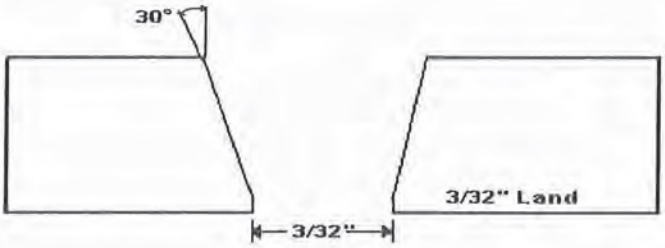
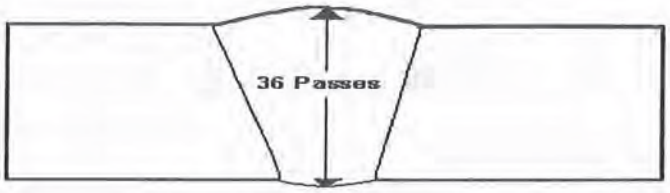
PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub Arc Systems		
PQR No:	SAS-1-1	**Date:**	January 4, 2002
Revision No.:	-----	**Revision Date:**	-----
WPS No:	SAS-1		
Welding Process(es):	SMAW/ SMAW/ SAW		
Types:	Manual/ Manual/ Machine		

JOINTS QW-402





BASE METALS QW-403

Material Spec.:	SA-516	to	SA-516
Type or Grade:	Grade 60		Grade 70
P-No.:	P-1 Group 1		P-1 Group 2
Thickness of Test Coupon:	1.75" wt.		
Diameter of Test Coupon:	Plate		
Other:	Carbon Equivalent (C.E) : 0.40		

POSTWELD HEAT TREATMENT QW-407

Temperature:	
Time:	
Other:	*Not Applicable*

PREHEAT QW-406

Preheat & Interpass Min.:	175 °F
Interpass Max.:	600°F
	Temperature monitored using Tempilstick

SHIELDING GAS QW-408

Shielding Gas:	N/A
Composition:	N/A
Flow Rate:	N/A

FILLER METALS QW-404

Process	SMAW	SMAW	SAW
SFA Spec No:	5.1	5.1	5.17
AWS Class. No:	E6010	E7018-1	EM12K
F-No:	F-3	F-4	F-6
A-No:	A-1	A-1	A-1
Size of Filler Metal:	1/8"	1/8"	3/32"
Deposited Metal:	0.250"	0.750"	0.750"
Flux Class:	N/A	N/A	F7A6 (Neutral)
Other:	Covered Electrode	Covered Electrode	Coiled Solid Wire
			(Lincoln L61/882)

ELECTRICAL CHARACTERISTICS QW-409

Process:	SMAW	SMAW	SAW
Current:	Direct (DC)	Direct (DC)	Direct (DC)
Polarity:	Reverse (EP)	Reverse (EP)	Reverse (EP)
Volts:	21	21	31
Amps:	110	125	450
Heat Input (J/in):	69 300	63 000	73 636

TECHNIQUE QW-410

Process:	SMAW	SMAW	SAW
Position:	3G	3G	2G
Progression:	Vertical Up	Vertical Up	Horizontal
Travel Speed (ipm):	2.5	2.25	16
String or Weave:	String	String and Weave	String
Oscillation:	N/A	N/A	N/A
Single / Multi Pass:	Multiple	Multiple	Multiple
Single / Multi Electrodes:	Single	Single	Single
Wire Feed Rate:	N/A	N/A	80 ipm

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

PQR # SAS-1-1

Tensile Test
QW-462

Specimen No.	Width In	Thickness In	Area in^2	Ultimate Total Load Lb	Ultimate Unit Stress psi	Type of Failure & Location
		See Attached Report				

Guided Bend Tests
QW-462

Type and Figure No.	Result
See Attached Report	

Toughness Tests
QW-170

Specimen No.	Notch Location	Notch Type	Test Temp	Impact Values	Lateral Exp % Shear	Lateral Exp Mils	Drop Weight Break	Drop Weight No Brk
			See Attached Report					

Fillet-Weld Tests
Not Applicable

Result-Satisfactory: Yes ____ No ____ Pen. Into Parent Material: Yes ____ No ____
Macro-Results:

Other Tests

Type of Test: Vickers Hardness Test to NACE MR01
Deposit Analysis: N/A

Welder's Name: Gary Kolman Clock No.: W-2638 Stamp ID: CC
Tests Conducted By: Qualimet Inc. Lab. Test No.: 636 – 01001

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Sub Arc Systems

Date: January 4, 2002 By: Gary Kolman

• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5670 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com

"Your source of Quality Materials Engineering"

MECHANICAL TEST REPORT

for Procedure Qualification Record # SAS-1-1

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, AB	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	1.750" wt plate	**Condition:**	As Welded
Test Specification:	ASME Section IX		

Tensile Tests QW - 462.1(a)

Sample Identification:	CCT1	CCT2
Sample Size – inch:(W x T)	1.723 x 0.753	1.717 x 0.759
Least X-Sect. Area - in^2:	1.30	1.30
Ultimate Load - lbs:	102 526	104 116
Ult. Ten. Strength - ksi:	72.3	71.6
Character of Failure:	Ductile	Ductile
Location of Failure:	Base Metal 516 Gr.60 Side	Base Metal 516 Gr.60 Side
Req'd Tensile Strength - ksi:	60.0	60.0
Pass or Fail:	Passed	Passed
Remarks:		

*Bend Test QW - 462.2

Sample Identification:	CCB1	CCB2	CCB3	CCB4
Type of Bend Test:	TSB	TSB	TSB	TSB
Pass or Fail:	Pass	Pass	Pass	Pass
Remarks:				

*Types of Bend Tests

TSB, TFB, TRB = transverse side, face or root bend

LSB, LFB, LRB = longitudinal side, face or root bend

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX.

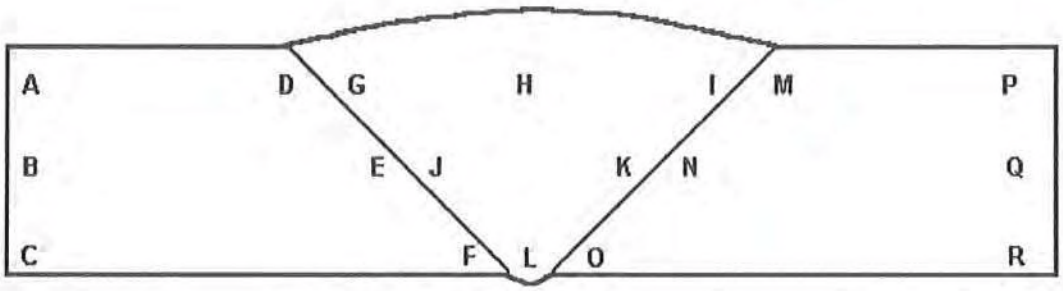
TEST RESULTS CERTIFIED BY: QUALIMET INC.

• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com
"Your source of Quality Materials Engineering"

HARDNESS TEST REPORT

for Procedure Qualification Record # SAS-1-1

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, Alberta T9X-1L6	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	1.750" wt plate	**Condition:**	As Welded
Test Method:	Hardness testing performed in accordance with ASTM E-92 using a Vickers Hardness Tester with a 10 kg load. (HV10)		
Equipment:	Matsuzawa Seiki Co. Ltd. Vickers Hardness Tester S/N: 7193M		
Calibration:	**Test Block :** 197 ± 6 DPH	**Act. Reading:**	197 DPH



Hardness Values

A	177	D	198	G	205	J	210	M	189	P	178
B	182	E	205	H	103	K	207	N	196	Q	181
C	173	F	201	I	208	L	202	O	194	R	179

These hardness values do not exceed 248 HV10 (HRC 22).

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX and NACE MR01

Test Results Certified by: QUALIMET INC.

• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 468-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com

"Your source of Quality Materials Engineering"

CHARPY V-NOTCH IMPACT TEST RESULTS

For Procedure Qualification Report # SAS-1

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, AB	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	1.750" wt plate	**Condition:**	As Welded
Specimen Type:	10.0 mm Charpy V Notch impact specimens		
Specification:	ASTM A-370, ASME Section VIII UG-84		
Qualification Temp.:	-46°C (-50°F)		

Sample Set	Sample Number	Impact Energy Ft-lb	(Joule)	Converted Full Size Impact Energy (J)	% Shear
Weld Zone – Root	1	14	19	24	20
Includes Both	2	48	65	81	20
SMAW Processes	3	38	51	64	20
	Average:	33	45	57	20
Weld Zone – Fill	1	58	79	79	10
	2	45	61	61	20
	3	88	119	119	40
	Average:	64	86	86	23
Heat Affected Zone	1	18	24	24	20
SA-516 Gr. 70	2	122	165	165	60
	3	101	137	137	70
	Average:	80	109	109	50
Heat Affected Zone	1	98	133	133	40
SA-516 Gr. 70	2	132	179	179	100
	3	86	117	117	40
	Average:	105	143	143	60

Remarks: These Charpy v-notch impact test results exceed the minimum requirements of ASME Section VIII and B31.3 Codes for –46°C; or CSA Z662-99 Codes for -46°C.

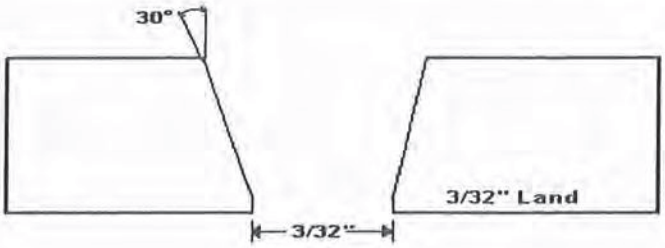
We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX.

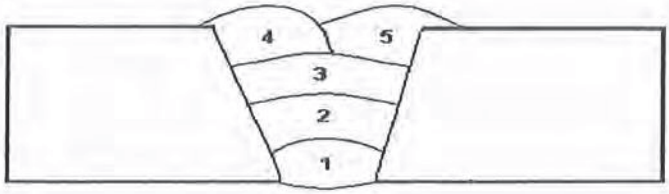
Test Results Certified By: M Flynn **QUALIMET INC.**

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub Arc Systems		
PQR No:	SAS-1-2	**Date:**	January 4, 2002
Revision No.:	-----	**Revision Date:**	-----
WPS No:	SAS-1		
Welding Process(es):	SMAW/ SMAW/ SAW		
Types:	Manual/ Manual/ Machine		

JOINTS QW-402





BASE METALS QW-403

Material Spec.:	SA-516	To	SA-516
Type or Grade:	Grade 60		Grade 70
P-No.:	P-1 Group 1		P-1 Group 2
Thickness of Test Coupon:	0.375" wt.		
Diameter of Test Coupon:	Plate		
Other:	Carbon Equivalent (C.E) : 0.38		

POSTWELD HEAT TREATMENT QW-407

Temperature:	
Time:	
Other:	*Not Applicable*

PREHEAT QW-406

Preheat & Interpass Min.:	50 °F
Interpass Max.:	600°F
	Temperature monitored using Tempilstick

SHIELDING GAS QW-408

Shielding Gas:	N/A
Composition:	N/A
Flow Rate:	N/A

FILLER METALS QW-404

Process	SMAW	SMAW	SAW
SFA Spec No:	5.1	5.1	5.17
AWS Class. No:	E6010	E7018-1	EM12K
F-No:	F-3	F-4	F-6
A-No:	A-1	A-1	A-1
Size of Filler Metal:	1/8"	3/32"	3/32"
Deposited Metal:	0.100"	0.125"	0.150"
Flux Class:	N/A	N/A	F7A6 (Neutral)
Other:	Covered Electrode	Covered Electrode	Coiled Solid Wire
			(Lincoln L61/882)

ELECTRICAL CHARACTERISTICS QW-409

Process:	SMAW	SMAW	SAW
Current:	Direct (DC)	Direct (DC)	Direct (DC)
Polarity:	Reverse (EP)	Reverse (EP)	Reverse (EP)
Volts:	21	21	30
Amps:	110	110	425
Heat Input (J/in):	39 610	55 428	36 428

TECHNIQUE QW-410

Process:	SMAW	SMAW	SAW
Position:	3G	3G	2G
Progression:	Vertical Up	Vertical Up	Horizontal
Travel Speed (ipm):	3.5	2.5	21
String or Weave:	String	String and Weave	String
Oscillation:	N/A	N/A	N/A
Single / Multi Pass:	Multiple	Multiple	Multiple
Single / Multi Electrodes:	Single	Single	Single
Wire Feed Rate:	N/A	N/A	83 ipm

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

PQR # SAS-1-2

Tensile Test
QW-462

Specimen No.	Width In	Thickness In	Area In^2	Ultimate Total Load Lb	Ultimate Unit Stress psi	Type of Failure & Location
		See Attached Report				

Guided Bend Tests
QW-462

Type and Figure No.	Result
See Attached Report	

Toughness Tests
QW-170

Specimen No.	Notch Location	Notch Type	Test Temp	Impact Values	Lateral Exp % Shear	Lateral Exp Mils	Drop Weight Break	Drop Weight No Brk
			See Attached Report					

Fillet-Weld Tests
Not Applicable

Result-Satisfactory: Yes ____ No ____ Pen. Into Parent Material: Yes ____ No ____
Macro-Results:

Other Tests

Type of Test: Vickers Hardness Test to NACE MR01
Deposit Analysis: N/A

Welder's Name: Gary Kolman **Clock No.:** W-2368 **Stamp ID:** CD
Tests Conducted By: Qualimet Inc. **Lab. Test No.:** 636 – 01001

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Sub Arc Systems

Date: January 4, 2002 **By:** Gary Kolman Gary Kolman

• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com

"Your source of Quality Materials Engineering"

MECHANICAL TEST REPORT

for Procedure Qualification Record # SAS-1-2

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, AB	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	0.375" wt plate	**Condition:**	As Welded
Test Specification:	ASME Section IX		

Tensile Tests QW - 462.1(a)

Sample Identification:	CDT1	CDT2
Sample Size - inch:(W x T)	0.7300 x 0.3600	0.7200 x 0.380
Least X-Sect. Area – In^2:	0.263	0.360
Ultimate Load – lbs:	22 340	22 408
Ult. Ten. Strength – ksi:	85.0	86.4
Character of Failure:	Ductile	Ductile
Location of Failure:	Base Metal SA-516 Gr.60 Side	Base Metal SA-516 Gr.60 Side
Req'd Tensile Strength – ksi:	60.0	60.0
Pass or Fail:	Passed	Passed
Remarks:		

*Bend Test QW - 462.2

Sample Identification:	CDB1	CDB2	CDB3	CDB4
Type of Bend Test:	TSB	TSB	TSB	TSB
Pass or Fail:	Pass	Pass	Pass	Pass
Remarks:				

*Types of Bend Tests
TSB, TFB, TRB = transverse side, face or root bend LSB, LFB, LRB = longitudinal side, face or root bend

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX.

