and, where practicable, shall have a cumulative length of at least 50% of the circumference prior to removal.
 - e) Cleaning methods: Hand or power tools may be used. Each pass shall be thoroughly cleaned and free of slag and scale prior to depositing the next weld layer. The completed weld shall be brushed and free of spatter.
 - f) Filler and Finish Beads and Finish to be achieved: The second pass shall be started as soon as possible after the completion of the first pass. The completed weld shall have a substantially uniform cross-section for its entire circumference. The crown of the weld shall not be below the surface of the adjacent base metal.
10. **REMOVAL AND REPAIR OF DEFECTS**
- a) Repairable defects shall be removed by grinding. Welding shall be performed following the details outlined in this specification.
11. **ATTACHMENTS**
- a) Procedure Qualification Test Record: PLC-218-1
 - b) Laboratory Test Reports
 - c) Radiographic Examination Results
 - d) Material Test Reports

**TABLE #1
WELDING PARAMETERS**

Pass	ELECTRODE		CURRENT		Volts	Arc Speed mm / min. (i.p.m.)	Heat Input kJ / mm (J / inch)
	Class	Size mm (in.)	Type & Polarity	Amps			
Root	E6010	3.2, 4.0 (1/8, 5/32)	DCRP	92 - 138	24 - 34	258 - 386 (10.1 - 15.2)	0.58 - 0.71 (14,700 - 17,970)
Hot	E7010-P1	3.2, 4.0, 5.0 (1/8, 5/32, 3/16)	DCRP	112 - 168	25 - 34	246 - 370 (9.7 - 14.6)	0.76 - 0.93 (19,325 - 23,620)
Fill	E7010-P1	4.0, 5.0 (5/32, 3/16)	DCRP	104 - 156	22 - 32	136 - 204 (5.3 - 8.0)	1.12 - 1.36 (28,365 - 34,670)
Cap	E7010-P1	4.0, 5.0 (5/32, 3/16)	DCRP	108 - 162	23 - 34	128 - 192 (5.0 - 7.6)	1.32 - 1.61 (33,510 - 40,955)

Note #1 - The use of a stripper pass is optional.

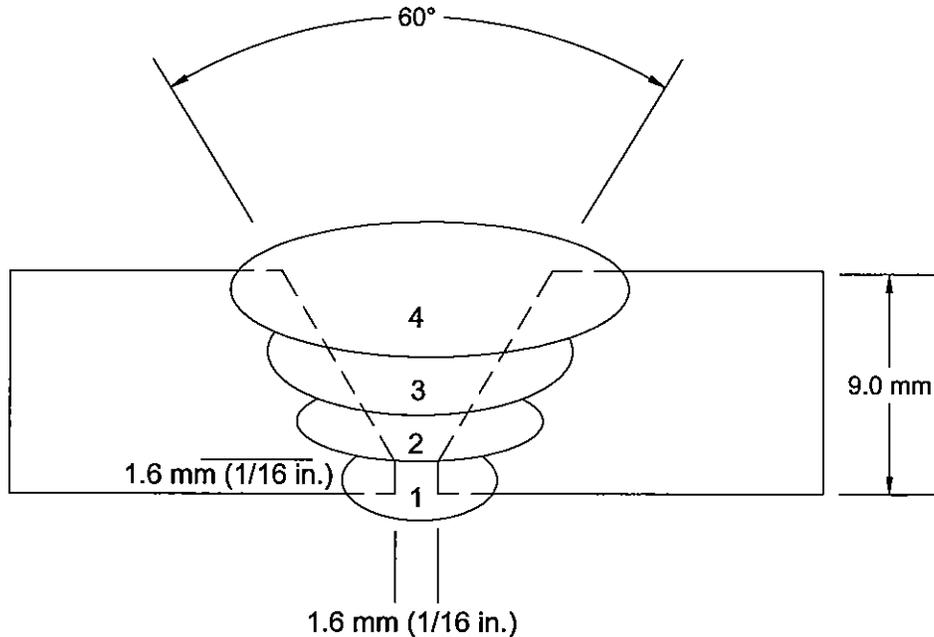
PROCEDURE QUALIFICATION TEST REPORT

PQR No.	PLC-218-1	Date	September 29, 2004
Welder	Shawn Moellmann	Certificate No.	W-14694
Base Material	CSA Z245.1	Grade	359
Heat Number	78371	Carbon Equivalent	0.14
Size	609.6 mm (24.0 in.) O.D.	Wall Thickness	9.0 mm (0.354 in.)
Preheat & Min. Interpass	66°C (150°F)	Max. Interpass	177°C (350°F)
Technique	Root & hot pass - string, Fill & Cap - weave	Thermal Condition	As welded
Welding Progression	Vertical down	Welding Position	Horizontal - fixed (5G)

