

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.

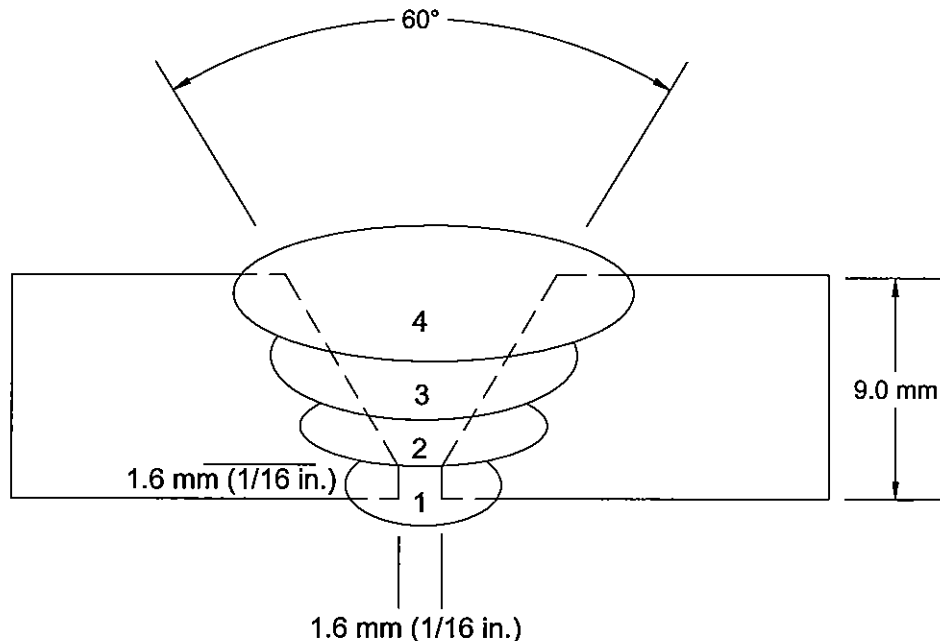
PROCEDURE QUALIFICATION TEST REPORT

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.



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		

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.



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 6, 2004

Attention: Wes Proft

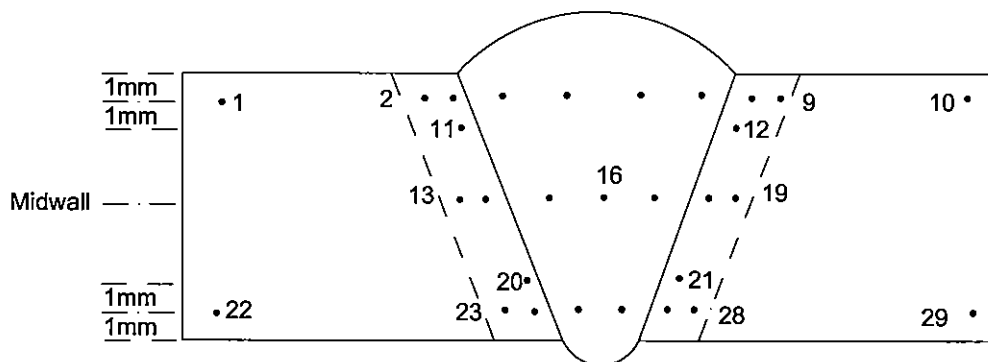
PQR No.: PLC-218-1
Material: CSA Z245.1 Gr. 359
Size: 609.6 mm (24.0 in.) O.D. x 9.0 mm (0.354 in.) w.t.
Thermal Condition: As Welded

Heat No.: 78371

HARDNESS TEST

TYPE OF TEST: Vickers
INSTRUMENT TYPE: Leco V-100-C1

LOAD: 10 kg



1) 200 HV	7) 190 HV	13) 166 HV	19) 164 HV	25) 170 HV
2) 179 HV	8) 189 HV	14) 182 HV	20) 183 HV	26) 171 HV
3) 185 HV	9) 178 HV	15) 174 HV	21) 185 HV	27) 182 HV
4) 195 HV	10) 198 HV	16) 178 HV	22) 192 HV	28) 170 HV
5) 185 HV	11) 190 HV	17) 169 HV	23) 164 HV	29) 204 HV
6) 187 HV	12) 185 HV	18) 179 HV	24) 180 HV	

We certify the test results in this report and that the specimen(s) were prepared and tested in accordance with the requirements of ASTM E92-82 (Reapproved 2003). 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 Kostiek / Robert Gottschlich, R.E.T.



STUPP CORPORATION
THE ENERGY FILLED COMPANY

SR15

Certificate of Tests

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

CUSTOMER

TEST PARAMETERS

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

ERW Fine Grained Steel / Aluminum Killed / Continuously Cast / Maked and Manufactured in U.S.A.

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

FRACTURE TOUGHNESS CRITERIA
SRSAB-20-32F ; SR6P-0F

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+58

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	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	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: _____



Toll Free: 1-800-261-8550

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
IP - 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 UW51
4. AMSE VIII DIV UW52

5. ANSI B31.1
6. CSA Z 662
7. API 650
8. OTHER:

TECHNIQUES

1. Single Wall Exposure 3. Single Wall Viewing
2. Double Wall Exposure 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																		
3																	Weld Coupons	
4																		
5	E04-854																(24" x .354"wt)	
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 to Object Distance	Minimum Source to Object Distance	Material	Thickness			IQI		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

ASNT / CGSB Level: II

Assistant:

Aucoin, Jeremy