TEST RESULTS CERTIFIED BY: **QUALIMET INC.**

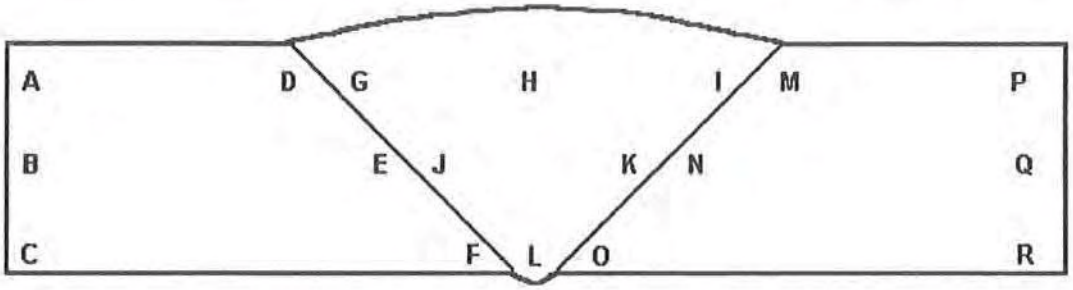
• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com

"Your source of Quality Material Engineering"

HARDNESS TEST REPORT

for Procedure Qualification Record # SAS-1-2

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, AB	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	0.375" wt plate	**Condition:**	As Welded
Test Method:	Hardness testing performed in accordance with ASTM E-92 using a Vickers Hardness Tester with a 10 kg load. (HV10)		
Equipment:	Matsuzawa Seiki Co. Ltd. Vickers Hardness Tester S/N: 7193M		
Calibration:	**Test Block :** 197 ± 6 DPH	**Act. Reading:**	197 DPH



Hardness Values

A	198	D	208	G	215	J	212	M	204	P	193
B	195	E	203	H	211	K	215	N	202	Q	189
C	196	F	206	I	210	L	209	O	207	R	195

These hardness values do not exceed 248 HV10 (22 HRC).

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX and NACE MR01

Test Results Certified by: M Ramu **QUALIMET INC.**

• 7817 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimetinc.com

"Your source of Quality Materials Engineering"

CHARPY V-NOTCH IMPACT TEST RESULTS

For Procedure Qualification Report # SAS-1-2

Client:	Sub Arc Systems	**Job Number:**	636-01001
Address:	4605-47 Steet Vermillion, AB	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60 to 70		
Size:	0.375" wt plate	**Condition:**	As Welded
Specimen Type:	8.5 mm Charpy V Notch impact specimens		
Specification:	ASTM A-370, ASME Section VIII UG-84		
Qualification Temp.:	-46°C (-50°F)		

Sample Set	Sample Number	Impact Energy Ft-lb	(Joule)	Converted Full Size Impact Energy (J)	% Shear
	1	10	14	16	20
Weld	2	12	16	19	20
	3	24	33	38	20
	Average:	15	21	24	20
Heat Affected Zone	1	82	111	131	70
SA516 Gr. 60	2	106	144	169	80
	3	146	198	233	100
	Average:	111	151	178	83
Heat Affected Zone	1	98	133	166	40
SA516 Gr. 70	2	132	179	224	100
	3	86	117	146	40
	Average:	105	143	179	60

Remarks: These Charpy v-notch impact test results exceed the minimum requirements of ASME Section VIII and B31.3 Codes for -46°C; or CSA Z662-99 Codes for -46°C.

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX.

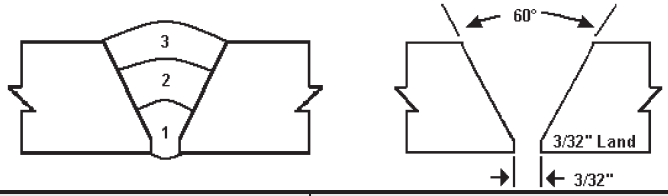
Test Results Certified By: **QUALIMET INC.**

PROCEDURE QUALIFICATION RECORD (PQR) QW-483

(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub Arc Systems	**By:**	Gary Kohlman
PQR No.:	SAS-1-3	**Date:**	January 4, 2002
Revision No.:	1[1]	**Revision Date:**	July 15, 2014
Welding Process(es):	SMAW / SMAW / SAW	**Types:**	Manual / Manual / Machine

JOINTS QW-402



BASE METALS QW-403

Material Spec.:	SA-516		SA-516
Grade/Type/Class:	Gr. 60		Gr. 70
P-No. Group No.:	P-1 Group 1	**to**	P-1 Group 2
Heat No.:	Not Recorded		Not Recorded
ASME C.E.:	Not Recorded		Not Recorded
CSA C.E.:	Not Recorded		Not Recorded
Thickness & Diameter:	0.249" thick plate (machined)		
Max Weld Deposit:	<0.500" per pass		

POSTWELD HEAT TREATMENT QW-407

Temperature:	
Time:	
Heating:	
	(Not Applicable)
Cooling:	
Other:	

PREHEAT QW-406

Preheat Temp. Min.:	50°F
Interpass Temp. Max.:	600°F
Interpass Temp. Min.:	50°F
Other:	Temperature monitored by tempilstiks

POSITIONS QW-405

Process:	F-3 SMAW	F-4 SMAW	SAW
Position:	3-G	3-G	2-G
Progression:	Vertical Up	Vertical Up	Horizontal
Other:	Not Applicable	Not Applicable	Not Applicable

FILLER METALS QW-404

Process:	**SMAW**	**SMAW**	**SAW**
SFA Specification No.:	5.1	5.1	5.17
AWS Classification No.:	E6010	E7018-1	EM12K
F-No.:	F-3	F-4	F-6
A-No.:	A-1	A-1	A-1
Size of Filler Metal:	1/8"	3/32"	3/32"
Deposited Weld Metal:	0.050"	0.075"	0.125"
Electrode-Flux (Class):	Not Applicable	Not Applicable	F7A6
Flux Trade Name:	Not Applicable	Not Applicable	Lincolnweld 882
Alloy Element/Flux:	Not Applicable	Not Applicable	None
Manufacturer:	Not Recorded	Not Recorded	Lincoln Electric
Trade Name:	Not Recorded	Not Recorded	L-61
Heat Number:	Not Recorded	Not Recorded	Not Recorded
Product Form:	Covered Electrode	Covered Electrode	Coiled Metal Cored Wire

SHIELDING GAS QW-408

Shielding Gas:			
Composition:			
Flow Rate:	***(Not Applicable)***	***(Not Applicable)***	***(Not Applicable)***
Trailing / Backing Gas:			
Flow Rate:			

ELECTRICAL CHARACTERISTICS QW-409

Current:	Direct (DC)	Direct (DC)	Direct (DC)
Polarity:	Reverse (EP)	Reverse (EP)	Reverse (EP)
Volts:	21	20	30
Amps:	110	105	425
Travel Speed (ipm):	5.5	4.3	24
Maximum Heat Input (J/in):	25 200	29 640	36 428
Wire Feed Speed (ipm):	Not Applicable	Not Applicable	82
Mode of Metal Transfer:	Not Applicable	Not Applicable	Not Applicable

TECHNIQUE QW-410

String or Weave:	String	String & Weave	String
Oscillation:	Not Applicable	Not Applicable	Not Applicable
Single / Multi Pass:	Single Pass from one side	Single Pass from one side	Single Pass from one side
Single / Multi Electrodes:	Single	Single	Single
Thermal Processes	Not Applicable	Not Applicable	Not Applicable
Wire Stick Out:	Not Applicable	Not Applicable	Not Recorded
Nozzle / Cup Size:	Not Applicable	Not Applicable	Not Applicable

[1] **Revision 1: Revision to correct editorial error.**

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

PQR # SAS-1-3 Revision 1

Tensile Test
QW-462

Specimen No.	Width in	Thickness in	Area in²	Ultimate Total Load Lb	Ultimate Unit Stress ksi	Type of Failure & Location
		(Not Applicable)				

Guided Bend Tests
QW-462

Specimen No.	Type	Figure	Result
	(Not Applicable)		

Toughness Tests
QW-170

Specimen No.	Notch Location	Notch Type	Test Temp	Full Size Values (ft-lbs)	% Shear	Lateral Exp Inches	Drop Weight Break	Drop Weight No Brk
CE-1	Weld	V-Notch	-50°F	76	80	Not Recorded	N/A	N/A
CE-2	Weld	V-Notch	-50°F	92	80	Not Recorded	N/A	N/A
CE-3	Weld	V-Notch	-50°F	100	100	Not Recorded	N/A	N/A
CE-4	HAZ (Grade 60)	V-Notch	-50°F	56	40	Not Recorded	N/A	N/A
CE-5	HAZ (Grade 60)	V-Notch	-50°F	72	40	Not Recorded	N/A	N/A
CE-6	HAZ (Grade 60)	V-Notch	-50°F	52	30	Not Recorded	N/A	N/A
CE-7	HAZ (Grade 70)	V-Notch	-50°F	82	40	Not Recorded	N/A	N/A
CE-8	HAZ (Grade 70)	V-Notch	-50°F	74	40	Not Recorded	N/A	N/A
CE-9	HAZ (Grade 70)	V-Notch	-50°F	72	40	Not Recorded	N/A	N/A