WELDING PARAMETERS

Pass	ELECTRODE		CURRENT		Voltage	Arc Speed mm / min. (i.p.m.)	Heat Input kJ / mm (J / inch)
	Class	Size	Type & Polarity	Amperage			
1	E6010	1/8	DCRP	115	30	322 (12.7)	0.64 (16,336)
2	E7010-P1	5/32	DCRP	140	31	308 (12.1)	0.85 (21,471)
3	E7010-P1	3/16	DCRP	130	31	170 (6.7)	1.24 (31,517)
4	E7010-P1	3/16	DCRP	135	29	160 (6.3)	1.47 (37,231)

Note: Lincoln Electric Co.: E6010 (Lincoln Fleetweld 5P+), E7010-P1 (Lincoln Shield-Arc Hyp+)
Stripper pass between passes 3 & 4





LUDWIG & ASSOCIATES LTD.

Materials and Welding Engineering

LABORATORY TEST REPORT

CUSTOMER: Petro-Line Construction Ltd.
608 - 21 Avenue
Nisku, AB
T9E 7Y1

Laboratory Test No.: E04-854.1
Date: October 7, 2004

Attention: Wes Proft

PQR No.:	PLC-218-1	Heat No.:	78371
Material:	CSA Z245.1 Gr. 359		
Size:	609.6 mm (24.0 in.) O.D. x 9.0 mm (0.354 in.) w.t.		
Thermal Condition:	As Welded		

TENSILE TEST

SAMPLE NUMBER	T1		T2	
WIDTH mm (in.)	25.4	(1.00)	25.4	(1.00)
THICKNESS mm (in.)	8.56	(0.337)	8.13	(0.320)
AREA sq. mm (sq. in.)	217	(0.337)	207	(0.320)
ULTIMATE LOAD N (lbs)	118 400	(26,600)	112 000	(25,200)
UTS MPa (psi)	545	(79,000)	542	(78,700)
FRACTURE TYPE	Partial Cup & Cone		Partial Cup & Cone	
FRACTURE LOCATION	Parent Metal		Parent Metal	

GUIDED-BEND TEST

SAMPLE WIDTH:	25.4 mm (1.00 in.)	SAMPLE THICKNESS:	9.0 mm (0.354 in.)
PLUNGER SIZE:	88.9 mm (3.50 in.)	YOKE SIZE:	120 mm (4.72 in.)
SAMPLE TYPE	Face Bend	Face Bend	Root Bend
SAMPLE NUMBER(S)	F1	F2	R1
RESULTS	Pass	Pass	Pass

NICK BREAK TEST

SAMPLE NUMBER(S)	N1	N2
REMARKS	Pass	Pass

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of CSA Z662 - 03. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report.

Laboratory Test Conducted By: _____

Mark Fung, T.T. / Robert Gottschlich, R.E.T.



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LABORATORY TEST REPORT

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Laboratory Test No.: E04-854.1
Date: October 7, 2004

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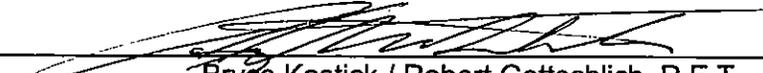
PQR No.:	PLC-218-1	Heat No.:	78371
Material:	CSA Z245.1 Gr. 359		
Size:	609.6 mm (24.0 in.) O.D. x 9.0 mm (0.354 in.) w.t.		
Thermal Condition:	As Welded		

NOTCH-TOUGHNESS TEST

TYPE OF TEST:	Charpy V-Notch	ORIENTATION:	Transverse
TEST TEMPERATURE:	-20°C (-4°F)	SPECIMEN SIZE:	10 x 8 mm

Specimen Number	Notch Location	Impact Values	
		Joules	(ft.lbs)
G2.1	Weld Metal within 1/16" of root	43.7	(32.2)
G2.2	Weld Metal within 1/16" of root	49.1	(36.2)
G2.3	Weld Metal within 1/16" of root	42.0	(31.0)
G3.1	HAZ	87.6	(64.6)
G3.2	HAZ	57.0	(42.0)
G3.3	HAZ	159	(117)

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASME Section VIII, Div. I, UG-84, 2001 edition and latest addenda. The information regarding material identification (i.e. size, thickness, heat number, etc.) has been provided by the customer whose name appears on this report.