Fillet-Weld Tests
Not Applicable

Result-Satisfactory: Yes _____ No _____ Pen. into Parent Material: Yes _____ No _____
Macro-Results:

Other Tests
Not Applicable

Type of Test:
Other:

Welder's Name: Gary Kohlman **Reg. No.:** W-2368 **Stamp ID:** CE
Tests Conducted By: Qualimet **Lab. Test No.:** 100-14010
Revisions By: Qualimet

We hereby recertify that the statements in this record have been revised in accordance with paragraph QW-200.2 are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Sub Arc Systems

Original Cert. Date: January 4, 2002 **Certified By:** Gary Kohlman

Recertification Date: July 16, 14 **Certified By:**

• 8055 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimet.ca

"Your source of Quality Materials Engineering"

REVISED CHARPY IMPACT TEST REPORT**

for Procedure Qualification Record # SAS-1-3

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-01001
Address:	4605-47 Street, Vermillion AB, T9X 1L6	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60/70 to SA-516 Grade 60/70	**Revision Date:**	July 15, 2014
Size:	0.249" w.t. Plate (machined)	**Condition:**	As Welded
Test Specification:	ASME Section VIII UG-84, ASTM A-370		
Test Equipment:	Satec Model S1-10, S/N: 1164		

Specimen Type:	Charpy V-Notch		
Qualification Temperature:	-50.0°F	**Test Temperature:**	-50.0°F

Specimen Size (mm): 5

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lat. Exp. (in.)
Weld (Includes all processes)	1	38	76	80	Not Recorded
	2	46	92	80	Not Recorded
	3	50	100	100	Not Recorded
	Average:	**45**	**89**	**87**	**Not Recorded**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASTM A370, ASTM E23 and their latest editions.

**Revision of test report to correct editorial error.

TEST RESULTS CERTIFIED BY: Qualimet

Hanibal Ghile, E.I.T.

• 8055 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimet.ca
"Your source of Quality Materials Engineering"

REVISED CHARPY IMPACT TEST REPORT**

for Procedure Qualification Record # SAS-1-3

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-01001
Address:	4605-47 Street, Vermillion AB, T9X 1L6	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60/70 to SA-516 Grade 60/70	**Revision Date:**	July 15, 2014
Size:	0.249" w.t. Plate (machined)	**Condition:**	As Welded
Test Specification:	ASME Section VIII UG-84, ASTM A-370		
Test Equipment:	Satec Model S1-10, S/N: 1164		

Specimen Type:	Charpy V-Notch		
Qualification Temperature:	-50.0°F	**Test Temperature:**	-50.0°F

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lat. Exp. (in.)
HAZ (Grade 60)	1	28	56	40	Not Recorded
	2	36	72	40	Not Recorded
	3	26	52	30	Not Recorded
	Average:	**30**	**60**	**37**	**Not Recorded**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASTM A370, ASTM E23 and their latest editions.

**Revision of test report to correct editorial error.

TEST RESULTS CERTIFIED BY: Qualimet

Hanibal Ghile, E.I.T.

• 8055 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimet.ca

"Your source of Quality Materials Engineering"

REVISED CHARPY IMPACT TEST REPORT**

for Procedure Qualification Record # SAS-1-3

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-01001
Address:	4605-47 Street, Vermillion AB, T9X 1L6	**Date:**	January 4, 2002
Materials:	SA-516 Grade 60/70 to SA-516 Grade 60/70	**Revision Date:**	July 15, 2014
Size:	0.249" w.t. Plate (machined)	**Condition:**	As Welded
Test Specification:	ASME Section VIII UG-84, ASTM A-370		
Test Equipment:	Satec Model S1-10, S/N: 1164		

Specimen Type:	Charpy V-Notch		
Qualification Temperature:	-50.0°F	**Test Temperature:**	-50.0°F

Specimen Size (mm): 5

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lat. Exp. (in.)
HAZ (Grade 70)	1	41	82	40	Not Recorded
	2	37	74	40	Not Recorded
	3	36	72	40	Not Recorded
	Average:	**38**	**76**	**40**	**Not Recorded**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASTM A370, ASTM E23 and their latest editions.

**Revision of test report to correct editorial error.

TEST RESULTS CERTIFIED BY: Qualimet

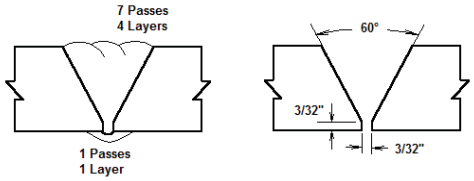
Hanibal Ghile, E.I.T.

PROCEDURE QUALIFICATION RECORD (PQR) QW-483

(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub-Arc Systems Inc.	**By:**	Gary Kohlman
PQR No.:	SAS-1-4	**Date:**	July 15, 2014
Revision No.:	0	**Revision Date:**	-----
Welding Process(es):	SMAW / SMAW /SAW	**Type(s):**	Manual / Manual / Machine

JOINTS QW-402



BASE METALS QW-403

Material Spec.:	SA-516		SA-516
Grade/Type/Class:	Grade 60/70		Grade 60/70
P-No. Group No.:	P-1 Group 1/2	**to**	P-1 Group 1/2
Heat No.:	E3D260		E3D260
Carbon Equivalent (ASME):	0.42		0.42
Carbon Equivalent (CSA):	0.42		0.42
Thickness & Diameter:	0.500" w.t. Plate		
Max Weld Deposit:	<0.500" per pass		

POSTWELD HEAT TREATMENT QW-407

Temperature:	
Time:	
Heating:	***(None – As Welded)***
Cooling:	
Other:	

PREHEAT QW-406

Preheat Temp. Min.:	50°F
Interpass Temp. Max.:	600°F
Interpass Temp. Min.:	50°F
Other:	Temperature monitored using tempilstiks

POSITIONS QW-405

Process:	F-3 SMAW	F-4 SMAW	SAW
Position:	3-G	3-G	2-G
Progression:	Vertical Up	Vertical Up	Horizontal
Other:	N/A	N/A	N/A

FILLER METALS QW-404

Process:	**SMAW**	**SMAW**	**SAW**
SFA Specification No.:	5.1	5.1	5.17
AWS Classification No.:	E6010	E7018-1	EM12K-H8
F-No.:	F-3	F-4	F-6
A-No.:	A-1	A-1	A-1
Size of Filler Metal:	1/8"	3/32"	3/32"
Deposited Weld Metal:	0.125"	0.125"	0.250"
Manufacturer:	Lincoln Electric	ESAB	Lincoln Electric
Trade Name:	Fleetweld 5P+	OK55	LA-61
Heat / Lot Number:	ED511111	SB248224	500344
Electrode-Flux (Class):	Not Applicable	Not Applicable	F7A6-EM12K-H8
Flux Tradename:	Not Applicable	Not Applicable	Lincolnweld 882 Flux
Flux Heat / Lot Number.:	Not Applicable	Not Applicable	12R13
Product Form:	Covered Electrode	Covered Electrode	Coiled Solid Wire

SHIELDING GAS QW-408

Shielding Gas:			
Composition:	***(Not Applicable)***	***(Not Applicable)***	***(Not Applicable)***
Flow Rate:			
Backing Gas:			

ELECTRICAL CHARACTERISTICS QW-409

Current:	Direct (DC)	Direct (DC)	Direct (DC)
Polarity:	Reverse (EP)	Reverse (EP)	Reverse (EP)
Volts:	22	22	30
Amps:	80	80 - 90	420
Travel Speed (ipm):	5.9	4.9 - 5.7	21.8
Maximum Heat Input (J/in):	18 040	23 704	34 650
Tungsten Electrode:	Not Applicable	Not Applicable	Not Applicable
STT Program Settings:	Not Applicable	Not Applicable	Not Applicable

TECHNIQUE QW-410

String or Weave:	String	String	String
Oscillation:	Not Applicable	Not Applicable	Not Applicable
Single / Multi Pass:	Single Pass from one side	Multiple Passes from one side	Multiple Passes from one side
Single / Multi Electrodes:	Single	Single	Single
Wire Stick Out:	Not Applicable	Not Applicable	1/4" to 1 1/4"
Nozzle / Cup Size:	Not Applicable	Not Applicable	Not Applicable

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

PQR # SAS-1-4 Rev.0

Tensile Test
QW-462

Specimen No.	Width (in)	Thickness (in)	Area (in^2)	Ultimate Total Load (lbs)	Ultimate Unit Stress (ksi)	Type of Failure & Location
			(Not Applicable)			

Guided Bend Tests
QW-462

Specimen No.	Type	Figure	Result
		(Not Applicable)	

Toughness Tests
QW-170

Specimen No.	Notch Location	Notch Type	Qual. Temp	Full Size Values (ft-lbs)	% Shear	Lateral Exp Inches	Drop Weight Break	Drop Weight No Brk
DG-1	Weld	V-Notch	-50°F	56	30	0.040	-----	-----
DG-2	Weld	V-Notch	-50°F	58	40	0.041	-----	-----
DG-3	Weld	V-Notch	-50°F	66	40	0.044	-----	-----
DG-4	HAZ	V-Notch	-50°F	56	-----**	-----**	-----	-----
DG-5	HAZ	V-Notch	-50°F	28	30	0.019	-----	-----
DG-6	HAZ	V-Notch	-50°F	89	-----**	-----**	-----	-----

**Shear and Lateral Expansion not recorded – specimen did not break

Fillet-Weld Tests
Not Applicable

Result-Satisfactory: **Yes** _____ **No** _____ Pen. into Parent Material: **Yes** ___ **No** _____
Macro-Results:

Other Tests

Type of Test: Not Applicable
Other: Not Applicable

Welder's Name: Keith Breedon **Reg. No.:** W-11618 **Stamp ID:** DG
Tests Conducted By: Qualimet **Lab. Test No.:** 100-14010

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME code.

Manufacturer: Sub-Arc Systems Inc.
Date: July 15, 2014 **Certified By:** Gary Kohlman

• 8055 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimet.ca

"Your source of Quality Materials Engineering"

CHARPY IMPACT TEST REPORT

for Procedure Qualification Record # SAS-1-4

Client:	Sub-Arc Systems Inc.	**Job Number:**	100-14010
Address:	4605-47 Street, Vermillion AB, T9X 1L6	**Date:**	July 15, 2014
Materials:	SA-516 Grade 60/70 to SA-516 Grade 60/70		
Size:	0.500" w.t. Plate	**Condition:**	As Welded
Test Specification:	ASME Section VIII UG-84, ASTM A-370		
Test Equipment:	Satec Model S1-10, S/N: 1164		

Specimen Type:	Charpy V-Notch		
Qualification Temperature:	-50.0°F	**Test Temperature:**	-50.0°F

Specimen Size (mm): 10

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lateral Expansion Inches
Weld (includes all processes)	DG-1	56	56	30	0.040
	DG-2	58	58	40	0.041
	DG-3	66	66	40	0.044
	Average:	**60**	**60**	**37**	**0.042**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASTM A370, ASTM E23 and their latest editions.

TEST RESULTS CERTIFIED BY: Qualimet

Hanibal Ghile, E.I.T.

• 8055 CORONET ROAD, EDMONTON, AB T6E 4N7 • (780) 469-5870 • FAX (780) 465-5829
• CALGARY (403) 278-9862 • 1-800-621-8979 • www.qualimet.ca

"Your source of Quality Materials Engineering"

CHARPY IMPACT TEST REPORT

for Procedure Qualification Record # SAS-1-4

Client:	Sub-Arc Systems Inc.	**Job Number:**	100-14010
Address:	4605-47 Street, Vermillion AB, T9X 1L6	**Date:**	July 15, 2014
Materials:	SA-516 Grade 60/70 to SA-516 Grade 60/70		
Size:	0.500" w.t. Plate	**Condition:**	As Welded
Test Specification:	ASME Section VIII UG-84, ASTM A-370		
Test Equipment:	Satec Model S1-10, S/N: 1164		

Specimen Type:	Charpy V-Notch		
Qualification Temperature:	-50.0°F	**Test Temperature:**	-50.0°F

Specimen Size (mm): 10

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lateral Expansion Inches
HAZ	DG-4	56	56	-----**	-----**
	DG-5	28	28	30	0.019
	DG-6	89	89	-----**	-----**
	Average:	**58**	**58**	-----**	-----**

**Shear and Lateral Expansion not recorded – specimen did not break

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASTM A370, ASTM E23 and their latest editions.

TEST RESULTS CERTIFIED BY: Qualimet

Hanibal Ghile, E.I.T.

SUB-ARC SYSTEMS INC.

Welding Procedure Specification

in accordance with

ASME Section IX

Welding Procedure Specification No.:	**SAS-2 Revision 2[1]**
Supporting PQR No. (s):	**SAS-2-1 Revision 1, SAS-2-2 Revision 1, SAS-2-3 Revision 1, SAS-2-4 Revision 1**

Qualified for

Process(es):	SAW (Leading) / SAW (Trailing)	**Position(s):**	Flat, Horizontal
Filler Metal F-No.:	F7A6-EM12K -H8 / F7A6-EM12K-H8	**A-No.:**	A-1 / A-1
AWS Classification:	F-6 / F-6	**Weld Type(s):**	Groove, Fillet, Weld buildup
Base Metal:	P-1 Group 1 or 2	To:	P-1 Group 1 or 2
Typical Materials:	This procedure is qualified for all P-1 materials as specified in Table QW-422 of ASME Section IX for applications where proven notch toughness properties are not required, and P-1 Group 1 or 2 materials only for applications where proven notch toughness properties are required.		
Diameter Range:	All diameters	**Condition(s):**	As Welded

Thickness Range:	**Normal Service**	**Impact Tested to -50°F**
ASME Section IX	0.062" to 1.500"	0.125" to 1.500"
ASME Section VIII	0.062" to 1.500"	0.125" to 1.500"
ASME B31.1	0.062" to 0.750"	0.125" to 0.750"
ASME B31.3	0.062" to 0.750"	0.125" to 0.750"

[1]**Revision 2:** Review and update to the current edition of the ASME code.

Provincial Registration

ABSA

SAFETY CODES ACT - PROVINCE OF ALBERTA
WELDING PROCEDURE

Reg. No. WP 2389.2
Spec No. SAS-2 (Rev 2)
Weld Process SAW
Matl. Gr. P No. 1 Gr 1+2 to P No. 1 Gr 1+2
Elect Gr. F No. 6 A No. 1
Th. Qual For 38.1mm P.W.H.T. NO
MIN TH QUAL 3.2mm., CVN -46°C

Yr. 14 Mo. 11 Day 5 Signed

JASON REINHART, P.ENG.
WELDING SPECIALIST

Provincial Registration

WELDING PROCEDURE SPECIFICATION (WPS) QW-482

(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub-Arc Systems Inc.	**By:**	Gary Kohlman
WPS No.:	SAS-2	**Date:**	June 4, 2010
Revision No.:	2[1]	**Revision Date:**	October 3, 2014
Supporting PQR's:	SAS-2-1 Revision 1, SAS-2-2 Revision 1, SAS-2-3 Revision 1, SAS-2-4 Revision 1		
Welding Process(es):	SAW / SAW	**Type(s):**	Machine / Machine

JOINTS QW-402		**Joint Details**
Joint Design:	Butt, Tee, Lap, Corner, etc.	**All ASME joint designs.** Reference construction
Backing:	F-6 SAW (Leading) with or without backing	drawings for joint details. Where joint details are not
	F-6 SAW (Trailing) with backing only	specified, refer to typical joint detail sheet provided.
Backing Material (Type):	Similar base or weld metal or backwelding as required. No Retainers.	