Laboratory Test Conducted By: 
Bryce Kostick / Robert Gottschlich, R.E.T.



SR15

Certificate of Tests

STUPP JOB NUMBER: ER 8414 REVISION: 0 HEAT NUMBER: 78371

CUSTOMER	TEST PARAMETERS															
	<table border="0"> <tr> <td colspan="2">HYDROSTATIC</td> <td colspan="2">ULTRASONIC</td> <td>SEAM ANNEALED TEMP</td> </tr> <tr> <td>PRESSURE</td> <td>DURATION</td> <td>DRILL HOLE</td> <td>NOTCH</td> <td>MINIMUM</td> </tr> <tr> <td>2,500 PSI</td> <td>10 Seconds</td> <td>0.125 In</td> <td>N10</td> <td>1,650° F</td> </tr> </table>	HYDROSTATIC		ULTRASONIC		SEAM ANNEALED TEMP	PRESSURE	DURATION	DRILL HOLE	NOTCH	MINIMUM	2,500 PSI	10 Seconds	0.125 In	N10	1,650° F
HYDROSTATIC		ULTRASONIC		SEAM ANNEALED TEMP												
PRESSURE	DURATION	DRILL HOLE	NOTCH	MINIMUM												
2,500 PSI	10 Seconds	0.125 In	N10	1,650° F												
ORDER DESCRIPTION	FRACTURE TOUGHNESS CRITERIA															
ERW Fine Grained Steel / Aluminum Killed / Continuously Cast / Maked and Manufactured in U.S.A.	SRSAB-20-32F ; SR6P-0F															
OD 24.000 Inches WALL 0.500 Inch GRADE API5L-X52/X60-PSL2 SPEC API-5L VERSION 42nd January 2000 QUANTITY 2,000.0 Feet STEEL PO 8486-03	Flattening tests acceptable per specifications. CHEMICAL FORMULA $CE = C + Mn/6 + Cr/5 + Mo/5 + V/5 + Ni/15 + Cu/15$ $Pcm = C + Si/30 + Mn/20 + Cu/20 + Cr/20 + Ni/60 + Mo/15 + V/10 + 5B$ CE Max=0.40% ; Pcm Max=0.25% ; Pipe manufactured, sampled, tested, and inspected in accordance with the specification(s) and meets requirements.															

TENSILE TESTS (in PSI)	SPECIMEN SIZE	2.0 in x 1.5 in			
COIL PIPE TEST TYPE	YIELD	TENSILE	ELONG%	YT Ratio	
41 7 TRANS PIPE	66,400	80,900	39	0.82	
41 7 TRANS PIPE WELD		84,800			

HARDNESS SURVEY					
COIL PIPE TEST TYPE	BM	HAZ WELD	HAZ	BM	
41 7 MICRO - VICKERS HARDNESS	210	174	185	179	217
41 7 MICRO - VICKERS HARDNESS	217	197	198	187	209
41 7 MICRO - VICKERS HARDNESS	207	220	224	225	223

CHARPY TESTS											
COIL PIPE ORIENTATION	LOCATION	SIZE	TEMP	SHEAR PERCENT				ENERGY IN FT-POUNDS			
				1	2	3	AVG	1	2	3	AVG
41 7 TRANSVERSE	BODY	2/3	32°F	100	100	100	100	103	152	108	121.0

DROP WEIGHT TESTS				TRANSVERSE FULL SIZE		
COIL PIPE LOCATION	TEMP	SHEAR PERCENT				
		1	2	AVG		
41 7 BODY	-40°F	95	95	95		
41 7 BODY	-40°F	95	95	95		

CHEMICAL TESTS																				
COIL PIPE	CE	Pcm	TYPE	C	Mn	P	S	Si	Al	Cb	V	Ti	N	Cr	Mo	Cu	Ni	B	Ca	Sn
	0.251	0.125	LADLE	0.060	1.080	0.013	0.004	0.182	0.031	0.045	0.003	0.010	0.005	0.030	0.010	0.020	0.020	0.0002	0.002	0.002
41 7	0.220	0.093	PROD	0.029	1.078	0.010	0.003	0.188	0.034	0.043	0.005	0.012	0.000	0.032	0.007	0.025	0.015	0.0000	0.002	0.000
41 7	0.230	0.105	PROD	0.041	1.071	0.009	0.003	0.189	0.040	0.043	0.005	0.012	0.000	0.031	0.007	0.025	0.013	0.0000	0.004	0.000

The undersigned, on behalf of Stupp Corporation, hereby certifies that the above materials have been inspected and tested in accordance with the methods prescribed in the applicable specifications, and the results of such inspection and tests are shown above. In determining properties or characteristics for which no methods of inspection or testing are prescribed by said specification, the standard mill inspection and testing practices of Stupp Corporation have been applied. Unless it appears otherwise in the results of such inspection and tests shown above, the undersigned employee of Stupp Corporation believes that said materials conform to said specification.