BASE METALS QW-403

P-No.: P-1 **Group No.:** *1 or 2 **to P-No.:** P-1 **Group No.:** *1 or 2

OR

Spec. type & grade: Not Applicable **to Spec. type & grade:** Not Applicable

OR

Chem. Analysis & Mech. Prop.: Not Applicable **to Chem. Analysis & Mech. Prop.:** Not Applicable

Thickness Range

		Normal Service	Impact Tested to -50°F		
Base Metal: Groove:	Section IX	0.062" to 1.500"	0.125" to 1.500"	**Fillet:**	All
	Section VIII	0.062" to 1.500"	0.125" to 1.500"	**Fillet:**	All
	B31.1	0.062" to 0.750"	0.125" to 0.750"	**Fillet:**	All
	B31.3	0.062" to 0.750"	0.125" to 0.750"	**Fillet:**	All
Pipe Dia Range: Groove:	All diameters			**Fillet:**	All

Other: *Limited to P-1 Group 1 or 2 only when proven notch toughness properties are required.

Maximum thickness of any weld layer shall not exceed .500"

FILLER METALS QW-404

	SAW (Leading)	SAW (Trailing)
Process:		
Specification No. (SFA):	5.17	5.17
AWS Classification No.:	F7A6-EM12K	F7A6-EM12K
F-No.:	F-6	F-6
A-No.:	A-1	A-1
Size of Filler Metals:	3/32", 1/8", 5/32", 3/16"	3/32", 1/8", 5/32", 3/16"
Weld Metal Thickness - Groove:	1.000"	1.000"
- Fillet:	Unlimited	Unlimited
Electrode-Flux (Class):	F7A6-EM12K-H8	F7A6-EM12K-H8
Manufacturer:	Lincoln Electric	Lincoln Electric
Tradename:	LA-61	LA-61
Flux Trade Name:	Lincoln 882 Flux	Lincoln 882 Flux
Alloy Flux:	Neutral	Neutral
Consumable Insert:	Not Applicable	Not Applicable
Supplemental Filler Metals:	Not Applicable	Not Applicable
Product Form:	Coiled Solid Wire	Coiled Solid Wire

[1]**Revision 2:** Review and update to the current edition of the ASME code.

WELDING PROCEDURE SPECIFICATION (WPS) QW-482

(Section IX, ASME Boiler and Pressure Vessel Code)

WPS # SAS-2 Rev.2

POSITIONS QW-405		POSTWELD HEAT TREATMENT QW-407	
Position(s) of Groove:	All	**Temp. Range:**	
Welding Progression:	F-6 SAW (Leading) Flat or Horizontal only.	**Time Range:**	***(None – As Welded)***
	F-6 SAW (Trailing) Flat or Horizontal only.	**Heating:**	
Position(s) of Fillet:	All	**Cooling:**	
PREHEAT QW-406		**GAS QW-408**	
Temperature Min.:		**Shielding Gas(es):**	
Interpass Temp. Max.:	***(See Next Page)***	**Composition:**	
Interpass Min.:		**Flow Rate:**	***(Not Applicable)***
Preheat Maintenance:	Monitor using tempilstiks, pyrometer or other suitable methods.	**Gas Backing:**	
		Other:	

ELECTRICAL CHARACTERISTICS QW-409

Current:	**F-6 SAW (Leading):**	Direct - DC	**F-6 SAW (Trailing):**	Direct - DC
Polarity:	**F-6 SAW (Leading):**	Reverse - EP	**F-6 SAW (Trailing):**	Reverse - EP
Amps (Range):	**F-6 SAW (Leading):**	250 - 750	**F-6 SAW (Trailing):**	250 - 750
Volts (Range):	**F-6 SAW (Leading):**	22 - 38	**F-6 SAW (Trailing):**	22 - 38
Travel Speed (Range):	**F-6 SAW (Leading):**	4 - 35	**F-6 SAW (Trailing):**	4 - 35
Maximum Heat Input: 0.125" to 0.625":	**F-6 SAW (Leading):**	30 240 J/in	**F-6 SAW (Trailing):**	30 240 J/in
0.625" to 1.500":	**F-6 SAW (Leading):**	30 240 J/in	**F-6 SAW (Trailing):**	30 240 J/in
Electrode Wire feed speed range:	50 - 550 ipm			
Tungsten Electrode Size & Type:	Not Applicable			
Mode of Metal Transfer for GMAW:	Not Applicable			
Other:	Maximum heat input mandatory only when proven notch toughness is required			

TECHNIQUE QW-410

String or Weave Bead:	String and weave. Weave size shall be controlled to prevent exceeding maximum heat inputs.
Orifice or Gas Cup Size:	1/4" to 1"
Initial Cleaning:	Base material must be thoroughly cleaned of all foreign material (scale, rust, oil, grease, paint, tar, etc.) at least 1" back on each side of the joint prior to welding. All surfaces to be welded shall be smooth, uniform and free from notches, slag, fins and burrs.
Interpass Cleaning:	Perform by wire brush, chipping hammer, power brushing, grinding, etc. after each weld layer.
Method of Back Gouging:	Arc air, gouge, grind, etc., grind to clean metal where thermal processes are used if required.
Oscillation:	Not Applicable
Contact Tube to Work Distance:	1/4" to 1 1/4"
Electrode Spacing:	1" to 6"
Multiple or Single Pass (per side):	Single or multiple passes per side, multiple only when proven notch toughness properties are required.
Multiple or Single Electrodes & Spacing:	Single or Multiple, multiple only when proven notch toughness properties are required.
Peening:	Peening is not allowed

TYPICAL WELDING PARAMETERS

	Filler Metal		Current			
Process	**AWS Classification**	**Diameter (in)**	**Type & Polarity**	**Amp. Range**	**Volt Range**	**Travel Speed (IPM)**
SAW	F7A6-EM12K	3/32	DC EP	250 - 750	22 - 38	4 - 35
SAW	F7A6-EM12K	1/8				
SAW	F7A6-EM12K	5/32				
SAW	F7A6-EM12K	3/16				

Notes: Number of weld layers and size of filler metal may vary with thickness of base material and position of weld.

WELDING PROCEDURE SPECIFICATION (WPS) QW-482

(Section IX, ASME Boiler and Pressure Vessel Code)

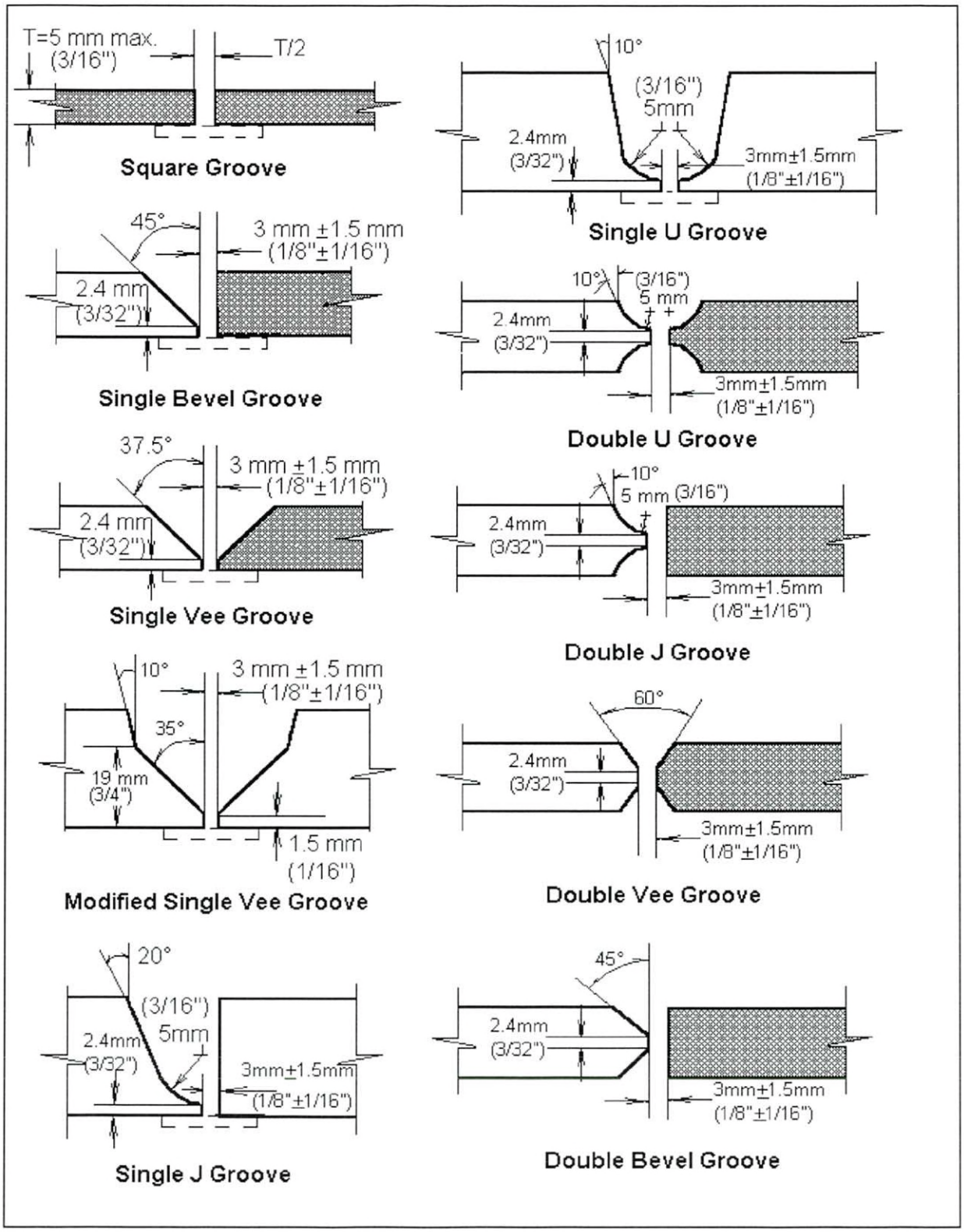
WPS # SAS-2 Rev.2

PREHEAT & INTERPASS TEMPERATURE MINIMUM AND MAXIMUM	
Section VIII :	50°F minimum for all P-1 materials except as listed below :
	175°F if the joint thickness exceeds 1.000" and the specified carbon content exceeds 0.30%
	200°F if the joint thickness is 1.250" to 1.500"
B31.1 :	50°F minimum for all P-1 materials except as listed below :
	175°F if the joint thickness exceeds 1.00" and the specified carbon content exceeds 0.30%
B31.3 :	50°F for all P-1 materials except as listed below:
	175°F if the specified minimum tensile strength of the base material exceeds 71 ksi
	175°F if the nominal wall thickness exceeds 1"
Max. Interpass Temp.:	650°F for normal service, 550°F for applications where proven notch toughness is required

Reference to relevant construction codes is mandatory prior to production welding to determine any supplementary restrictions.

Typical Joint Details QW-482

Prepared by: Qualimet

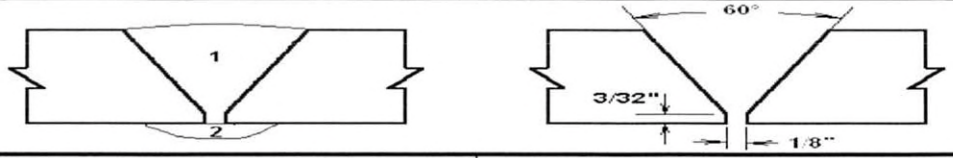


PROCEDURE QUALIFICATION RECORD (PQR) QW-483

(Section IX, ASME Boiler and Pressure Vessel Code)

Company Name:	Sub-Arc Systems Inc.	**By:**	Gary Kohlman
PQR No.:	SAS-2-1	**Date:**	June 4, 2010
Revision No.:	1[1]	**Revision Date:**	October 3, 2014
Welding Process(es):	SAW / SAW	**Types:**	Machine / Machine

JOINTS QW-402



BASE METALS QW-403			POSTWELD HEAT TREATMENT QW-407	
Material Spec.:	SA-516	SA-516	**Temperature:**	
Grade/Type/Class:	Grade 70	Grade 70	**Time:**	
P-No. Group No.:	P-1 Group 2 to	P-1 Group 2	**Heating:**	***(Not Applicable)***
Heat No.:	0934K-54	0934K-54	**Cooling:**	
Carbon Equivalent (CE):	0.39	0.39	**Other:**	
Thickness & Diameter:	0.249" Plate (machined)			
Max Weld Deposit:	<0.500" per pass			

PREHEAT QW-406		POSITIONS QW-405		
Preheat Temp. Min.:	50°F	**Process:**	**SAW (Leading)**	**SAW (Trailing)**
Interpass Temp. Max.:	550°F	**Position:**	2-G	2-G
Interpass Temp. Min.:	50°F	**Progression:**	Horizontal	Horizontal
Other:	Temperature monitored by tempilsticks	**Other:**	Not Applicable	Not Applicable

FILLER METALS QW-404

Process:	**SAW (Leading)**	**SAW (Trailing)**
SFA Specification No.:	5.17	5.17
AWS Classification No.:	EM12K-H8	EM12K-H8
F-No.:	F-6	F-6
A-No.:	A-1	A-1
Size of Filler Metal:	3/32"	3/32"
Deposited Weld Metal:	0.125"	0.125"
Manufacturer:	Lincoln Electric Co.	Lincoln Electric Co.
Trade Name:	LA-61	LA-61
Heat / Lot Number:	Not Recorded	Not Recorded
Electrode-Flux (Class):	F7A6-EM12K-H8	F7A6-EM12K-H8
Flux Tradename:	Lincolnweld 882 Flux	Lincolnweld 882 Flux
Flux Heat / Lot Number.:	Not Recorded	Not Recorded
Product Form:	Coiled Solid Wire	Coiled Solid Wire
Other:	Recrushed Slag Not Permitted	Recrushed Slag Not Permitted

ELECTRICAL CHARACTERISTICS QW-409

Process:	**SAW (Leading)**	**SAW (Trailing)**
Current:	Direct - DC	Direct - DC
Polarity:	Reverse - EP	Reverse - EP
Volts:	27	27
Amps:	400	300
Travel Speed (ipm):	20.0 - 26.0	20.0 - 24.0
Maximum Heat Input (J/in):	32 400	24 300
Tungsten Electrode:	Not Applicable	Not Applicable
STT Program Settings:	Not Appilcable	Not Appilcable
Other:	Not Applicable	Not Applicable

TECHNIQUE QW-410

String or Weave:	String	String
Oscillation:	Not Applicable	Not Applicable
Single / Multi Pass:	Single Pass Per Side	
Single / Multi Electrodes:	Multiple Electrodes	
Wire Stick Out:	1/4" to 1 1/4"	1/4" to 1 1/4"
Electrode Spacing:	Not Recorded	Not Recorded
Nozzle / Cup Size:	Not Recorded	Not Recorded

[1]**Revision 1:** Review and update to the current edition of the ASME code.