Charles S. Craighead
Stupp Corporation

1/29/04
Appr: _____



RADIOGRAPHIC INSPECTION REPORT

CLIENT: **Ludwig & Associates Limited**

DATE: 09/29/2004 PAGE 1 OF 1

JOB #: 9994 P.O. #: E04-854

LOCATION: **In-House**

DEPT. CODE: NDT Sales - In Shop & Fab - 25-3000

DESCRIPTION: Fabrication Welds

NO. **R 7785**

DEFECT LEGEND

F - INCOMPLETE FUSION
 P - INCOMPLETE PENETRATION
 UC - UNDERCUTTING
 S - SLAG
 BT - BURN THROUGH
 P - POROSITY
 HL - HIGH / LOW
 C - INTERNAL CONCAVITY
 LC - LOW COVER
 W - WINDOW
 HB - HOLLOW BEAD
 C - CRACK
 AC - ARC BURNS
 SH - SHRINKAGE
 1 - SLIGHT, 2 - MEDIUM, 3 - SEVERE

CODE LEGEND

1. ANSI B31.3 NORMAL
 2. ANSI B31.3 SEVERE
 3. AMSE VIII DIV I UWS1
 4. AMSE VIII DIV UWS2
 5. ANSI B31.1
 6. CSA Z 662
 7. API 650
 8. OTHER:

TECHNIQUES

- 1. Single Wall Exposure
- 2. Double Wall Exposure
- 3. Single Wall Viewing
- 4. Double Wall Viewing

FILM NO.	LOCATION	DIA.	WLDR SYM	IF	IP	UC	S	BT	P	IC	LC	TECH #	CODE #	ACC	REMARKS	REJECT
1																
2															Weld Coupons	
3															(24" x .354"wt)	
4																
5	E04-854															
6	-1	0 - 35										1.3	6	✓		
7		35 - 70												✓		
8		70 - 105												✓		
9		105 - 140												✓		
10		140 - 170												✓		
11		170 - 0 cm												✓		
12																
13																
14	E04-854														(4" x .337"wt)	
15	-2	0 - 12										2.3	6	✓		
16		12 - 24												✓		
17		24 - 0 cm												✓		
18																
19																
20	E04-854														(4" x .252"wt)	
21	-3	0 - 12										2.3	6	✓		
22		12 - 24												✓		
23		24 - 0 cm												✓		
24																
25																

No. of Exp.	Film Brand & Design.	Screen Type & Thickness	No. of Film per Cassette	Type of Energy	Physical Size	Activity or K.V.	Maximum Source Size Object to Film Distance	Minimum Source to Object Distance	Material	Thickness			IOL		Exp. Time C/Min (mAS)
										Base	Weld	R.F.	Type	Size	
2	AGFA	.005x.010 Pb	1	1R192	12"	50 CI		12"	P1				ASTM	B	
6	"	"	"	"	"	"		4.5"	"				"	"	

This Certificate of Report is valid only for that work which was specifically requested. The Company is not responsible for any views or opinions expressed by employees performing this work which fall outside the contract terms or reference. All Certificates and / or reports are the result of work performed in conformance with applicable specifications and standards to the best of our ability and intent. However, the Company will not be responsible for deviation within the normal limits of accuracy in accordance with the standard practices. Final Code Acceptance shall require Client and Manufacturer Representative's signatures.

A.M.		P.M.		TOTAL HOURS		KILOMETERS
TIME IN	TIME OUT	TIME IN	TIME OUT	S.T.	hrs.	
				O.T.	hrs.	

SUBSISTENCE	
MANDAY	OT / MEALS

FILM
6 - 2 3/4" x 17"
6 - 2 3/4" x 8 1/2"

Film interpretation is done in accordance with the specified code, to the best of my professional ability.

Radiographer: Aucoin, Wade *W. Aucoin* ASNT / CGSB Level: II Assistant: Aucoin, Jeremy