PROCEDURE QUALIFICATION RECORD (PQR) QW-483
(Section IX, ASME Boiler and Pressure Vessel Code)

PQR # SAS-2-1 Revision 1

Tensile Test
QW-462

Specimen No.	Width in	Thickness in	Area in²	Ultimate Total Load Lb	Ultimate Unit Stress ksi	Type of Failure & Location
ZB-T1	0.742	0.244	0.181	15 054	83.0	Ductile - Base
ZB-T2	0.746	0.241	0.180	14 656	81.5	Ductile - Base

Guided Bend Tests
QW-462

Specimen No.	Type	Figure	Result
ZB-B1	TFB	QW-462.3(a)	Pass
ZB-B2	TFB	QW-462.3(a)	Pass
ZB-B3	TRB	QW-462.3(a)	Pass
ZB-B4	TRB	QW-462.3(a)	Pass

Toughness Tests
QW-170

Specimen No.	Notch Location	Notch Type	Test Temp	Impact Values (ft-lbs)	% Shear	Lateral Exp Inches	Drop Weight Break	Drop Weight No Brk
ZB-1	Weld	V-Notch	-50°F	49	50	0.040	N/A	N/A
ZB-2	Weld	V-Notch	-50°F	30	40	0.026	N/A	N/A
ZB-3	Weld	V-Notch	-50°F	67	60	0.053	N/A	N/A
ZB-4	HAZ	V-Notch	-50°F	67	60	0.054	N/A	N/A
ZB-5	HAZ	V-Notch	-50°F	75	70	0.056	N/A	N/A
ZB-6	HAZ	V-Notch	-50°F	123	100	0.065	N/A	N/A

Fillet-Weld Tests
Not Applicable

Result-Satisfactory: Yes _____ No _____ Pen. into Parent Material: Yes _____ No _____
Macro-Results:

Other Tests

Type of Test: Hardness Testing - See Attached Report
Other:

Welder's Name: Matt MacKenzie **Reg. No.:** Not Applicable
Welder's Name: Joel Overguard **Reg. No.:** Not Applicable **Stamp ID:** ZB
Tests Conducted By: Qualimet **Lab. Test No.:** 636-10004
Revised By: Qualimet

We hereby recertify that the statements in this record have been revised in accordance with paragraph QW-200.2 are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: Sub-Arc Systems Inc.
Original Cert. Date: June 4, 2010 **By:** Gary Kohlman
Recertification Date: October 3, 2014 **By:** Gary Kohlman

Qualimet

• 7817 COLBERT ROAD • EDMONTON, AB T6E 1H2 • (780) 440-5870 • FAX (780) 465-8829
• CALGARY • (403) 278-9867 • 1-800-661-8979 • www.qualimetinc.com
"Your source of Quality Materials Engineering"

MECHANICAL TEST REPORT

for Procedure Qualification Record # SAS-2-1

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-10004
Address:	4605-47 Street Vermillion AB T9X 1L6	**Date:**	June 4, 2010
Materials:	SA-516 Grade 70		
Size:	0.249" Plate (machined)	**Condition:**	As Welded
Test Specification:	**ASME Section IX**		

Tensile Tests QW-462.1(a)

Sample Identification:	ZB-T1	ZB-T2
Sample Size - inch:(W × T)	0.742 x 0.244	0.746 x 0.241
Least X-Sect. Area - in2:	0.181	0.180
Ultimate Load - lbs:	15 054	14 656
Ult. Ten. Strength - ksi:	83.0	81.5
Character of Failure:	Ductile	Ductile
Location of Failure:	Base Metal	Base Metal
Req'd Tensile Strength - ksi:	70.0	70.0
Pass or Fail:	Pass	Pass
Remarks:	-----	-----

Bend Tests QW-462.3 (a)

Sample Identification:	ZB-B1	ZB-B2	ZB-B3	ZB-B4
***Type of Bend Test:**	TFB	TFB	TRB	TRB
Pass or Fail:	Pass	Pass	Pass	Pass
Remarks:	-----	-----	-----	-----

*Types of Bend Tests **TSB, TFB, TRB = transverse side, face or root bend** **LSB, LFB, LRB = longitudinal side, face or root bend**

We certify that the statements in this record are acceptable, in accordance with the requirements of ASME Section IX.

TEST RESULTS CERTIFIED BY:

Qualimet

Sean Lepine, E.I.T.

CHARPY IMPACT TEST REPORT

for Procedure Qualification Record # SAS-2-1

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-10004
Address:	4605-47 Street Vermillion AB T9X 1L6	**Date:**	June 4, 2010
Materials:	SA-516 Grade 70		
Size:	0.249" Plate (machined)	**Condition:**	As Welded
Test Specification:	ASME Section IX, ASME Section VIII UG-84, ASTM A-370		

Specimen Type:	Charpy V-Notch
Qualification Temperature:	-50°F
Test Temperature:	-50°F

Specimen Size (mm): 5.35

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lateral Expansion Inches
Weld Zone	ZB-1	26	49	50	0.040
	ZB-2	16	30	40	0.026
	ZB-3	36	67	60	0.053
	Average:	**26**	**49**	**50**	**0.040**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASME Section IX and the latest addenda.

TEST RESULTS CERTIFIED BY:

Qualimet

Sean Lepine, E.I.T.

CHARPY IMPACT TEST REPORT

for Procedure Qualification Record # SAS-2-1

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-10004
Address:	4605-47 Street Vermillion AB T9X 1L6	**Date:**	June 4, 2010
Materials:	SA-516 Grade 70		
Size:	0.249" Plate (machined)	**Condition:**	As Welded
Test Specification:	ASME Section IX, ASME Section VIII UG-84, ASTM A-370		

Specimen Type:	Charpy V-Notch
Qualification Temperature:	-50°F
Test Temperature:	-50°F

Specimen Size (mm): 5.35

Sample Set	Sample Number	Actual Impact Energy (ft-lb)	Full Size (ft-lb)	Shear (%)	Lateral Expansion Inches
HAZ	ZB-4	36	67	60	0.054
	ZB-5	40	75	70	0.056
	ZB-6	66	123	100	0.065
	Average:	**47**	**88**	**77**	**0.058**

We certify that the statements in this record are acceptable and that the specimen(s) were prepared and tested in accordance with the requirements of the current edition of ASME Section IX and the latest addenda.

TEST RESULTS CERTIFIED BY:

Qualimet

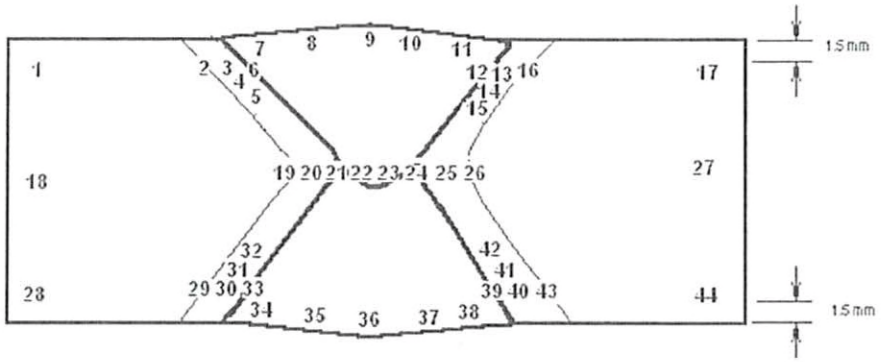
Sean Lepine, E.I.T.

HARDNESS TEST REPORT

for Procedure Qualification Record # SAS-2-1

Client:	Sub-Arc Systems Inc.	**Job Number:**	636-10004
Address:	4605-47 Street Vermillion AB T9X 1L6	**Date:**	June 4, 2010
Materials:	SA-516 Grade 70		
Size:	0.249" Plate (machined)	**Condition:**	As Welded
Test Specification:	NACE RP0472		

Test Method:	Hardness testing performed in accordance with ASTM E-92 (Vickers Hardness of Metallic Materials) using a Vickers tester with a 1kg load.



Vickers Hardness Values

1	153	**10**	190	**19**	165	**28**	172	**37**	193
2	156	**11**	192	**20**	171	**29**	158	**38**	192
3	169	**12**	183	**21**	191	**30**	189	**39**	195
4	167	**13**	183	**22**	186	**31**	182	**40**	176
5	169	**14**	179	**23**	204	**32**	181	**41**	175
6	182	**15**	185	**24**	195	**33**	206	**42**	178
7	182	**16**	163	**25**	180	**34**	189	**43**	172
8	198	**17**	159	**26**	169	**35**	203	**44**	167
9	179	**18**	160	**27**	165	**36**	203		

We certify that the statements in this record are acceptable, in accordance with the requirements of NACE RP 0472. RP 0472-2005 paragraph 5.3 states "The maximum allowable HAZ hardness shall be 248 HV the maximum weld deposit hardness should be 248 HV and the average weld deposit hardness should not exceed 210 HV"

TEST RESULTS CERTIFIED BY:

Qualimet

Sean Lepine, E.I.T.